Project Number: P2970_Issue 2

Appendix 9.2

Geotechnical Preliminary Sources Study Report

Cavan Regional Sports Campus, Cavan
County Cavan

Client: McAdam Design

Issued: March 2024

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1.0 INTRODUCTION

1.1 Report Brief

MCL Consulting Ltd (MCL) was appointed by McAdam Design, on behalf of Cavan County Council, to undertake a Preliminary Risk Assessment for lands north, south and west of Royal School Cavan and west of Breffni Park GAA grounds, County Cavan.

The development comprises the following components:-

- Indoor sports complex to include sports halls with spectator seating, fitness studios, changing facilities, reception, café and ancillary accommodation.
- 7 no. outdoor sports pitches.
- Covered sports arena with playing pitch, spectator seating and other ancillary accommodation.
- Ancillary sporting facilities include 8 lane athletics track and cricket practice nets.
- New vehicular access / junction and closure of Park Lane/Dublin vehicular junction, relocation of existing Breffni Park turnstiles to facilitate reconfiguration of Park Lane, bridge structure, internal roads, cycle/pedestrian paths, associated car/bus/cycle parking, electric charge points and streetlighting.
- Pedestrian access points of Kilnavarragh Lane and Dublin Road.
- Hard and soft landscaping including acoustic fencing, wildlife habitat area/corridors, artificial badger-sett, walking trails and other ancillary works such as spectator stands, retaining walls, fencing and ball stop fencing, team shelters, toilet block, floodlighting, signage, drainage infrastructure including attenuation tanks, SuDs and culverting of a minor watercourse, storage space, ESB Substation, ancillary accommodation and all associated site works to accommodate the development.
- The proposed bridge is a single span integral reinforced concrete bridge, supported on piled foundations.

1.2 Methodology and Scope of Works

The purpose of the GPSSR was to identify potential risks from pollution or ground conditions at or around the site which would influence assessment of the suitability of the site for any future redevelopment. This information can also be used to inform potential site investigation requirements, development requirements and associated costs to support proposed development plans.

The assessment undertaken has been compiled and assessed using available data sources supported by a site walkover. Consideration has been given to the following;

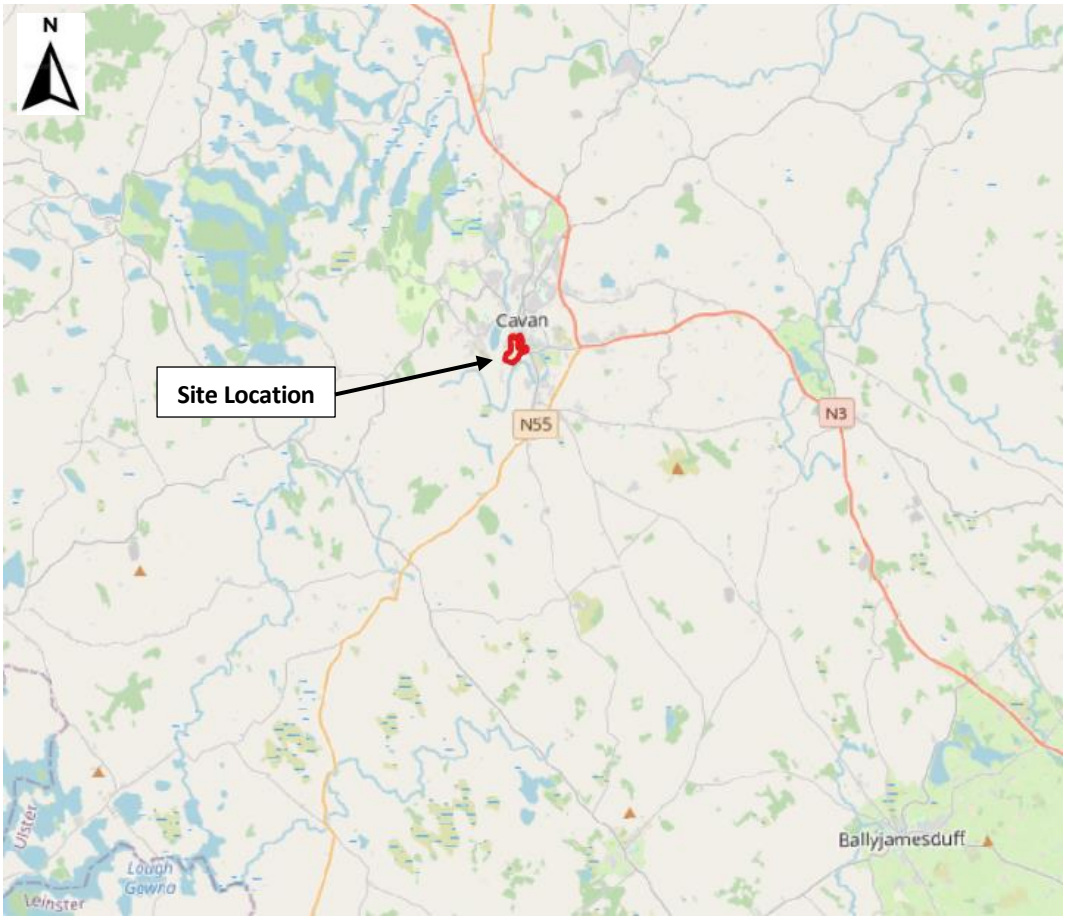
- topography;
- existing services;
- existing structures/buildings;
- historical land use;
- contamination sources;
- superficial / bedrock /structural geology;
- groundwater and drainage;
- flooding;
- radon setting and
- identification of potential geotechnical and H&S risks.

2.0 SITE LOCATION AND DESCRIPTION

2.1 Site Location

The site, c.28ha, is located in central Cavan, County Cavan, on lands surrounding Royal School, College Street and west/northeast of Kingspan Breffni (IGR: 241769, 303932). A site location map is presented as Figure 1 and the site area is presented as Figure 2.

Figure 1: Site Location Map



The site currently occupied by agricultural land adjacent to Royal College, County Cavan and Breffni Park GAA. The surrounding area is characterised as largely residential, with mixed recreational and commercial land uses surrounding. A summary of the properties / land-use immediately adjacent to the site is presented in Table 1.

Table 1: Summary of Adjacent Land Use

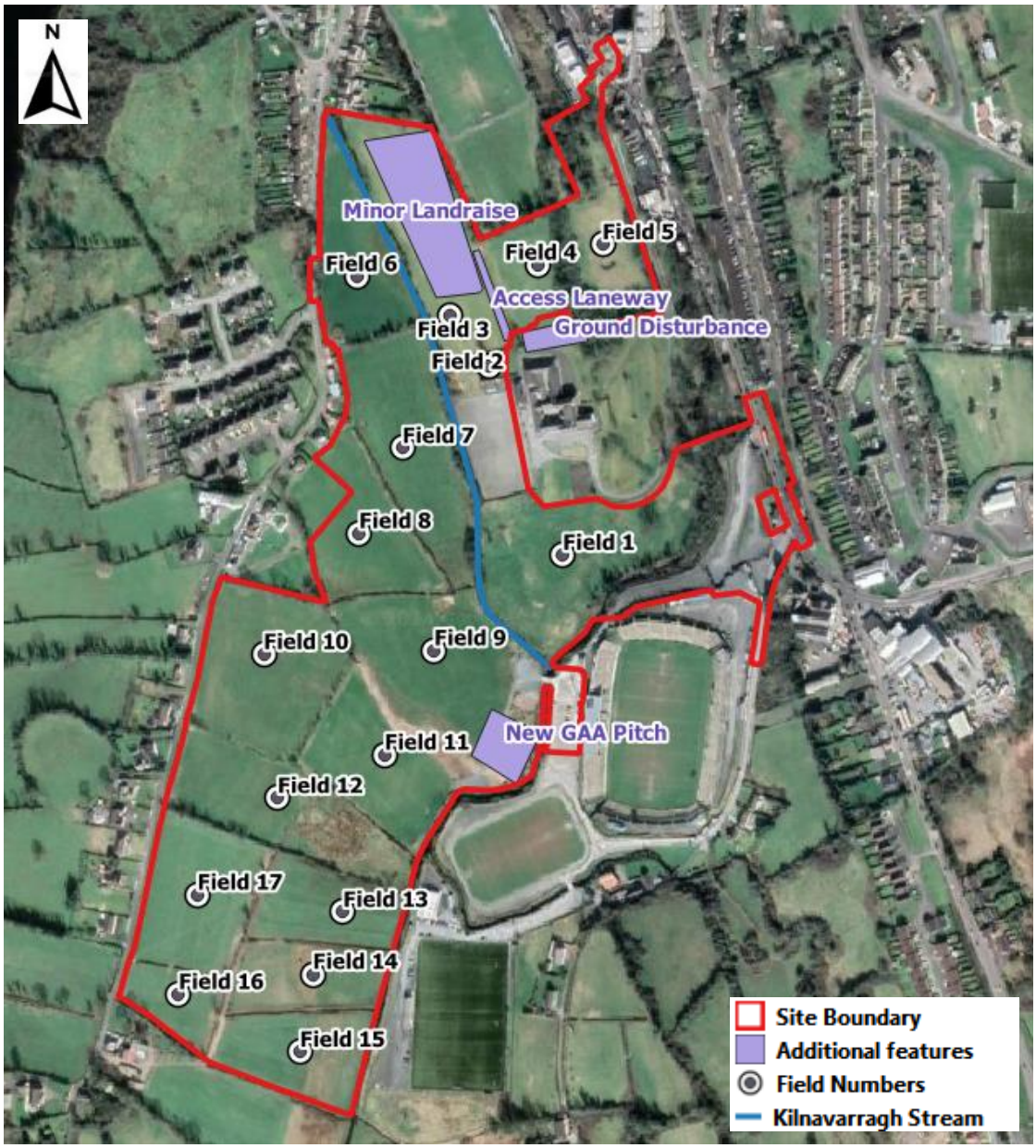
Orientation from Site	Neighbouring Property/ Land Use beyond Site Boundaries
North	Sport fields are directly to the north of the site with residential/commercial properties beyond this leading into Cavan town.
South	Developed sport fields lie directly to the south with adjacent agricultural fields. Lands beyond this are dominated by agricultural lands with small residential properties within.
East	Residential/commercial properties with agricultural properties beyond.
West	Agricultural/residential properties are adjacent to the site with Swellan Lough beyond this. Lands beyond this are for agricultural/residential use.

Figure 2: Aerial Image of the Site Boundary

2.1 Site Description

A site walkover was undertaken by MCL on 20th April 2023. Photographs taken during the site walkover are included in Appendix 2. A tributary (Kilnavarragh Stream) of the Cavan River enters the site via a culvert under the Kilnavarragh Lane, flowing southwards in an open wooded channel, before flowing southeast into the Cavan River. This tributary roughly dissects the site into east and west. Therefore, for ease of description, the site can be divided into lands east of the Kilnavarragh Stream and lands west of the Kilnavarragh Stream, as shown on Figure 3. The site consists of 17no. separate fields also shown on Figure 3.

Figure 3: Separation of Site into field sections



2.1.1 East of Kilnavarragh Stream

This area of site can be accessed via access road into Royal School Cavan. From this access road, there is an all-weather gravel sports pitch used by the school (Plate 1). To the west of this pitch is the Kilnavarragh Stream. South of the pitch is Field 1 (Plate 3), which is greenfield land. The topography slopes to the south/southeast in this area, where the field borders the Cavan River. There was an area of marshy land in the southwest of this field along the Kilnavarragh Stream. Drainage pipes from Breffni Park grounds (Plate 6) were identified flowing into the Cavan River.

Plate 2 View looking south from recently constructed Aggregate Access Laneway con structed allowing access to farmlands north of new school building, note ponded water on surface of laneway.

North of Field 1 is a gravel pitch currently used by Royal School Cavan as a Car Park in the south and a Physical Education ground. Slightly upgradient of the Gravel Pitch is a grass field (Field 2). East of Field 2, beyond the site boundary and encroaching into Field 4 is an active construction site (Plate 11) where the construction of a new 2-storey school building structure has recently been completed. Groundworks within this area include a land cut / reprofiling and land-raising in an area behind the new-constructed retaining structure (Plate 17).

To the north of the new school building, within Field 3 and Field 4, localised land-stripping has been undertaken to create a new hardcore access lane (Plate 13). This leads northwards, opening up into a large area of very recent minor land raise (Plate 13, 14 and 15). A c.1m thick layer of what appears to be mainly clay materials arising from the school development cut has been spread out over agricultural lands to the north of the school development. The western area of Field 3 and the eastern area of Field 4 have remained mainly greenfield.

Field 5 is located slightly upgradient of Field 4 and is greenfield land. There is then a steep decline in topography eastwards towards the Cavan River (Plate 18).

2.1.2 West of Kilnavarragh Stream

Field 6 and Field 7 are located west of the Kilnavarragh Stream. The topography increases west from Field 2 and Field 3 to Field 6 and Field 7. The topography decreases from Field 6 towards Field 7. Field 6, Field 7 and Field 8 are all greenfield land with no previous activities occurring in these areas.

Field 9 can be accessed via a newly-constructed bridge across the Cavan River located within the grounds of Breffni Park GAA grounds car park (Plate 19). The land slopes upgradient in a northwest direction from the bridge. In the east of this field, a car park associated with Cavan GAA is currently under construction (Plate 20). A GAA playing pitch has recently been constructed along the south/southwest of Field 9 (Plate 26). This would have required a programme of ground disturbance cut and fill / alteration of land profile to create a flat platform on what have originally been sloping lands.

The field boundary and associated small area of woodland observed to exist between Field 9 and Field 11, as observed by comparing aerial photography dated between 2021 and 2022 (Figure 4), has recently been removed creating a strip of bare / disturbed cleared ground now partly occupied by the new playing field.

Figure 4: Area of Recent Ground Disturbance

Aerial Image dated 26/03/22

Aerial Image dated 05/05/21

In the northwest corner of Field 9, along the boundary with Field 8, a low flowing watercourse enters the site flowing southeast (Plate 24).

Field 10 located upgradient of Field 11, the boundaries of which is separated by a ditch with limited water flow (Plate 25). Field 12 is also separated from Field 10 and Field 11 by a ditch, with limited, stagnant water. Field 10, Field 11 and Field 12 (scrub) are all greenfield land with no evidence of former land use activity.

Field 13-17 are located in the southernmost regions of the site (Plate 28 to Plate 30). The walkover of these fields indicated that the vast majority of areas are all greenfield land, with no evidence of contaminating land use evident. There is a clear decrease in elevation between Fields 16 and 17 and the lower Fields 13-15, with the lower fields meeting the Cavan River on the eastern boundary. Fields 13-15 showed extensive flooding during the site visit, likely from field drains present along the field boundaries. The flooding covered a large portion of the eastern sections of the fields (Plate 31 to Plate 33).

2.2 Site Topography

The topography of the site various extensively, with extreme inclines and declines in topography identified during the site walkover. In Field 1, Topography slopes downward east and southeast towards the Cavan River. Field 3 and Field 4 are relatively flat, however there is a sharp decline in topography at Field 5, sloping down east towards the Cavan River.

Topography sharply increases west and northwest from Field 3 to Field 6, and sharply decreases south from Field 6 to Field 7. Within Field 9, Topography increases north and northeast towards Field 8, whilst gradually sloping down south towards Field 11. Field 10 is located slightly upgradient up Field 9, 10 and 11. Topography changes are seen in Field 16 and Field 17, as they gradually slope down to the east / southeast into Fields 13-15. Fields 13-15 slope down to the east / southeast, eventually becoming level with the Cavan River.

The development proposals will require a very significant cut/fill operations throughout the entire site, owing to the dramatic topography changes identified on site.

3.0 ENVIRONMENTAL DATA COLLECTION AND REVIEW

3.1 Site History

Information relating to the development history of both sites was determined by the review of the available historical Ordnance Survey (OS) maps published by the Ordnance Survey of Ireland (OSI) and publicly available aerial photography available via Google Earth. Table 2 provides a summary of historical mapping with distances have been taken from the site boundary.

Table 2: Summary of Historical Mapping

Historical Source Map	Description
OSI MapGenie 6 Inch First Edition (1829-1841)	The site is undeveloped and cleared as fields/farmland. There is a *'College'* c.30m to the east. The '*Dublin Road*' lies to the east and runs north into Cavan town. There are '*Forts'* c.200m and c.780m to the east. Cavan town is mainly residential properties with an '*Old Church*' c.290m, a '*School House'* c.270m, a '*Court House'* c.630m, and a *'Church'* c.670m to the north of the site with a '*Jail'* c.390m, '*Presbyterian Meeting House'* c.430m and a '*Barracks'* c.240m northwest of the site. Further out of Cavan town, a '*Malt House'* and *'Swellan College'* lie to the northwest c.540m and c.580m respectively. A '*Fort'* lies c.40m to the west with another '*Fort'* c.290m west. '*Swellan* Lough' lies c.290m to the west with '*Green* Lough' c.250m to the east and '*Killymooney Lough'* c.640m northeast.
OSI MapGenie 6 Inch Last Edition (1830-1930)	The site remains undeveloped, however there have been some trees planted along field borders in the site. The '*College'* c.30m east has been renamed to '*Royal School'*. Cavan town has been developed, with the following buildings developed to the north; '*Hall*' c.580m, '*Court House'* c.620m, '*Bank'* c.660m, '*Temperance Hall*' c.720m, '*St Patricks R.C. Cathedral*' c.780m, '*Printing Works'* c.730m, '*St Josephs R.C. Church'* c.480m, '*Water Works'* c.460m, '*Grave Yard'* c.330m. The '*Presbyterian Meeting Hall'* has been repurposed as a '*Masonic Hall Methodist Church'* with the '*Barracks'* c.240m renamed to '*Infantry Barracks*'. A '*Smithy'* has been constructed c.400m northwest. A building c.740m to the northwest has been renamed to '*Swellan House'*. '*Greenlough Cottage'* has been constructed c.500m to the southeast. A building c.540m to the west has been named '*Glenara House'*. '*St Clare's Cottage'*, '*Cavan School*' and '*Cavan Saw Mill'* have been constructed c.10m to the southeast of the site. A '*Cemetary'* has been constructed c.170m to the east. '*Breffni Terrace'* has been constructed c.60m east. A '*Recreation Ground*' has been constructed immediately to the north of the site. A railway running north-south has been constructed c.640m west, with a '*station*' constructed c.750m northwest.
OSI MapGenie 25 Inch (1897-1913)	The site remains undeveloped. There has been little development in the surrounding area with development mainly occurring as the repurposing/redevelopment of buildings within Cavan town.
Google Earth (2012-2022)	The site remains undeveloped. Cavan town seems to have undergone little development with buildings being slightly updated or repurposed but no significant expansion of the town area. A residential development has been constructed c.50m to the east with an industrial/commercial complex c.510m and another c.870m to the east. Multiple commercial/industrial properties have been constructed to the southeast; '*Tractamotors Limited'* c.200m southeast and '*ZGM Auto Repair*' c.60m southeast. To the south of these commercial/industrial properties are residential properties. '*Kingspan Breffni'* has been constructed immediately to the south of the site with adjacent playing fields. A larger residential property group has been developed c.430m. There has been no other significant development to the south. There has been a residential development immediately to the west of the site with another residential development c.730m to the west. '*County Cavan Golf Club'* has been developed with playing greens c.1.6km to the northwest.
Google Aerial 2023	The area of recent hedgerow / woodland clearance / disturbed ground is evident. The field boundary and associated small area of woodland observed to exist between Field 9 and Field 11, has been removed creating a strip of bare / disturbed cleared ground now partly occupied by the new playing field. Work has begun on the creation of the car park in Field 9.

3.2 Regulatory Searches

The following datasets were reviewed:

- NIAH (National Inventory of Architectural Heritage), and ASI (Archaeological Survey of Ireland);
- EPA Ireland (Groundwater in SAC Species, Drinking Water, Wastewater Discharge Authorisations, Mine Shafts of Workings, Radon, Hydrology, and Protected Areas);
- Groundwater Data Viewer online map viewer;
- FloodInfo Ireland Flood Maps;
- Geological Survey Ireland (Bedrock (1:100,000), Quaternary Sediments (1:50,000), Groundwater Wells and Springs, Groundwater Karst Data, Bedrock Aquifer, Groundwater Vulnerability).

3.2.1 Historical and Industrial Records

A review of the NIAH (National Inventory of Architectural Heritage), and ASI (Archaeological Survey of Ireland) shows there are 5no. sites located within 250m of the site, as shown below in Figure 5 and Table 3.

Figure 5: Historic sites within 250m of the site

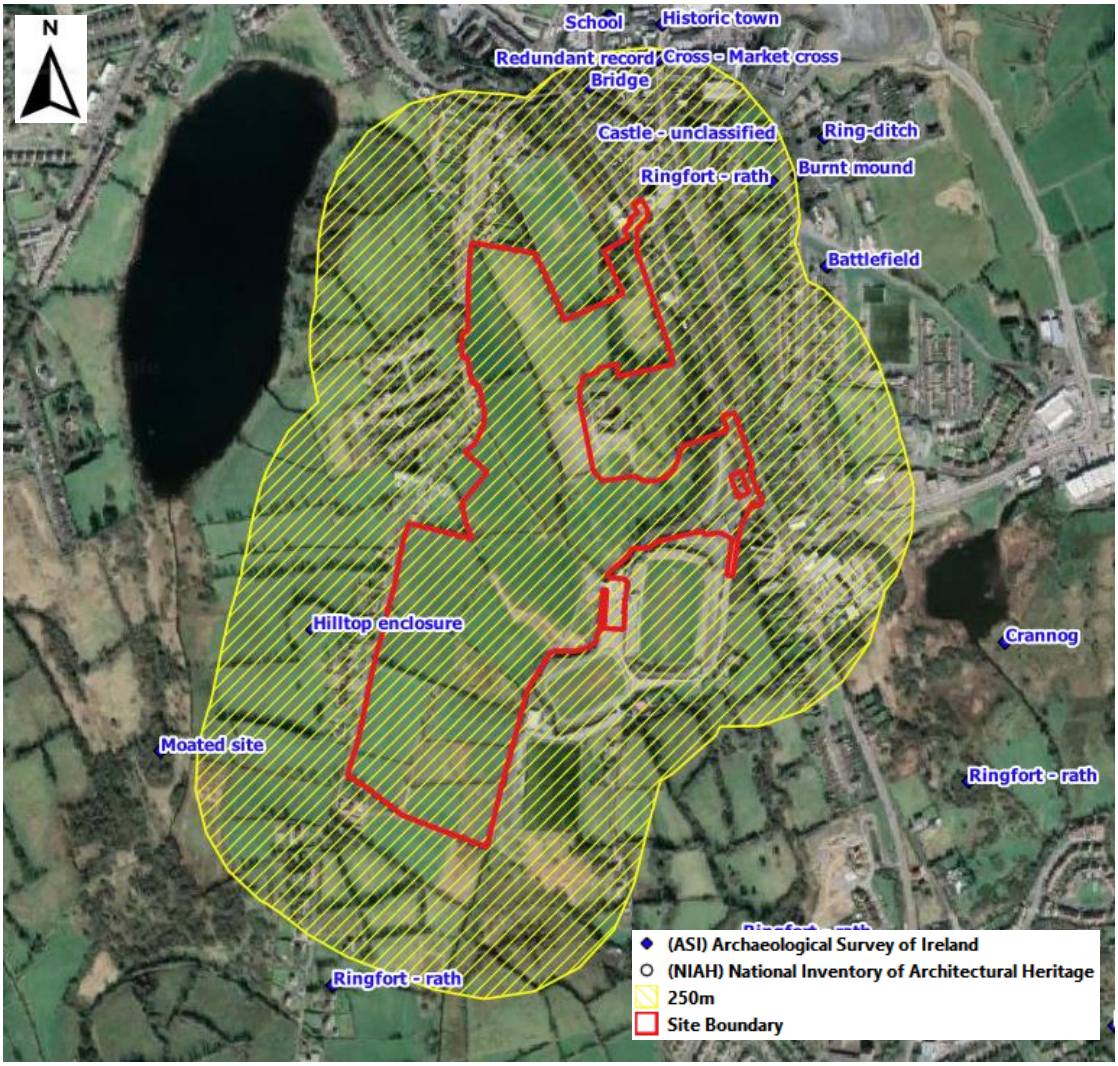


Table 3: Summary of Historical sites within 250m of the site

Name/Historical ID	Distance
Bridge (ASI ID: 29997)	c.200m North
Cross – Market cross (ASI ID: 30015)	c.240m North
Ringford - rath (ASI ID: 147963)	c.210m East
Castle – unclassified (ASI ID: 29996)	c.240m Northeast
Hilltop enclosure (ASI ID: 30682)	c.110m West

3.2.2 Waste

The EPA Ireland online map viewer indicates there are no waste facility sites within 500m of the site. The nearest waste facility is Cavan Waste Disposal Ltd (Reg CD: W0207-1), located c.2.1km east.

3.2.3 Abstractions

A review of the Groundwater Data Viewer online map viewer indicates there are no abstractions within 500m of the site.

3.2.4 Discharges

The EPA Ireland online map viewer indicates that there are 5no. Wastewater Discharge Authorisations within 500m of the site as shown in Figure 6 below and summarised in Table 4. These discharges are located upflow of the site and therefore are not expected to have any impact on the development.

Figure 6: EPA Discharges within 500m

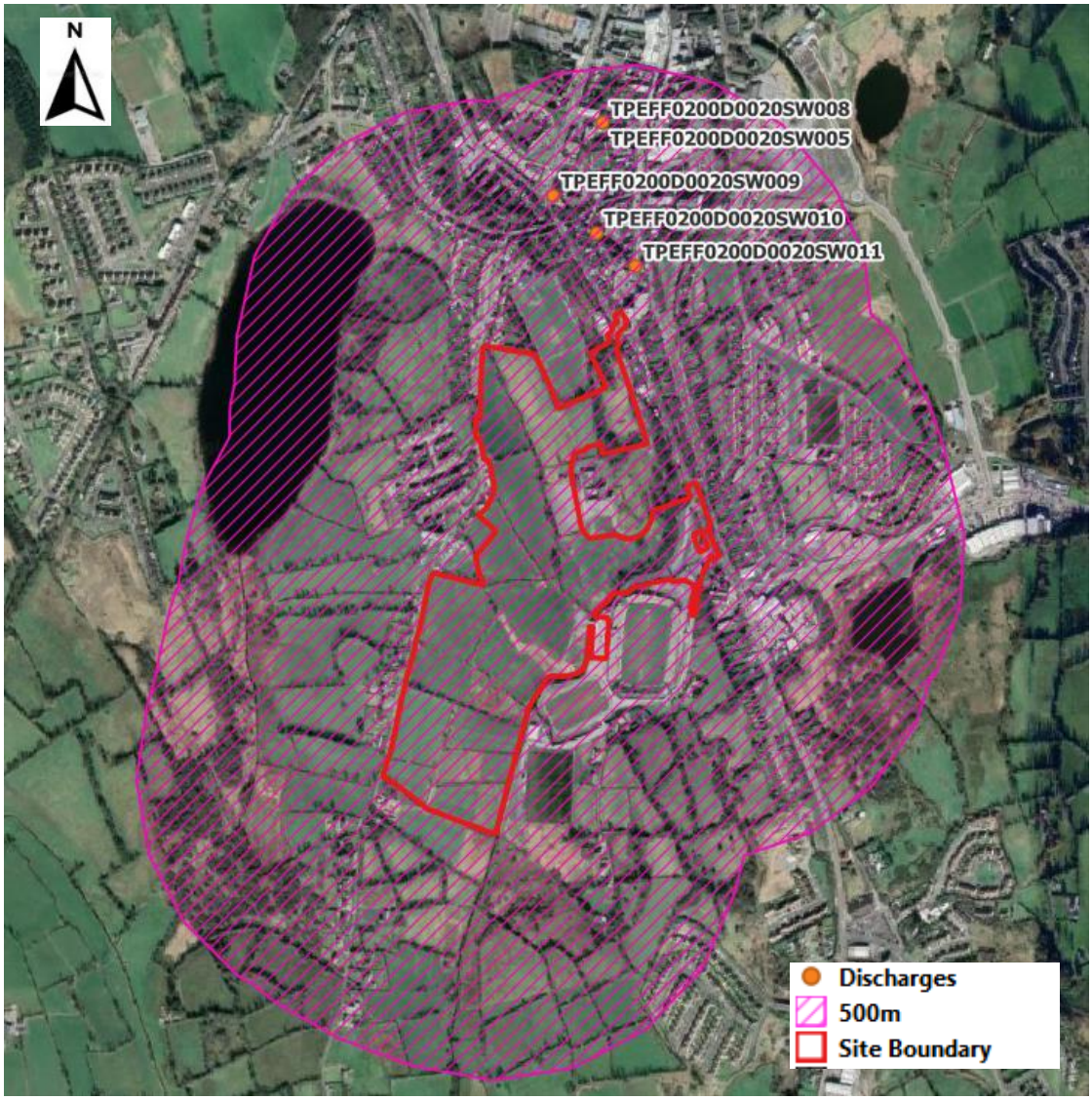


Table 4: Summary of EPA Discharges within 500m

Discharge Location Emission ID	Distance	Emission Type
TPEFF0200D0020SW005	c.420m north	Storm Water Overflow
TPEFF0200D0020SW008	c.420m north	Storm Water Overflow
TPEFF0200D0020SW009	c.300m north	Storm Water Overflow
TPEFF0200D0020SW010	c.210m north	Storm Water Overflow
TPEFF0200D0020SW011	c.140m north	Storm Water Overflow

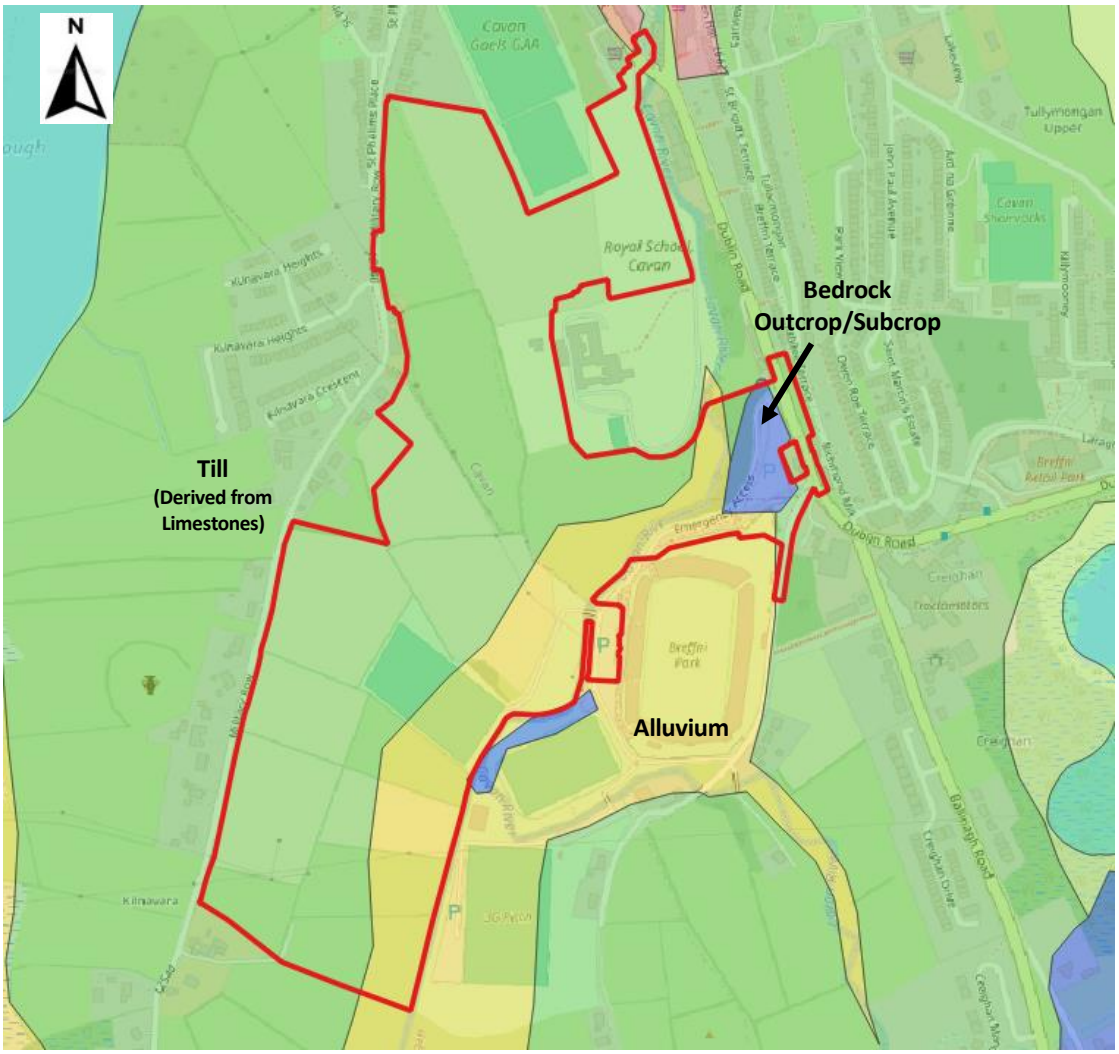
3.3 Geology and Ground Conditions

3.3.1 Superficial and Bedrock Deposits

Geological information on the site was obtained from review of the published GSI Cavan Bedrock Geology Map (1901)(*Sheet 68, 1:63,360*), the GSI Bedrock (1:100,000) and GSI Quaternary Sediments (Superficial Geology) (1:50,000).

The underlying superficial geology is shown in Figure 7, indicating the majority of the site is underlain by Till (derived from limestones), aside from a portion in the south of the site which is occupied by Alluvium. There is a small area in the west where Greywacke bedrock is outcropping.

Figure 7: Superficial Geology



Areas of exposed till and reworked till are presented in the vicinity of the school construction site (Figure 3), where the development has cut into the till and a retaining wall constructed (Plate 18). It would appear that the excavated till has been deposited, along with other construction wastes in an area to the north of the new school building (Field 3), Creating an area topped with c1m thick made ground (see Figure 3).

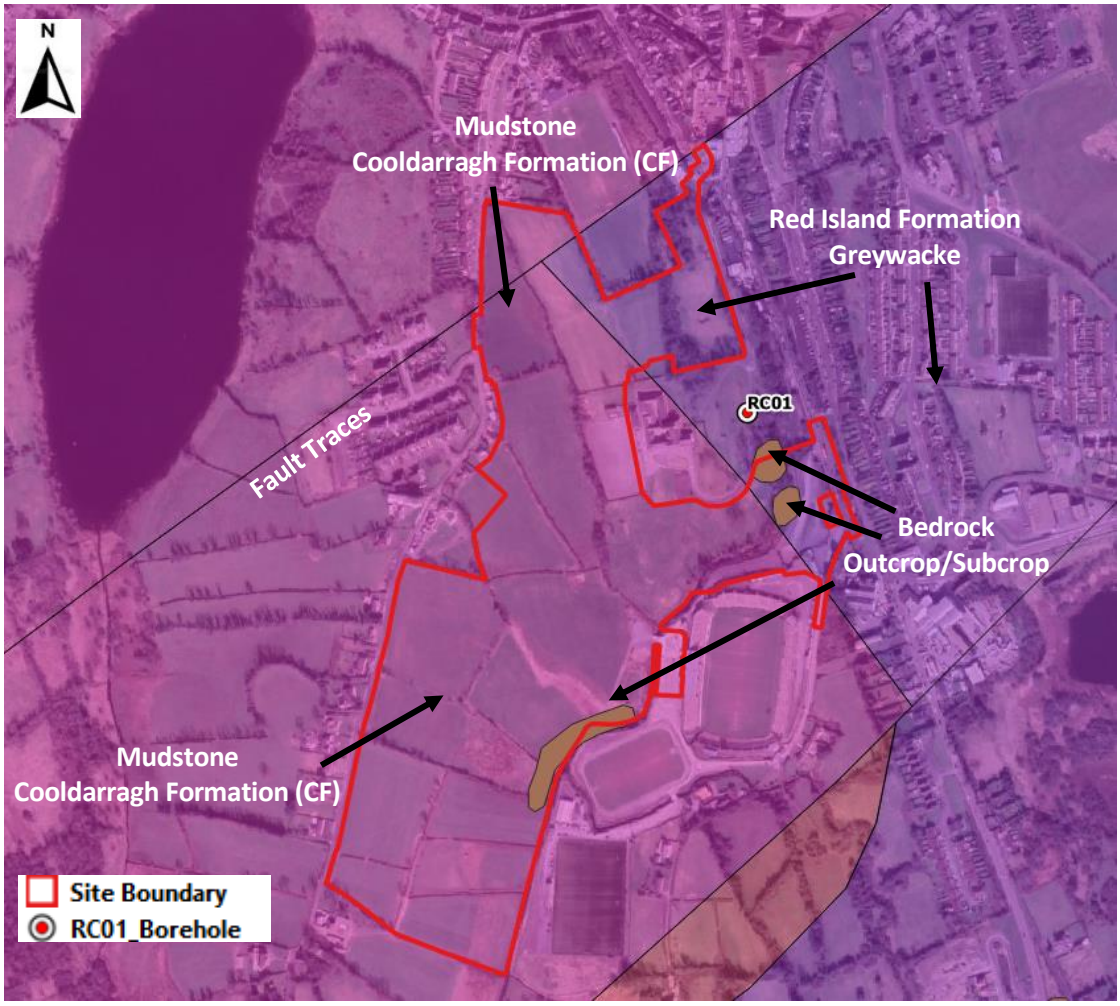
It is possible that river gravels may underlie area mapped as alluvium along the margins of the Cavan River.

In terms of bedrock, mapping indicates that the majority of the site is underlain by the Carboniferous-age evaporitic to marginal marine Cooldaragh Formation. This is described in

geological publications as a sequence mainly consisting of pale brown-grey calcareous siltstones, limestones, mudstones and evaporites up to 125m thick.

The much older greywacke of the Red Island Formation juxtaposes the Carboniferous sequence along an unconformity fault line running roughly northwest to southeast through the northern area of the site.

Figure 8: Bedrock Geology



3.3.2 GSI Boreholes

A review of GSI Groundwater Wells and Springs highlights that there are 6no. boreholes located within 1km of the site. These are shown in Figure 9 and Table 5 below.

Figure 9: Boreholes within 1km of the site

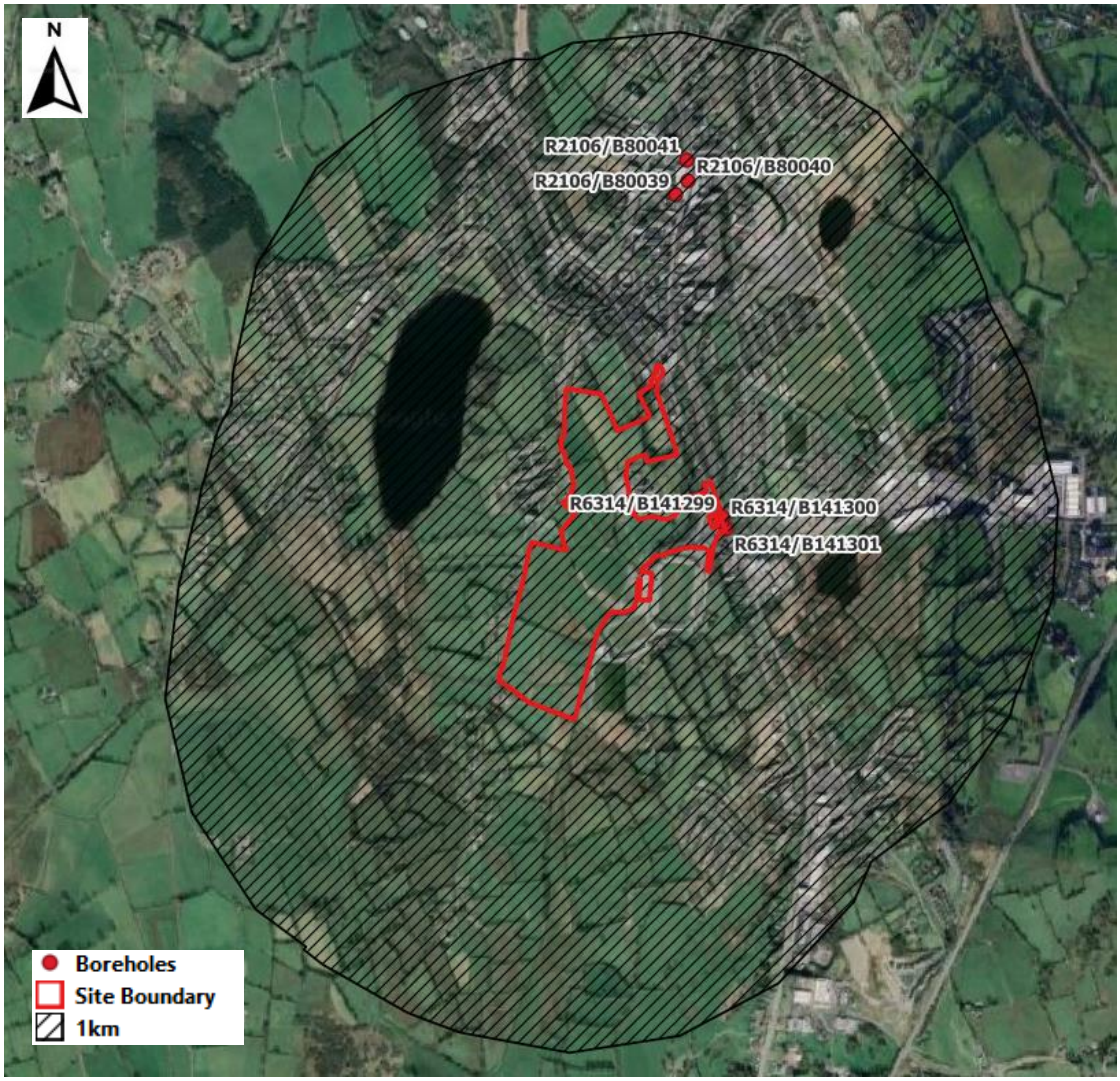


Table 5 Geotechnical Borehole Records

Borehole ID	Depth Reached	Bedrock met
R6314/B141301	9.3m	No
R6314/B141300	9.5m	No
R6314/B141299	9.1m	No
R2106/B80039	1.2m	Yes
R2106/B80040	3m	Yes
R2106/B80041	2.5m	Yes

3.3.3 Site Investigation Data

A steel wellhead was observed on lands to the east of the main school building and the Royal School were contacted and provided a Geotechnical Investigation Report in relation to an instructive investigation undertaken by Causeway Geotech Ltd in August 2022, as presented in **Appendix 5**. This included the drilling of 5 No. boreholes. This indicated the drift geology to be clay with cobbles and sand layers. Fractured Limestone bedrock was identified at 3.5m depth close to the school's access road. This is evidence which suggests that at least some of the site could be underlain by Carboniferous Limestones of the Cooldaragh Formation.

3.3.4 Abandoned Mines and Shafts

A review of the EPA Ireland online map viewer indicates there are no mapped mine shafts or workings within 1km of the site.

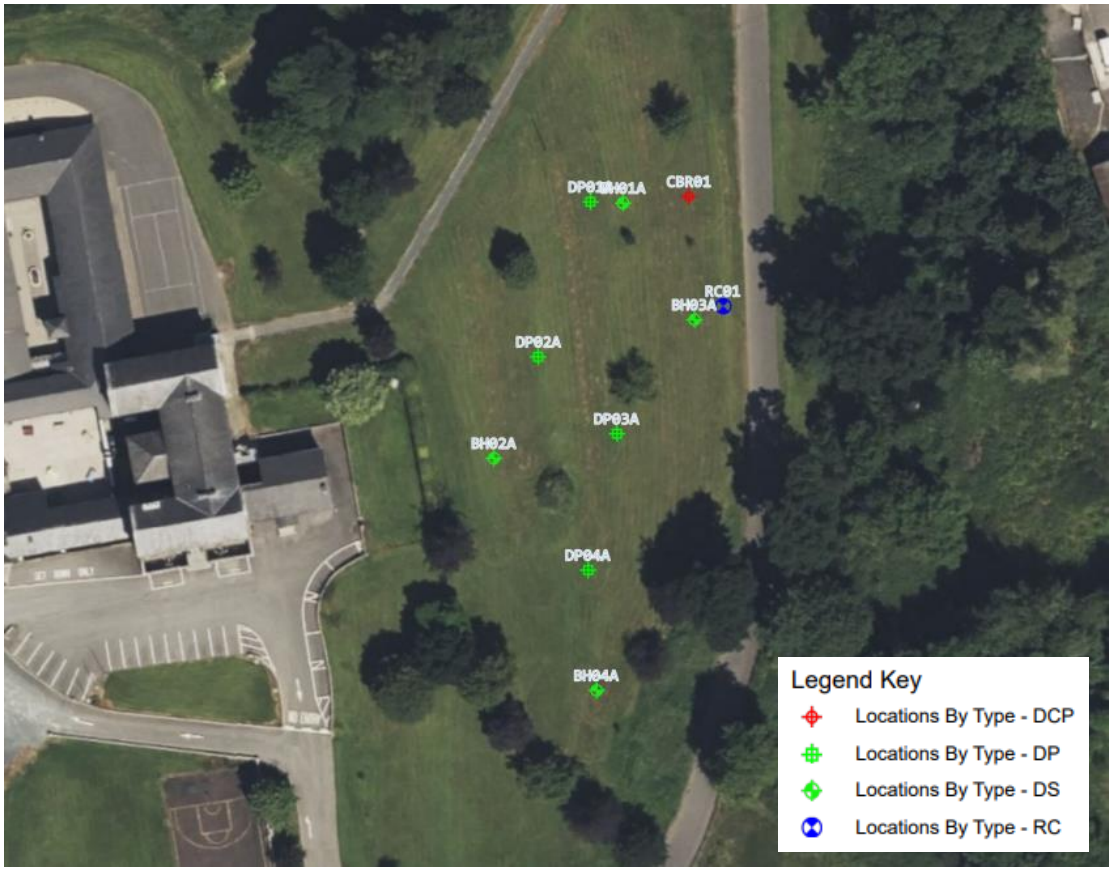
3.3.5 Karst and Dissolution Features

A review of the GSI Groundwater Karst Data (ROI/NI) indicate that there are no mapped features within 1km of the site. No field evidence of surface karstic features, such as sinkholes etc., was observed during the geological walkover survey. It is however possible that the limestones of the Cooldaragh Formation, likely to be present underlying at least a portion of the site, may contain unrecorded karstic features, such as open conduits or cave structures.

3.4 Previous Ground Investigation

A Geotechnical Ground Investigation, completed by Causeway Geotech Ltd (Report No.22-0788, **Appendix 5**), was carried out to the east of the site, east of the current school building. Although not within the Red Line Boundary, these works provide a useful insight into the underlying conditions of the general area. The ground investigation was undertaken between 22nd June and 28th July 2022. The works involved drilling four windowless sampling boreholes (BH01A-BH04A) and one rotary drilled borehole (RC01). The locations are shown below in **Figure 10.**

Figure 10: Causeway Geotech Investigative Locations



Below summarises the ground types encountered in the exploratory holes, in approximate stratigraphic order:

- Topsoil: encountered typically in 300mm thickness across the site.
- Glacial Till: sandy gravelly clay, frequently with low cobble content, typically soft or firm in upper horizons, becoming stiffer with increasing depth.
- Bedrock (Limestone): Medium strong light grey thickly laminated limestone rockhead was encountered at a depth of 3.70m in RC01.

The borehole logs are presented in Appendix 5. Sandy gravelly Clay was encountered at every windowless sampler borehole location until termination, to a maximum depth of 4.45mbgl (BH01A). At RC01, gravelly Clay overlies the bedrock which was encountered at 3.50mbgl, until termination at 6.70mbgl.

Groundwater was encountered at BH04A at a depth of 3.10mbgl and was not encountered at any other location. The report states that; G*roundwater was not noted during drilling at any of the other borehole locations. However, it should be noted that the casing used in supporting the borehole walls during drilling may have sealed out additional groundwater*

strikes and the possibility of encountering groundwater during excavation works should not be ruled out.

The Causeway Geotech Ltd Geotechnical assessment was completed to investigate ground conditions for a proposed construction of new school gymnasium building in the area of the investigation. The investigation included a number of geotechnical tests to assess ground condition for the purposes of construction, including indirect CBR tests, geotechnical laboratory testing of soils and rock properties.

Recommendations included the use of spread foundations and ground bearing floor slabs. In relation to retaining walls, the report suggests that any retaining structures will have to penetrate beneath the soft to firm clay strata and bear onto the underlying stiff clay or bedrock.

Testing of soil Ph and soluble sulphate indicated Design Sulphate Class DS-1 and ACEC Class AC01s.

CBRs tests on roadway / hardstand locations indicated a CBR of 7.2% at a depth of 0.5m, therefore requiring a 340mm thick capping layer, and the report also recommends the use of geosynthetics in the construction of paved areas.

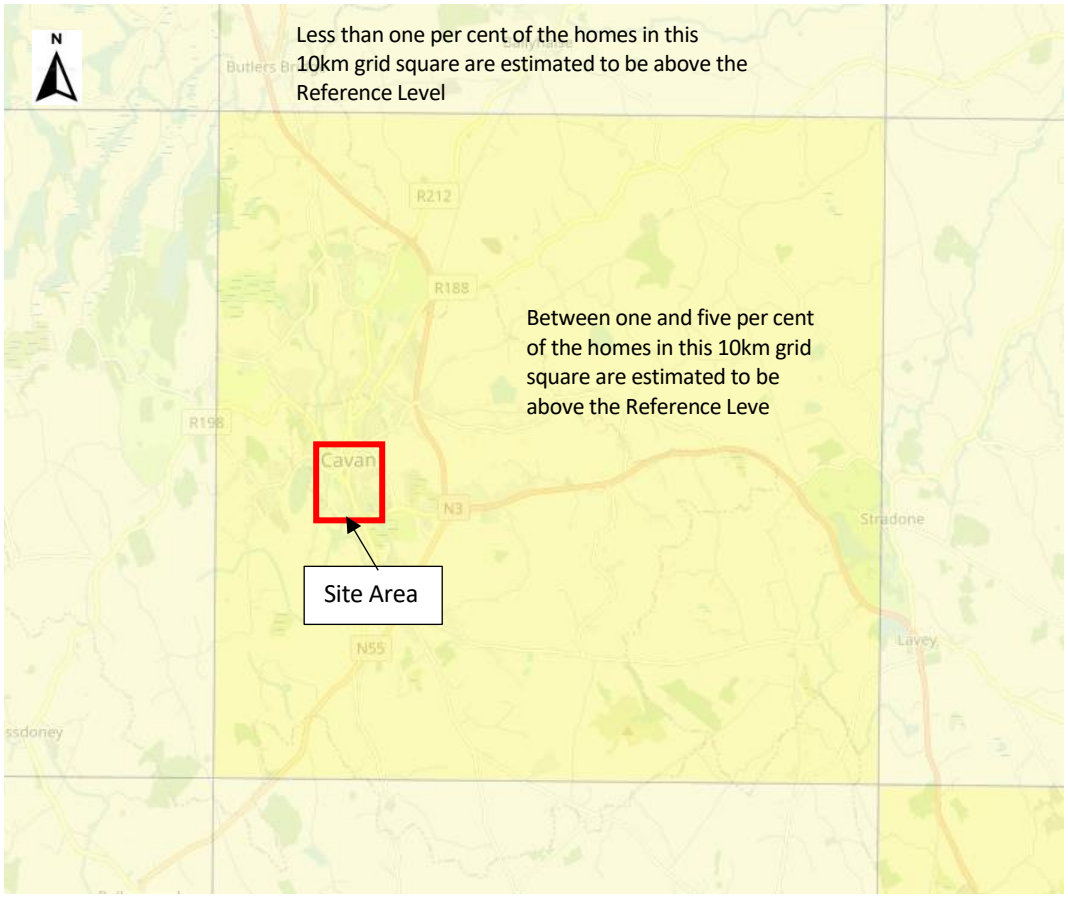
Groundwater levels were recorded above Finished Floor Level and as such a piled wall with associated drainage management system was suggested as the most appropriate retaining structure.

Whist this is useful information, it is very likely that ground conditions at larger development site will vary across the site compared to the area covered by the Causeway Geotech Investigation.

3.5 Radon

The EPA Ireland online map viewer indicates that Radon on the site area is at around 1.112%, (as per the pre May 2022 map) meaning between one and five per cent of the homes in this 10km^2 grid square are estimated to be above the Reference Level of 200 becquerels per cubic metre (Bq/m^3). The Radon Risk Map of Ireland indicates most of the site shows 1 in 20 homes in the area are likely to have high radon levels, with the western extent showing between 1 in 10 homes having a likely high radon level.

Figure 11: EPA Pre May 2022 Radon Map



3.6 Hydrogeology and Groundwater Vulnerability

The underlying Superficial Deposits of Glacial Till/Boulder Clay is not recognised as a potential Superficial Aquifer, due to its low permeability and inability to transmit significant quantities of groundwater.

Similarly, generally low permeability silt-dominated alluvium mapped along the river margin is considered an aquitard. It is possible that river gravels may be present under parts of the mapped areas of alluvium. These units, if significantly thick and laterally continuous along the river channel can transmit useable quantities of groundwater and provide important baseflow to the river.

Information from the Causeway Geotech Ltd Site Investigation of a portion of the Royal School lands to the west of the Cavan River indicates that the shallow drift would appear to be reasonably dry, though some groundwater was encountered in a sand layer at a depth of 3.1m.

The EPA Ireland online map viewer indicates that the Greywacke Bedrock Aquifer which encroaches into northern site area has an Aquifer Code of '*Pl*', characterised as a *Poor*

Aquifer, which is generally unproductive except for Local Zones. The aquifer is located within the Red Island Formation with Greywacke units.

The majority of the site is underlain by the Cooldaragh Formation This is described in geological publications as a sequence mainly consisting of pale brown-grey calcareous siltstones, limestones, mudstones and evaporites up to 125m thick. An intrusive site Investigation report prepared by Causeway Geotech Ltd (**Appendix 5**) covering a portion of the Royal School lands to the west of the Cavan River identified Limestone bedrock at a depth of 3.5m below ground level. This was described as laminated with white calcite veins and also as fractured. No groundwater was encountered in the upper 3m of bedrock, with the borehole terminated in dry limestone.

The EPA Ireland online map viewer indicates that this hydrogeological unit has an Aquifer Code of '*Li*', characterised as a *Locally important Aquifer – Bedrock which is Moderately Productive only in Local Zones'*.

A report entitled 'The County Cavan Groundwater Protection Scheme, December 2008' lists the Cooldaragh Formation as having an aquifer class of 'Li', Locally Important only in local zones' fissured aquifer with usually modest yields, however in major fracture zones groundwater flows can be much higher. In area of the aquifer elsewhere in Cavan, the karstic limestones of the Cooldaragh Formation have 'Excellent' groundwater yields: in excess of approximately 400 m^3/d (4000 gph).

Karstic groundwater systems, and groundwater systems relying on fracture flow are characterised by groundwater being restricted to the network of interconnected fractures and joints, and the groundwater within these systems is usually confined (under pressure). Therefore, where the cut-fill engineering associated with the development may encounter or intersect a bedrock groundwater zone, groundwater could potentially enter excavations with significant force and rise to a much higher level that the elevation of the groundwater zone.

This deskstudy hydrogeological assessments therefore suggests that there could be a reasonably active bedrock groundwater system underlying the site, with the potential of significant quantities of groundwater being encountered in excavations made into the bedrock as part of the development scheme, and the potential need for construction phase and/or operational phase groundwater control. There is also the potential for shallow

unconfined groundwater to be encountered in any permeable drift deposits (such as sands and gravels) close to the margins of the Cavan River.

The nature of the local groundwater systems will however depend on the local hydrogeological conditions which should be investigated further during the geotechnical investigation.

A review of the GSI Groundwater Vulnerability indicates that the site is largely characterised by a vulnerability rating of 'Moderate', with the southeast of the site along the margins of the Cavan River listed as having a vulnerability rating of 'High' to 'Extreme', as shown in **Figure 12.** The latter vulnerability rating is likely in relation to the possible existence of shallow unconfined groundwater occurring in permeable drift deposits (Sand/Gravel) along the river margin.

Figure 12: Groundwater Vulnerability Map

3.7 Hydrology

According to the EPA Ireland online map viewer, the Cavan River (36C02), flows along the eastern boundary, with the Green lough stream (36G01) joining the Cavan River at the southern most point of the site, as shown below in **Figure 13** and **Table 6**. Kinnypottle Stream (36K05) then joins the Cavan River as a tributary c.360m to the north. The Swellan Lower is located c.310m to the west of the site and flows to the south.

During the site walkover, the Kilnavarragh Stream was identified to be dissecting the site into east and west, flowing in an open channel south through the site and converging with the Cavan River along the eastern site boundary. A small watercourse / ditch was observed draining lands north of the school. Various other very small field drains / ditches were recorded along various field boundaries within and around the site.

Figure 13: Local Watercourses

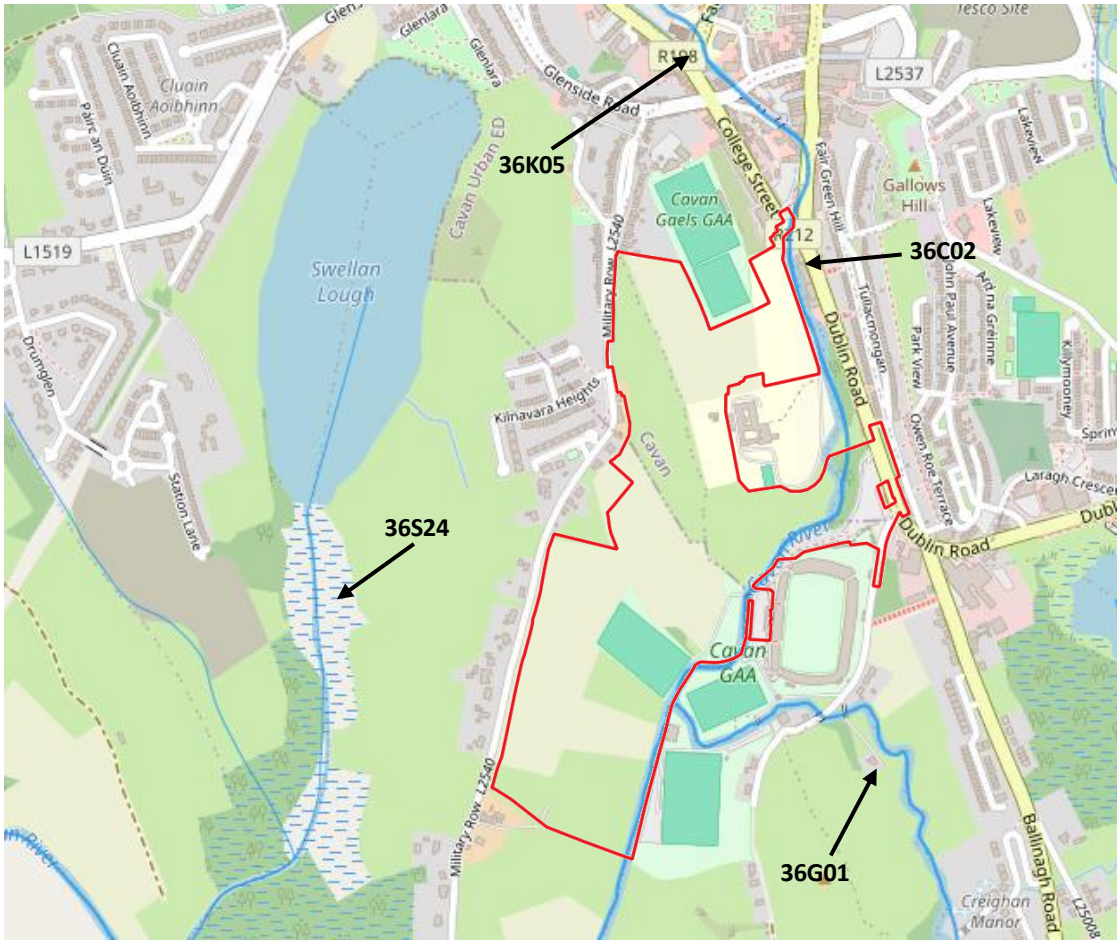


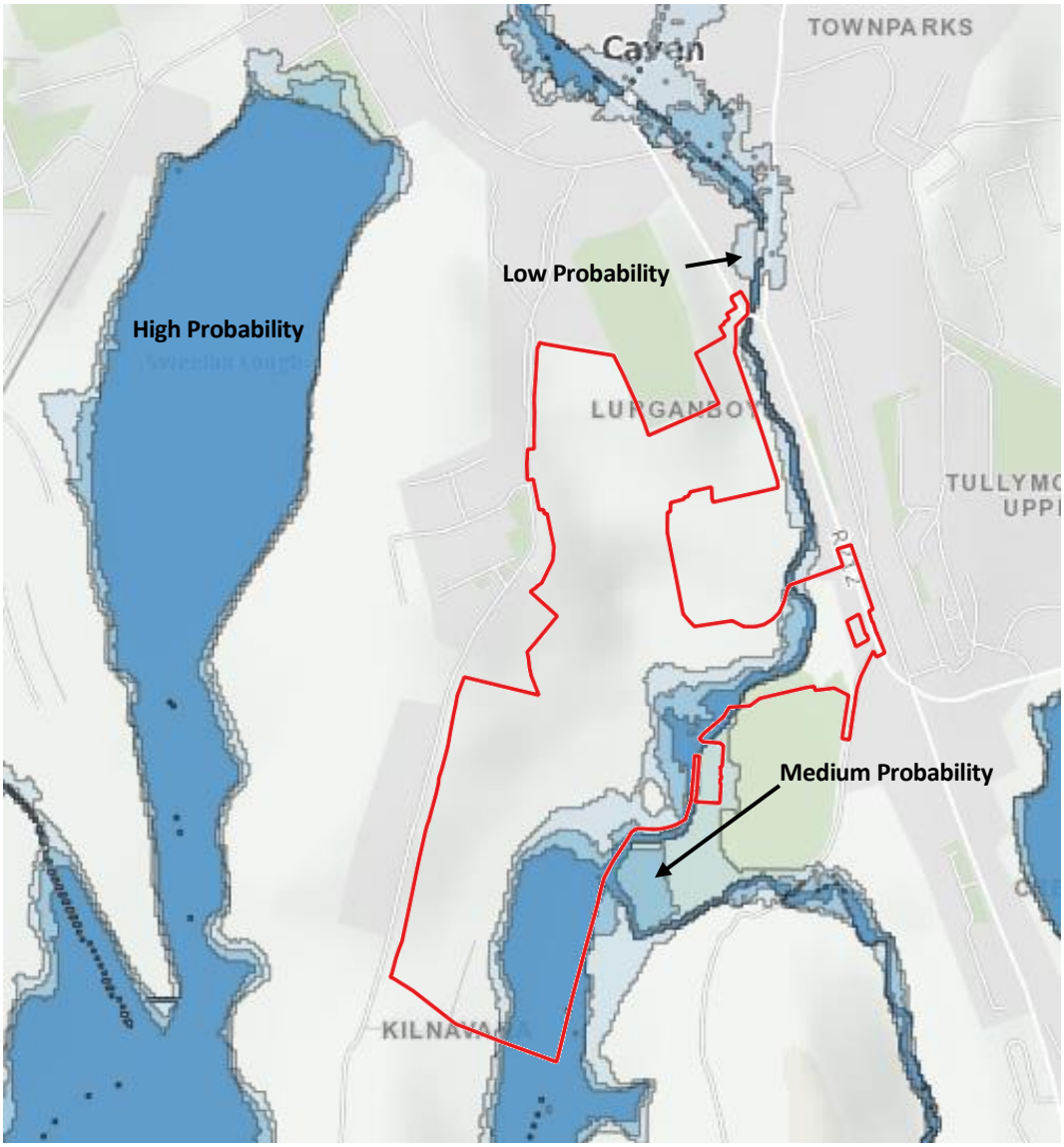
Table 6: Summary of Local Watercourses

EPA Name	EPA Code	Distance from site
Cavan 36	36C02	Eastern border
Kinnypottle Stream	36K05	c.360m north
Swellan Lower	36S24	c.310m west
Green lough stream	36G01	Southern most point

A review of the FloodInfo Ireland Flood Maps indicates that the western/southwestern areas of the site adjacent to the Cavan River is located within the 'High Probability' for River Flooding, as shown below in **Figure 14.**

A Flood Risk and Drainage Assessment are outside the scope of a PRA-PSSR.

Figure 14: FloodInfo Flood Mapping



3.8 Protected Areas

A review of the EPA Ireland online interactive map indicates that the nearest Natural Heritage Area is the Drumkeen House Woodland (000980) c.2.6km north, the Lough Oughter and Associated Loughs SAC (000007) c.3.5km north and the Lough Oughter SPA (004049) c.3.6km northwest. The site is likely to be hydraulically connected to these as the Cavan River flows into these.

3.9 Service Searches

During the site walkover, a raised manhole was encountered in Field 1, overhead electricity power lines in Field 9 and flood lights in the gravel playing pitch were observed. To assist in the identification of any services which may be present at the site, MCL Consulting requested service searches from the following service providers:

- BT Ireland
- Enet Ireland
- Gas Networks Ireland
- ESB Networks
- Eir Ireland
- Virgin Media

Responses received from the service providers searches are presented as Appendix 3.

Service Search responses were not received from the following by the submission of this report; Enet Ireland, ESB Networks, Eir Ireland.

BT Ireland, Gas Networks Ireland, and Virgin Media indicate that they have no assets or networks in the area.

4.0 PRELIMINARY ASSESSMENT OF LAND QUALITY AND GEOTECHNICAL RISKS

Table 7 below provides commentary on the preliminary assessment findings of Section 2 and Section 3.

Table 7: Site Assessment Summary

Geotechnical and Health and Safety Assessment Feature	Influence	Commentary, Concerns
Existing Services and Structures	Constraints on site investigation and possible existing foundations and live services	The site is mainly undeveloped, greenfield land. There is unlikely to be many services underlying the site. There may however be lighting services installed in the vicinity of the newly created car park and the new GGA playing field west of the Cavan River and in the vicinity of the newly constructed bridge across the Cavan River. The GAA activities and facilities may also include unmapped drainage services. There a number of overhead power lines which may require diversion to facilitate the development.
Topography	Site Layout Groundworks Accessibility	There is extensive changes in topography throughout the site. Very significant degrees of cut/fill will be required for this proposal. This may involve deep excavations into underlying drift and bedrock. Some areas of the site have already been subject to man-made alteration of topographical levels, including the area of ground disturbance and minor land raising north of the Royal School and ground disturbance and cut-fill for playing field creation west of the Cavan River.
Slope Stability	Embankments/cuttings Earth retaining features Engineered fills. Bridge Construction Drift Geology Solid Geology Groundwater Ingress	A retaining wall (Plate 18) is evident at the new school building, east of Field 2. A n area of ground disturbance and cut-fill is evident in the area of a newly constructed GAA pitch and new concrete and steel access bridge. An area of minor landraise of c 1m thick and comprising mainly of uncompacted clays is evident on a large area of lands to the north of the Royal School. Significant cut/fill operations, including deep excavations and construction of substantial retaining structures with associated groundwater control will be required as part of the development proposal. Dewatering of water-bearing drift and potentially karstic bedrock units may be required to control groundwater ingress for the construction phase. The volume, pressures and flow rates of groundwater which might enter excavations and cuttings is not yet unknown. A new bridge and a number of substantial structures are to be constructed as part of this development. The construction of these will likely involve piling through drift into the underlying bedrock. The development will include the culverting and possible diversion of a local watercourse. The culvert may end up at substantial depth and overlain by structures. Specialist culvert design may be required to ensure integrity of the

Geotechnical and Health and Safety Assessment Feature	Influence	Commentary, Concerns
		culvert to prevent rick of failure, and undermining of foundations.
Flooding	Further Risk Assessment Site Layout	The western/southwestern areas of the site adjacent to the Cavan River is located within the 'High Probability' for River Flooding. A Flood Risk Assessment is recommended.
Made Ground / Settlement	Variation in nature and thickness of Made Ground may influence settlement characteristics/foundation design	There is expected to be limited Made Ground across the site. Made Ground is likely to underlie the Gravel Pitch and the areas where minor landraise material was identified in Field 3 and Field 9.
Soft ground / Settlement	Variation in nature and thickness of natural soils may influence settlement characteristics/foundation design	Soft ground may be encountered across the site. During the site walkover waterlogged areas were noted throughout the lower portions of the site, with marshy land abundant in the site. It is highly likely that the waterlogged and marshland areas will have significantly softer ground and design aspects of the development on site should take this into consideration.
Bedrock Type Discontinuities	Potential for fracturing/faulting to affect ground stability	The nearest Fault runs through the northeast extent of the site, which could not affect the development if works occurred at significant depths. The bedrock consists primarily of the Cooldarragh Formation (flaggy mudstone and limestone), with smaller extents of the Red Island Formation (Greywacke, microconglomerate and argillite) across the eastern areas of the site. The depth to bedrock is unknown, however previous GI has identified Limestone bedrock at 3.5mbgl east of the Royal School. Borehole logs and photographic record of the bedrock indicate it may be substantially fractured.
Karst or Gypsum Dissolution Features	Potential to influence ground stability	No local records indicated near the site. The site is predominantly underlain by the Cooldaragh Formation, a sequence of mudstones and limestones. GI drilling has identified the presence of Limestone underlying lands at shallow depth at the Royal School. No karstic features were recorded during the PSSR walkover, however, this limestone bedrock has the potential to include unrecorded karstic features such as open conduits at depth. These may be intersected by cut / excavation construction activities resulting in large ingresses of groundwater. Karst features at depth could also result in ground instability risks for large structures such as bridges / retaining walls etc relying on bedrock stability for support.
Mines and Shafts	Potential to influence ground stability	Not expected.
Groundwater	Large inflows requiring management Stability of any excavations	No significant groundwater expected in Till due to the low permeability. However, sand and gravels underlying alluvial deposits can be productive and provide baseflow to local watercourses. The western/southwestern areas of the site is designated *High Probability* of flooding. The underlying greywacke bedrock aquifer in the marginal eastern areas is characterised as a poor productivity. However, the Cooldarragh Formation comprises limestone units which can be up to 100m thick. These are considered as

Geotechnical and Health and Safety Assessment Feature	Influence	Commentary, Concerns
		a locally productive aquifer, capable of yielding significant quantities of groundwater, and elsewhere in Cavan can deliver large quantities of groundwater through fracture and karstic flow mechanisms. Bedrock groundwater will usually be confined (under pressure) in nature, with a relatively high piezometric surface created by uncontrolled open excavation into such units. No karstic features were recorded during the PSSR walkover, however, the limestone bedrock has the potential to include unrecorded karstic features such as open conduits at depth. These may be intersected by cut / excavation construction activities potentially resulting in large ingresses of groundwater. There is a potential need for Aquifer Dewatering to facilitate the development during the construction phased and groundwater pressures behind retaining structures will likely need to be managed in the longer term. There are no abstractions within 500m of the site which could be affected by the development.
Contaminated Ground	Potential for Impact on surrounding environment and human health Potential Investigation and Remedial Costs	A Preliminary Risk Assessment for the site has also been undertaken by MCL *Preliminary Risk Assessment, P2970, May 2023.* The site was assessed as **Moderate Risk**. The PRA has recommended a Phase 2 Generic Quantitative Risk Assessment, entailing a targeted Ground Investigation to assess the Human Health and Environmental risks associated from the minor landrasie on site, potential Made Ground within the gravel pitch and the risk of ground gas from the Alluvium on site. A Construction Environmental Management Plan (CEMP) is also recommended to be completed prior to the commencement of any construction works. This is required to demonstrate how risks would be managed to mitigate any surface run off to the adjacent watercourses.
Ground gas	Potential for Impact on human health Requirement for protective features	Made Ground, a potential source of ground gas, is expected in the areas of minor landraise and within the gravel pitch. Alluvium, which is also a potential source of ground gas, is expected along the east of the site. Areas in which proposed buildings are located should be targeted to identify ground gas concentrations.
Radon	Naturally Occurring Risk to Human Health Requirement for protective features	Radon on the site area is at around 1.112%, meaning between 1-5% of the homes in this 10km^2 grid square are estimated to be above the Reference Level of 200 becquerels per cubic metre (Bq/m^3). A High Radon Area is any area where it is predicted that 10% or more of homes will exceed the Reference Level. The Radon Risk Map of Ireland indicates most of the site shows 1 in 20 homes in the area are likely to have high radon levels, with the western extent showing between 1 in 10 homes having a likely high radon level. Radon protections may be needed in any buildings, carried out as per EPA guidance.
Asbestos	Presence of Made Ground of unknown origin or	Asbestos is unlikely to be located on site. The only potential source could be in the minor landraise clays in Field 3 and Field 9. Operatives undertaking the works should have

Geotechnical and Health and Safety Assessment Feature	Influence	Commentary, Concerns
	because of past demolition Potential for Impact on human health	appropriate training to recognise potential ACM. Should ACM be detected, it should be tested and quantified for appropriate disposal.
Requirement for S.I.	Site investigation is required	A Contaminated Land Assessment ground investigation is recommended comprising of shallow boreholes in areas highlighted to be potentially contaminated, as stated in the Preliminary Risk Assessment. The ground investigation will establish if any contaminants are present in the underlying soils and groundwater, or if any ground gas is present. Geotechnical Investigations should be carried out, as summarised in Section 5.0 below.

5.0 SUMMARY AND RECOMMENDATIONS

The site is mainly greenfield land, with the Kilnavarragh Stream dissecting the site east and west and the Cavan River located along the eastern boundary of the site. A gravel pitch is located west of the school, in which Made Ground is likely to be present. There was evidence of potentially contaminated material in Field 3 from construction activities currently undergoing to the east of Field 2. Minor landraise material was also identified in Field 9, presumably from the construction of the car park to the east. Review of Geological Maps indicates that Alluvium is present on site, which is a potential source of ground gas.

The Preliminary Risk Assessment undertaken by MCL Consulting (*Preliminary Risk Assessment, P2970, May 2023)* has deemed the site as **Moderate Risk** and recommended further assessment is required (a Phase 2 Generic Quantitative Risk Assessment) in the risk assessment process set out in LCRM. A targeted ground investigation is recommended to be undertaken in areas identified as potentially contaminated to establish if contaminants are present in the underlying soils and/or groundwater.

Geotechnical Investigations should be carried out in all areas where structures are proposed, including the area of minor landraise in Field 3. CBR testing should be undertaken in all areas where new roads are constructed and within the new pitches. Standard Penetrations Tests are recommend for foundation design. These should be appropriately spatially distributed to ensure maximum coverage of the site is established.

A significant degree of Cut/Fill will be required throughout the site due to the extreme changes in topography. This may involve blasting through bedrock which should be risk assessed to mitigate any impact to the local residential dwellings and structures of surrounding properties.

Any significant Cut/Fill could impact on the drainage patterns and groundwater flow in the area, possibly affecting the Lough Oughter and Associated Loughs SAC/SPA.

The underlying bedrock contains limestone units, which have already been identified at shallow depth at the Royal School. These limestones may contain karstic features which could affect the stability of the bedrock and its ability to support large structures such as a proposed road bridge across the Cavan River. The geotechnical investigation should be extended a suitable depth into the bedrock to establish the presence and nature of any karst features proximal to large structures and in any areas of deep cut which might intersect or involve excavations into the bedrock.

The Cooldaragh Formation is a mixed lithology unit, and a faulted block of this sequence underlies the majority of the site. There is potential therefore for the geological and hydrogeological conditions to vary considerably across the site even over short distances.

The Cooldaragh Formation when considered on a broad basis, is classified as a moderately productive, locally important aquifer. Where the limestone occurs, it may contain karstic features with higher than normal groundwater yields.

If groundwater is encountered in the shallow bedrock within the development zone, then pumping tests, supervised by a hydrogeologist, may need to be carried out to allow for the design of appropriate dewatering / groundwater control mechanisms for the construction phase. If groundwater dewatering is envisaged to potentially be required, then appropriate groundwater quality sampling and testing should also be included in the geotechnical investigation to assist assessment of possible disposal routes for abstracted groundwater.

A Piling Risk Assessment is recommended to assess the environmental, ecological and water pollution risk for the spectators stand, the bridge crossing site and for any other permanent or temporary structures which require piling, such as cofferdams, pile walls, retaining structures etc. It is likely that low vibration piling solution would be recommended at this site due to its environmental sensitivity.

Drainage Management systems would also be required, particularly where retaining walls are constructed so to avoid the build up of groundwater pressures or surface water drainage on the site. Where trees are to be felled, it should be ensured that the rootball is also fully removed and the affected lands reinstated and compacted to prevent future land subsidence issues.

A long stretch of subsidiary watercourse (tributary of the Cavan River) will require culverting or substantial diversion or both as part of the development proposal. It may be necessary to construct other structures over portions of such a culvert. The culvert may end up at a substantial depth below formed ground level due to the necessary cut-fill and may therefore need to be properly designed to withstand ground pressures. Diversion of a watercourse may results in changes to the local hydraulics of the Cavan River. The affects of watercourse diversion may need to be accounted for in any flood models developed for the site.

The construction phase of the development has a high probability of impacting the Cavan River and other watercourses and will require substantial mitigation during the construction phase. Therefore, a Construction and Environmental Management Plan (CEMP) is recommended to be undertaken prior to the beginning of the construction phase to mitigate any environmental risks.

Report prepared by:

Ryan McCluskey BSc MSc FGS
Consultant Geologist

Prepared and Reviewed by:

Thomas Martin BSc MSc AMIEnvSc
Land Quality Consultant

Appendix 1: Site Development Plan

LEGEND

1. Sports Building
2. Sports Arena
3. Synthetic Hockey Pitch (non-water based)
4. Athletics Track (400m)
5. External Synthetic Multi-Sport Pitch
6. Sand Mattress GAA Fields
7. Covered Stands (3No.)
8. Toilet Block
9. Cricket Practice Nets

- SITE BOUNDARY
- NATURAL TURF PITCH SURFACE
- SYNTHETIC GRASS PITCH SURAFCE
- ATHLETICS TRACK - EPDM POLYMERIC RUBBER SURFACE
- GRASS SURFACE / SOFT LANDSCAPED AREAS (Refer to Landscape Architects Drawings ref: XXXX)
- EXISTING NATURAL LANDSCAPE AND HABITAT MAINTAINED
- WILDLIFE HABITAT CREATION ZONE (Refer to Landscape Architects Drawings ref: XXXX)
- PEDESTRIAN PAVEMENT - ASPHALT / BITMAC
- PEDESTRIAN PAVEMENT - NATURAL GRANITE AGGREGATE CONCRETE PAVING SLABS
- VEHICULAR PAVEMENT - ACCESS ROAD / PARKING
- EXISTING DENSE HEDGEROW VEGETATION
- EXISTING TREE
- PROPRIETARY CONCRETE BLOCK GEOSYNTHETHIC REINFORCED SEGMENTAL RETAINING WALL SYSTEM (Refer Detail X on Dwg XXXXX)
- TIMBER CRIBB RETAINING WALL STRUCTURE (Refer Detail X on Dwg XXXXX)
- 12M HIGH BALL CATCH NET (Refer Detail X on Dwg XXXXX)
- 1.2M HIGH OPEN MESH FENCING (Refer Detail X on Dwg XXXXX)
- 3.0M HIGH OPEN MESH FENCING (Refer Detail X on Dwg XXXXX)
- 4.2M HIGH OPEN MESH FENCING (Refer Detail X on Dwg XXXXX)
- 1.1M HIGH GALVANISED STEEL SAFETY RAILINGS (Refer Detail X on Dwg XXXXX)
- 1.2M HIGH TIMBER POST & RAIL FENCE (Refer Detail X on Dwg XXXXX)
- 2M HIGH TIMBER ACOUSTIC FENCE (Refer Detail X on Dwg XXXXX)
- 600MM HIGH TIMBER KNEE RAIL FENCE (Refer Detail X on Dwg XXXXX)
- PROPOSED ACCESSIBLE SHARED PEDESTRIAN AND CYCLE ROUTE LINKING DUBLIN ROAD AND KILNAVARRAGH LANE - Max Gradient < 1:21
- PROPOSED LOCATION OF FLOODLIGHT COLUMN (Refer Detail X on Dwg XXXXX)
- PROPOSED BOLLARD PATHWAY LIGHT
- PROPOSED LIGHTING COLUMN - SINGLE LUMINAIRE
- PROPOSED LIGHTING COLUMN - DOUBLE LUMINAIRE
- ELECTRIC VEHICLE (EV) CHARGE POINT
- PROPOSED DUCTING PROVIDED FOR FUTURE EV CHARGING POINT
- PROPOSEDF FIXED BOLLARD - STAINLESS STEEL WITH VISIBILITY BAND. REFER TO LANDSCAPE MATERIALITY SHEET CSC-MLA-XX-00-DR-L-3001
- PROPOSED REMOVABLE BOLLARD - STAINLESS STEEL WITH VISIBILITY BAND. REFER TO LANDSCAPE MATERIALITY SHEET CSC-MLA-XX-00-DR-L-3001
- PROPOSED LITTER BIN. REFER TO LANDSCAPE MATERIALITY SHEET CSC-MLA-XX-00-DR-L-3001
- PROPOSED EV CHARGING PARKING SPACE
- PROPOSED ACCESSIBLE PARKING SPACE
- 75.45 PROPOSED LEVELS

Proposed pedestrian and cycle access to accessible route linking Kilnavarragh Lane and Dublin Road

Controlled gated egress to facilitate emergency vehicle access only when sporting events are taking place

Proposed location of artificial badger sett

30 mm disconstruction zone to proposed new badger sett

Proposed self-closing pedestrian access gate connection to proposed walking trail from Kilnavarragh Lane

Proposed pedestrian access gate connection to proposed walking trail from Kilnavarragh Lane

Covered Cycle Parking - refer to Landscape Materiality Sheet CSC-MLA-XX-00-DR-L-3001

Automated Vehicle Barrier - refer to construction details drawing no A2156-302

Proposed pedestrian access to Royal School

Proposed location of Electric Car Charge Point with Sign - refer to signage detail drawing A2156-601

Proposed closure of Dublin Road junction to Park Lane to re-route traffic - pedestrian access only

Proposed replacement public ingress and egress structure for Kingspan Breffni stadium

Proposed new bridge structure over Cavan River

Proposed self-closing pedestrian access gate connection to proposed walking trail from Kilnavarragh Lane

Kilnavarragh Heights

Lurganboy

Playground

Royal School

Sports Ground

Breffni Park

Cavan River

Grave Yard

Green Lou

Pond

Pond

Pond

Sports Ground

Resource Centre

Joint Policing Centre

DUBLIN ROAD

BALLYNAGH ROAD

Killymooney

Killymooney

Park Lane

Cavan River

10kV

38kV

77.3

77.2

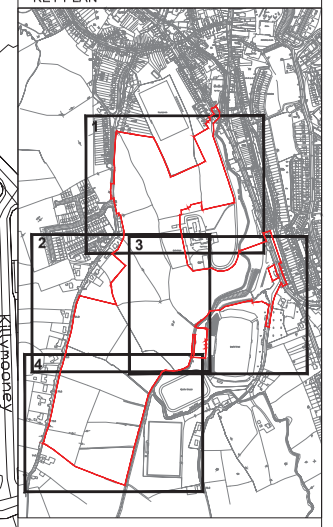
76.6

NOTES

1. All measurements shown are in metres, and all levels are to ordnance datum unless otherwise indicated
2. All Coordinates are to Irish Grid, unless otherwise noted.

N

KEY PLAN



Rev	Issue Date	Description	App

Status	PLANNING
Client	Cavan County Council
Project	Cavan Regional Sports Campus
Drawing	Proposed Site Plan Overall
Scale	1:1250 @ A0

McAdam ENHANCING LOCAL COMMUNITIES

Contact Details: 1c Montgomery House, 478 Castlereagh Road, Belfast, BT5 6BQ. T: 028 9040 2000. E: admin@mcadamdesign.co.uk. www.mcadamdesign.co.uk

Drawn	moc	Checked	pa
Date	04/03/24	Date	04/03/24
Approved	moc		
Date	04/03/24		
Project Number	A2156	Drawing Number	100-10
Revision	-		

Appendix 2: Site Walkover Photographs

Plate 1: Gravel Playing Pitch looking west

Plate 2: Gravel Playing Pitch looking north west

Plate 3: Field 1 looking south

Plate 4: Field 1 looking east

Plate 5: Kilnavarragh Stream disecting site (Western Boundary Field 1)

Plate 6: Cavan River at south east Field 1

Plate 7: Cavan River East of Field 1

Plate 8: North East of Field 1

Plate 9: Cavan River North East of Field 1

Plate 10: Field 3 looking North East

Plate 11: Construction of New School Building East of Field 2

Plate 12: Field 3 looking towards Field 4. Gravel Road for construction vehicles

Plate 13: Field 3 looking north. Constrcuction landraise material evident

Plate 14: Landraise material in Field 3

Plate 15: Watercourse east of Field 3

Plate 16: Field 4 looking east

Plate 17: New school building with recently constructed retaining wall, note cutting made into ground to accommodate building

Plate 18: Field 3 looking east. Steep decline in topography eastwards

Plate 19: Cavan River from the bridge between Breffni Park and Field 9

Plate 20: Car Park east of Field 9

Plate 21: Field 9 looking north west. Incline in topography north west

Plate 22: Clay Stockpile in Field 9

Plate 23: Field 9 looking west

Plate 24: Watercourse entering the north west corner of Field 9, along the boundary with Field 8

Plate 25: Ditch on Boundary of Field 10 and Field 11

Plate 26: GAA pitch recently constructed within Field 9 and Field 11

Plate 27: Field 10 looking north west

Plate 28: Field 13-15, looking east

Plate 29: Field 13-15, south east

Plate 30: Field 16 and 17, facing southwest

Plate 31: Flood extent on Fields 13-15, facing south

Plate 32: Flood extent on Fields 13-15

Plate 33: Flood extent on Fields 13-15

Appendix 3: Services Searches

Thomas Martin

From: Steven Corcoran <Steven.Corcoran@gasnetworks.ie> on behalf of DIG <Dig@gasnetworks.ie>
Sent: 11 April 2023 09:02
To: Ryan McCluskey
Subject: RE: P2970 - MCL Gas Service Request

Thank you for your enquiry to the Gas Networks Ireland ***Dial Before You Dig*** service.

Gas Networks Ireland has ***No recorded Gas Network*** within your area of interest.

Before you start work, you must have a current gas network map (or maps) for the work location. A current gas network map (or maps) must always be kept on site while work is under way.

The Gas Network

For an overview of the existing Gas Network, please refer to the Gas Networks Ireland safety booklet, ***Safety advice for working in the vicinity of natural gas pipelines***, available at https://www.gasnetworks.ie/home/safety/dial-before-you-dig/

Reading your Map

- High pressure transmission gas pipe is shown **Red.**
- Medium pressure distribution gas pipe is shown **Blue.**
- Low Pressure distribution gas pipe is shown **Green.**

The gas network map is indicative only. You must conform to the safety and legal notices printed on the map. For further information on reading this map refer to the ***Safety Information*** below.

Breaking Ground

- Supervision by Gas Networks Ireland is **not** required when working in the vicinity of Distribution gas pipes (unless noted otherwise). Safe digging practices **must** be followed. All work in the vicinity of a gas transmission pipeline **must** be carried out in compliance with:
    - Health and Safety Authority, ***Code of Practice for Avoiding Danger from Underground Services.***

Critical Activity

Quarrying or blasting must not be carried out within 400 m of the gas network until Gas Networks Ireland has been consulted on **1800 42 77 47**

Aurora Telecom

- Part of the Aurora Telecom Network may be present on your network map. For further information, Aurora can be contacted on **01 892 6166** (Office Hours) or auroralink@gasnetworks.ie.

Safety Information

- Before starting work any work in the vicinity of the gas network, please refer to the Gas Networks Ireland safety booklet, ***Safety advice for working in the vicinity of natural gas pipelines***, available at https://www.gasnetworks.ie/home/safety/dial-before-you-dig/

  This booklet contains important safety information, including advice on how to read the gas network maps you have requested.

If you did not request this map, please contact Customer Service on **1800 200 694**.

Thank you for your enquiry to Gas Networks Ireland.

T 1800 20 50 50 (Emergency)
T 1800 42 77 47 (Dial Before You Dig enquiries)

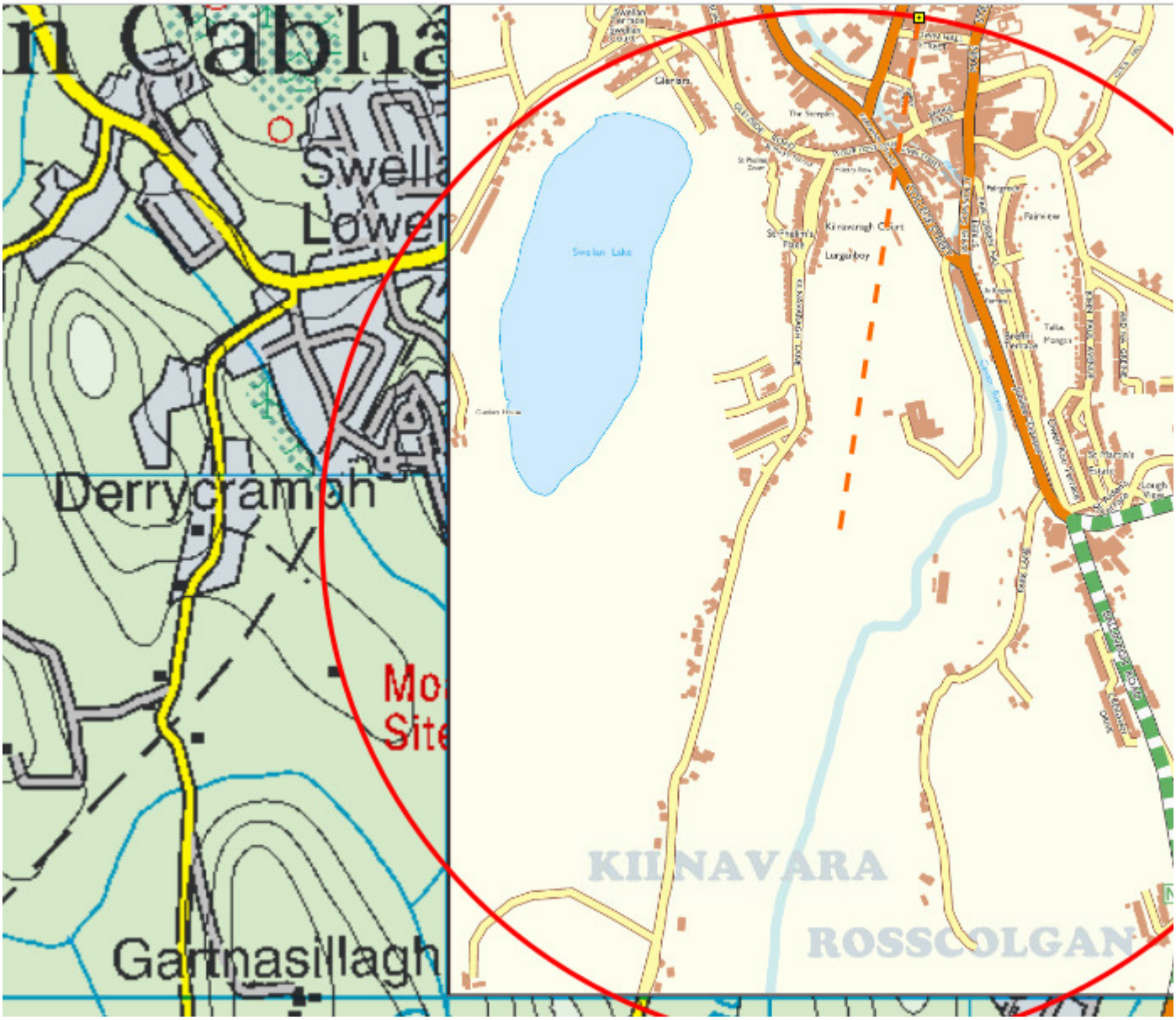
E dig@gasnetworks.ie

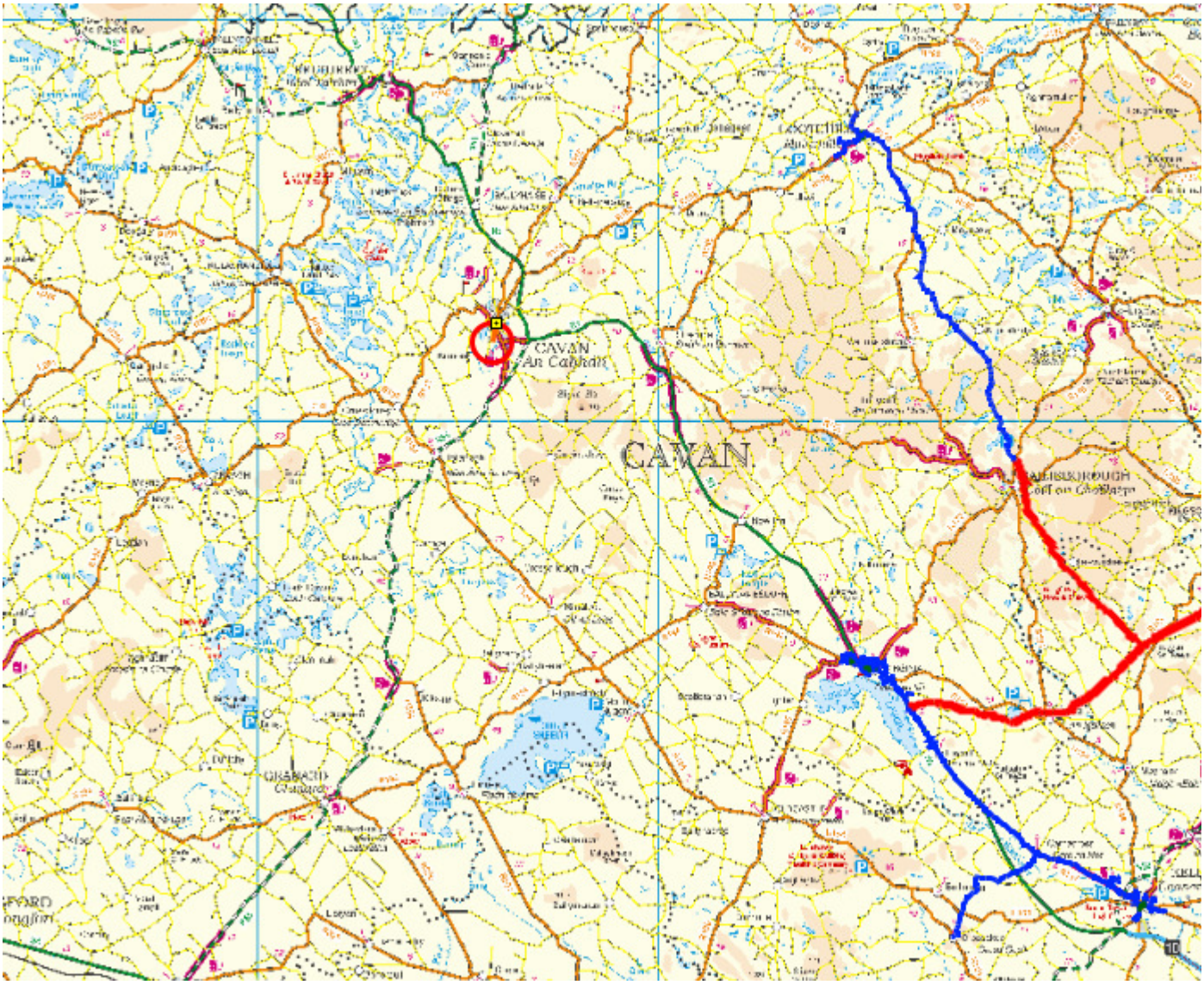
Gas Networks Ireland Networks Services Centre, St. Margaret's Road, Finglas, D11 Y895 gasnetworks.ie | Find us on Twitter

Useful Publications

- Heatlh and Safety Authority, ***Code of Practice for Avoiding Danger from Underground Services***
- Heatlh and Safety Authority, ***Guide to Safety in Excavations***

Both are available free of charge from: Health and Safety Authority on **1890 289 389** www.hsa.ie


Derrycramph
Garrnasillagh
Swellan Lake
Kinnaragh Court
Lurgalboy
KILNAVARA
ROSSCOLGAN



From: Ryan McCluskey <ryan.mccluskey@mclni.com>
Sent: Friday, April 7, 2023 2:12 PM
To: DIG <Dig@gasnetworks.ie>
Subject: P2970 - MCL Gas Service Request

Good Afternoon,

We are undertaking a desk top information gathering for land located west of College Street and west/northwest of Kingspan Breffni, in Cavan, County Cavan (IGR: 241769, 303932), as outlined in the attachment.

Can you confirm if you have any assets in the vicinity please?

Kind Regards,
Ryan

Ryan McCluskey BSc MSc

Graduate Geologist

MCL Consulting

p:028 9074 7766 | m: 07719958738
e: ryan.mccluskey@mclni.com
w:www.mclni.com
a: Unit 5, Forty Eight North, 48 Duncrue Street,
Belfast, BT3 9BJ

Contaminated Land • Hydrogeology • Waste Management • Planning • Air, Noise & Odour • Hydrology • Flood Risk • Ecology • Geotechnical / Drilling • Topographical Surveys • Environmental Monitoring

---

From: gis.ireland@bt.com
To: Ryan McCluskey
Subject: RE: P2970 - MCL BT Service Request
Date: 07 April 2023 14:14:42
Attachments: image001.png
image002.png
image003.png
image004.png
image005.jpg
image006.jpg
image007.png
image009.png

Afternoon Ryan,

I can confirm BT ireland do not have any infrastructure in the area outlined.

Kind Regards,

BTI GIS Team

From: Ryan McCluskey <ryan.mccluskey@mclni.com>
Sent: 07 April 2023 14:09
To: GIS Ireland <gis.ireland@bt.com>
Subject: P2970 - MCL BT Service Request

> You don't often get email from ryan.mccluskey@mclni.com. Learn why this is important

Good Afternoon,

We are undertaking a desk top information gathering for land located west of College Street and west/northwest of Kingspan Breffni (IGR: 241769, 303932).

Can you confirm if you have any assets in the vicinity please?

Kind Regards,
Ryan

photo

Ryan McCluskey BSc MSc

Graduate Geologist

MCL Consulting

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w:www.mclni.com
a: Unit 5, Forty Eight North, 48 Duncrue Street,
Belfast, BT3 9BJ

Contaminated Land • Hydrogeology • Waste Management • Planning • Air, Noise & Odour • Hydrology • Flood Risk • Ecology • Geotechnical / Drilling • Topographical Surveys • Environmental Monitoring

Thomas Martin

From: Sinead Daly <Sinead.Daly@virginmedia.ie> on behalf of Civils <Civils@virginmedia.ie>
Sent: 14 April 2023 14:42
To: Ryan McCluskey
Cc: Civils
Subject: RE: P2970 - MCL Virgin Media Service Request

Ryan,

I refer to your query of 7th April about the above location. Virgin Media does not have any record of underground services at this location as indicated by your drawing.

WHILST THE INFORMATION GIVEN IS BELIEVED TO BE CORRECT NO WARRANTY IS MADE AS TO ITS ACCURACY. THIS INFORMATION MUST NOT BE RELIED UPON IN THE EVENT OF EXCAVATION OR OTHER WORKS CARRIED OUT IN THE SITE AREA. NO LIABILITY OF ANY KIND WHATSOEVER IS ACCEPTED BY VIRGIN MEDIA, ITS SERVANTS OR AGENTS FOR ANY ERROR OR OMISSION IN RESPECT OF INFORMATION CONTAINED WITHIN THIS COMMUNICATION. THE ACTUAL POSITION OF UNDERGROUND SERVICES MUST BE VERIFIED AND ESTABLISHED ON SITE BEFORE ANY MECHANICAL PLANT IS USED.

Regards,

Sinead Daly | *Plant Protection Support*
Construction Office
Virgin Media | Unit 7, Westgate Business Park, Ballymount, Dublin 24.
E: civils@virginmedia.ie | Sinead.daly@virginmedia.ie

From: Ryan McCluskey <ryan.mccluskey@mclni.com>
Sent: Friday 7 April 2023 14:13
To: Civils <Civils@virginmedia.ie>
Subject: P2970 - MCL Virgin Media Service Request

Good Afternoon,

We are undertaking a desk top information gathering for land located west of College Street and west/northwest of Kingspan Breffni, in Cavan, County Cavan (IGR: 241769, 303932), as outlined in the attachment.

Can you confirm if you have any assets in the vicinity please?

Kind Regards,

Ryan

Ryan McCluskey BSc MSc

Graduate Geologist

MCL Consulting

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Belfast, BT3 9BJ

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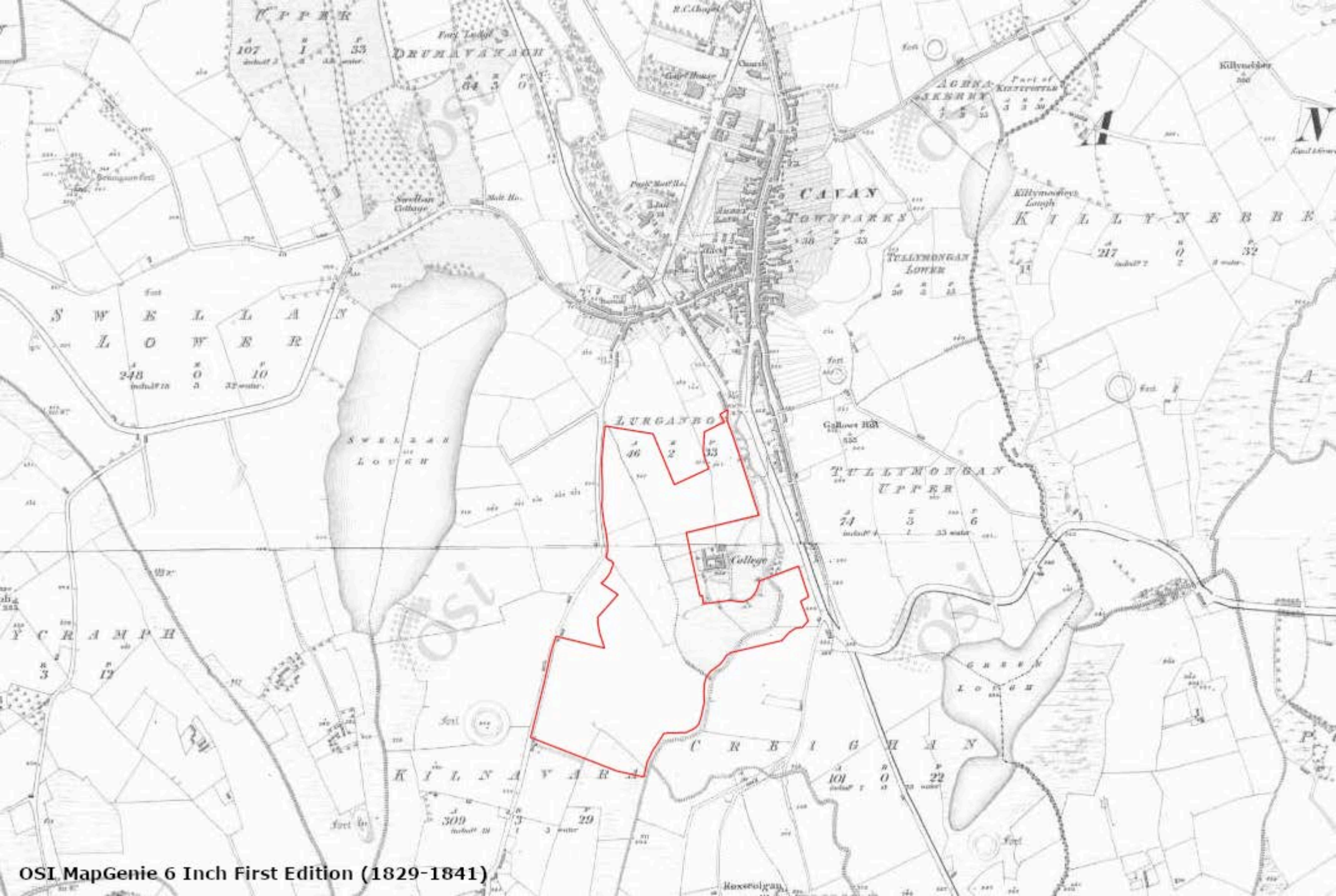
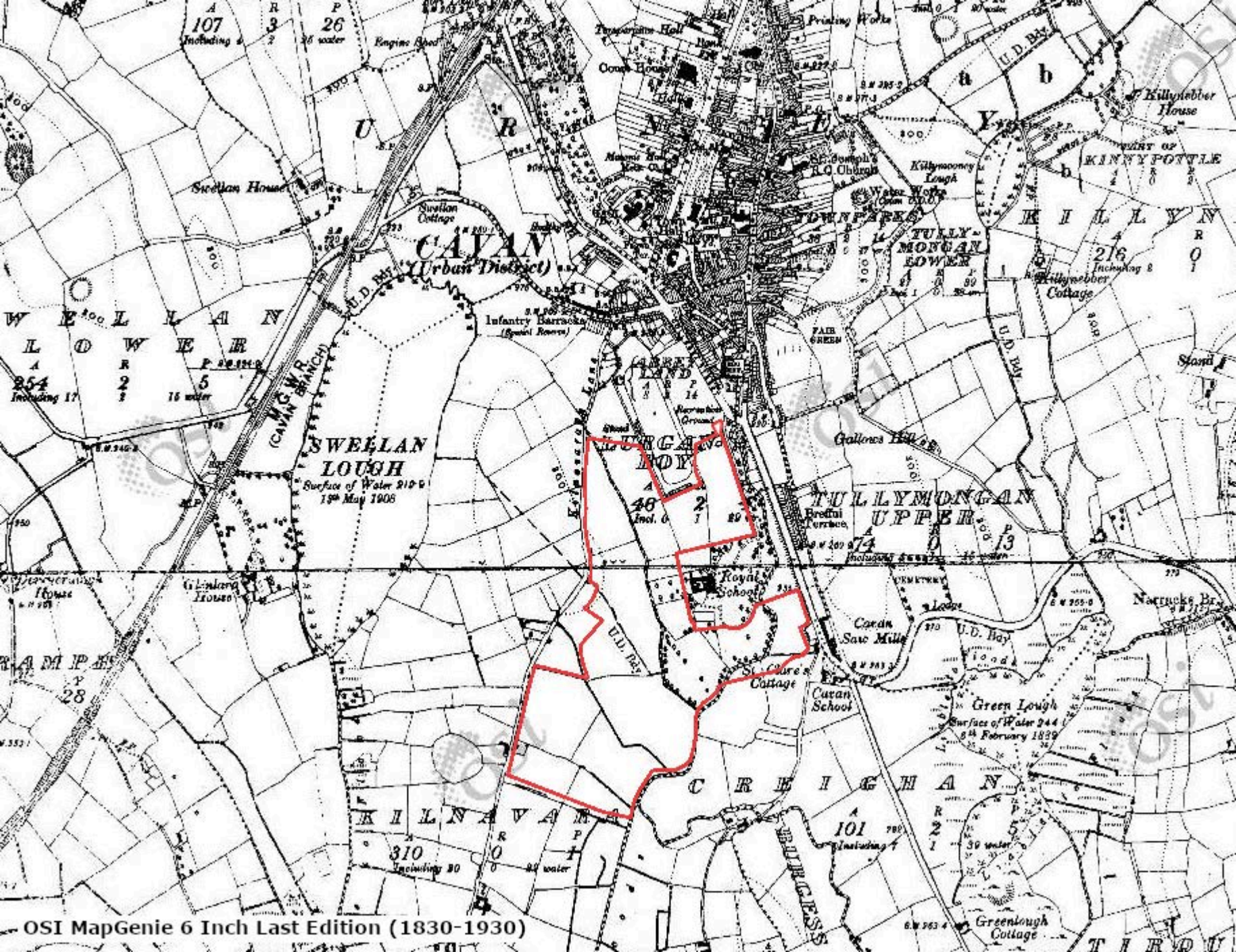
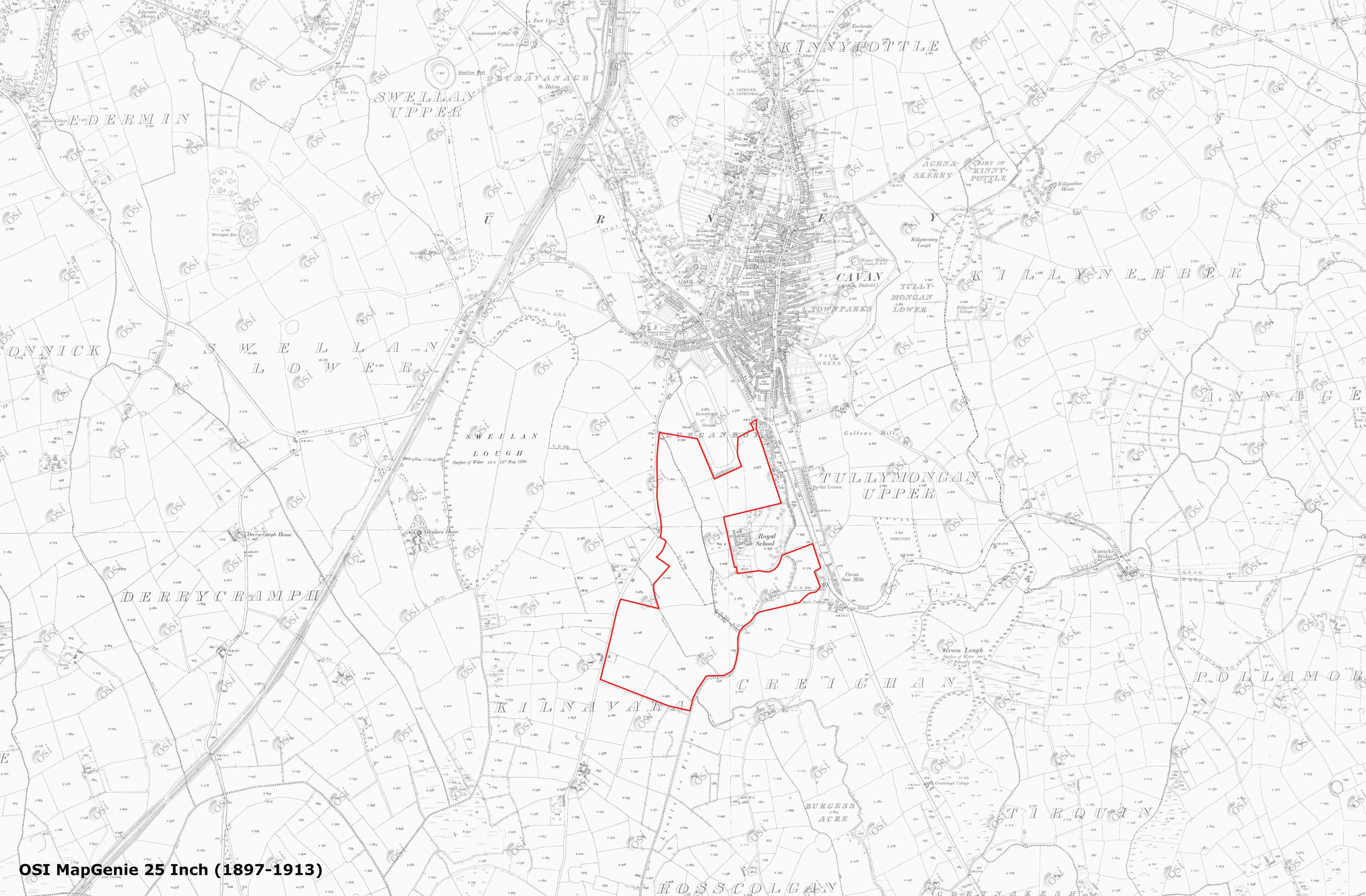
Appendix 4: Historical Maps



OSI MapGenie 6 Inch First Edition (1829-1841)



OSI MapGenie 6 Inch Last Edition (1830-1930)



OSI MapGenie 25 Inch (1897-1913)

Appendix 5: Causeway Geotech Ltd Site Investigation

Royal School Cavan Permanent Works – Ground Investigation

Client:	Cavan and Monaghan Education and Training Board (CMETB)
Client's Representative:	Collins Boyd Engineering
Report No.:	22-0788
Date:	August 2022
Status:	Final for Issue

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Approved: ISO 9001 • ISO 14001 • OHSAS 18001

CONTENTS

APPENDICES

Document Control Sheet

Report No.:		22-0788			
Project Title:		Royal School Cavan Permanent Works			
Client:		Cavan and Monaghan Education and Training Board (CMETB)			
Client's Representative:		Collins Boyd Engineering			
Revision:	A00	**Status:**	Final for Issue	**Issue Date:**	5th August 2022
Prepared by:		**Reviewed by:**		**Approved by:**	
 Rachel White BA(Mod) Geoscience		 Sean Ross BSc MSc MIEI PGeo		 Darren O'Mahony BSc MSc MIEI EurGeol PGeo	

The works were conducted in accordance with:

British Standards Institute (2015) BS 5930:2015+A1:2020, Code of practice for ground investigations.

BS EN 1997-2: 2007: Eurocode 7 - Geotechnical design - Part 2 Ground investigation and testing.

Geotechnical Society of Ireland (2016), Specification & Related Documents for Ground Investigation in Ireland

Laboratory testing was conducted in accordance with:

British Standards Institute BS 1377:1990 parts 2, 4, 5, 7 and 9

METHODS OF DESCRIBING SOILS AND ROCKS

Soil and rock descriptions are based on the guidance in BS5930:2015+A1:2020, The Code of Practice for Ground Investigation.

Abbreviations used on exploratory hole logs	
U	Nominal 100mm diameter undisturbed open tube sample (thick walled sampler).
UT	Nominal 100mm diameter undisturbed open tube sample (thin walled sampler).
P	Nominal 100mm diameter undisturbed piston sample.
B	Bulk disturbed sample.
LB	Large bulk disturbed sample.
D	Small disturbed sample.
C	Core sub-sample (displayed in the Field Records column on the logs).
L	Liner sample from dynamic sampled borehole.
W	Water sample.
ES / EW	Soil sample for environmental testing / Water sample for environmental testing.
SPT (s)	Standard penetration test using a split spoon sampler (small disturbed sample obtained).
SPT (c)	Standard penetration test using 60 degree solid cone.
(x,x/x,x,x,x)	Blows per increment during the standard penetration test. The initial two values relate to the seating drive (150mm) and the remaining four to the 75mm increments of the test length.
(Y for Z/ Y for Z)	Incomplete standard penetration test where the full test length was not achieved. The blows 'X' represent the total blows for the given seating or test length 'Z' (mm).
N=X	SPT blow count 'N' given by the summation of the blows 'X' required to drive the full test length (300mm).
HVP / HVR	In situ hand vane test result (HVP) and vane test residual result (HVR). Results presented in kPa.
V VR	Shear vane test (borehole). Shear strength stated in kPa. V: undisturbed vane shear strength VR: remoulded vane shear strength
Soil consistency description	In cohesive soils, where samples are disturbed and there are no suitable laboratory tests, N values may be used to indicate consistency on borehole logs – a median relationship of Nx5=Cu is used (as set out in Stroud & Butler 1975).
dd-mm-yyyy	Date at the end and start of shifts, shown at the relevant borehole depth. Corresponding casing and water depths shown in the adjacent columns.
▽	Water strike: initial depth of strike.
▼	Water strike: depth water rose to.
Abbreviations relating to rock core – reference Clause 36.4.4 of BS 5930: 2015+A1:2020	
TCR (%)	Total Core Recovery: Ratio of rock/soil core recovered (both solid and non-intact) to the total length of core run.
SCR (%)	Solid Core Recovery: Ratio of solid core to the total length of core run. Solid core has a full diameter, uninterrupted by natural discontinuities, but not necessarily a full circumference and is measured along the core axis between natural fractures.
RQD (%)	Rock Quality Designation: Ratio of total length of solid core pieces greater than 100mm to the total length of core run.
FI	Fracture Index: Number of natural discontinuities per metre over an indicated length of core of similar intensity of fracturing.
NI	Non Intact: Used where the rock material was recovered fragmented, for example as fine to coarse gravel size particles.
AZCL	Assessed zone of core loss: The estimated depth range where core was not recovered.
DIF	Drilling induced fracture: A fracture of non-geological origin brought about by the rock coring.
(xxx/xxx/xxx)	Spacing between discontinuities (minimum/average/maximum) measured in millimetres.

Royal School Cavan Permanent Works

1 AUTHORITY

On the instructions of Colins Boyd Engineering, ("the Client's Representative"), acting on the behalf of Cavan and Monaghan Education and Training Board (CMETB) ("the Client"), a ground investigation was undertaken at the above location to provide geotechnical and environmental information for input to the design and construction of a proposed construction of a school gymnasium building.

This report details the work carried out both on site and in the geotechnical and chemical testing laboratories; it contains a description of the site and the works undertaken, the exploratory hole logs and the laboratory test results. A discussion on the recommendations for construction is also provided.

All information given in this report is based upon the ground conditions encountered during the ground investigation works, and on the results of the laboratory and field tests performed. However, there may be conditions at the site that have not been taken into account, such as unpredictable soil strata, contaminant concentrations, and water conditions between or below exploratory holes. It should be noted that groundwater levels usually vary due to seasonal and/or other effects and may at times differ to those recorded during the investigation. No responsibility can be taken for conditions not encountered through the scope of work commissioned, for example between exploratory hole points, or beneath the termination depths achieved.

This report was prepared by Causeway Geotech Ltd for the use of the Client and the Client's Representative in response to a particular set of instructions. Any other parties using the information contained in this report do so at their own risk and any duty of care to those parties is excluded.

2 SCOPE

The extent of the investigation, as instructed by the Client's Representative, included boreholes, dynamic probing, soil sampling, environmental sampling, in-situ and laboratory testing, and the preparation of a report on the findings including recommendations for construction.

3 DESCRIPTION OF SITE

As shown on the site location plan in Appendix A, the works were conducted on a greenfield site directly to the east of Royal School, located in Tullymongan Upper, Cavan. The site is bordered by College Street to the east, Kilnvarragh Lane to the west, Terry Coyle Park to the north and Kingspan Breffini to the south. The site falls rapidly in elevation from west (73mOD) to east (65mOD).

4 SITE OPERATIONS

4.1 Summary of site works

Site operations, which were conducted between 22nd June and 28th July 2022, comprised:

- five boreholes
  - four boreholes by dynamic (windowless) sampling
  - one borehole by rotary drilling
- a standpipe installation in two boreholes
- four dynamic probes
- two follow-on dynamic probes; and
- one indirect CBR test.

The exploratory holes and in-situ tests were located as instructed by the Client's Representative, as shown on the exploratory hole location plan in Appendix A.

4.2 Boreholes

A total of five boreholes were put down in a minimum diameter of 150mm through soils and rock strata to their completion depths by a combination of methods, including light percussion boring using a Dando Terrier rig, and rotary drilling by a Comacchio 205 tracked rotary drilling rig.

The borehole logs state the methodology and plant used for each location, as well as the appropriate depth ranges.

A summary of the boreholes, subdivided by category in accordance with the methods employed for their completion, is presented in the following sub-sections.

4.2.1 Dynamic sampled boreholes

Four boreholes (BH01A-BH04A) were put down to completion by light percussion boring techniques using a Dando Terrier dynamic sampling rig. The boreholes were put down initially in 150mm diameter, reducing in diameter with depth as required, down to 50mm by use of the smallest sampler.

Hand dug inspection pits were carried out between ground level and 1.20m depth to ensure boreholes were put down clear of services or subsurface obstructions. The boreholes were taken to depths of 3.35m – 4.45m where they were terminated on encountering virtual refusal.

Disturbed (bulk and small bag) samples were taken within the encountered strata.

Standard penetration tests were carried out in accordance with BS EN 22476-3:2005+A1:2011 at standard depth intervals using the split spoon sampler ($SPT_{(s)}$) or solid cone attachment ($SPT_{(c)}$). The penetrations are stated for those tests for which the full 150mm seating drive or 300mm test drive was not possible. The *N*-values provided on the borehole logs are uncorrected and no allowance has been made for energy ratio corrections. The SPT hammer energy measurement report is provided in Appendix H.

Any water strikes encountered during boring were recorded along with any changes in their levels as the borehole proceeded. Details of the water strikes are presented on the individual borehole logs.

Appendix B presents the borehole logs.

4.2.2 Rotary drilled borehole

One borehole (RC01) was put to completion by rotary drilling techniques only. The borehole was completed using a Comacchio 205 tracked drilling rig.

Symmetrix-cased full hole rotary percussive drilling techniques were employed to advance the boreholes to bedrock, after which rotary coring was employed to recover core samples of the bedrock. SPTs were carried out at standard intervals throughout the overburden.

The core was extracted in up to 1.5m lengths using a metric T2-101 core barrel, which produced core of nominal 84mm diameter, and was placed in triple channel wooden core boxes.

The core was subsequently photographed and examined by a qualified and experienced Engineering Geologist, thus enabling the production of an engineering log in accordance with *BS 5930: 2015+A1:2020: Code of practice for ground investigations*.

Appendix B presents the borehole logs, with core photographs presented in Appendix C.

4.3 Dynamic probes

Four dynamic probes (DP01A-DP04A) were conducted using the DPSHB method as described in BS EN ISO 22476-3:2005+A1:2011. The method entails a 63.5kg hammer falling 0.75m onto a 50.5mm diameter cone with an apex angle of 90°.

Two dynamic probes (BH02ADP and BH03ADP) were conducted as a follow on from the boreholes using the same method.

Appendix B provides the follow-on dynamic probe logs on the sheet following the relevant borehole log in the form of plots, against depth, of the number of blows per 100mm penetration. Appendix D provides the standalone dynamic probe logs in the form of plots, against depth, of the number of blows per 100mm penetration.

4.4 Standpipe installations

A groundwater monitoring standpipe was installed in boreholes BH01A and BH04A.

Details of the installations, including the depth range of the response zone, are provided in Appendix B on the individual borehole logs.

4.5 Indirect CBR test (DCP)

An indirect CBR test was conducted at one location (CBR01) using a Dynamic Cone Penetrometer (DCP). The equipment was developed in conjunction with the UK Transport Research Laboratory, is used widely throughout the world, and is referred to in the UK Highway Agency Interim Advice Note 73/06.

The test results are presented in Appendix E in the form of plots of the variation with depth of the penetration per blow. Straight lines have been fitted to the plots and the CBR for each depth range estimated using the following relationship, which is derived from Kleyn & Van Heerden (1983):

$$\text{Log CBR} = 2.48 - 1.057 \text{ Log (mm/blow)}$$

4.6 Surveying

The as-built exploratory hole positions were surveyed following completion of site operations by a Site Engineer from Causeway Geotech. Surveying was carried out using a Trimble R10 GPS system employing VRS and real time kinetic (RTK) techniques.

The plan coordinates (Irish Transverse Mercator) and ground elevation (mOD Malin) at each location are recorded on the individual exploratory hole logs. The exploratory hole plan presented in Appendix A shows these as-built positions.

5 LABORATORY WORK

Upon their receipt in the laboratory, all disturbed samples were carefully examined and accurately described, and their descriptions incorporated into the borehole logs.

5.1 Geotechnical laboratory testing of soils

Laboratory testing of soils comprised:

- **soil classification:** moisture content measurement, Atterberg Limit tests and particle size distribution analysis.
- **soil chemistry:** pH, BRE Suite D and water soluble sulphate content

Laboratory testing of soils samples was carried out in accordance with British Standards Institute: *BS 1377, Methods of test for soils for civil engineering purposes; Part 1 (2016), and Parts 2-9 (1990).*

The test results are presented in Appendix F.

5.2 Geotechnical laboratory testing of rock

Laboratory testing of rock sub-samples comprised:

- unconfined compressive strength (UCS) tests

Test	Test carried out in accordance with
Uniaxial compression strength tests	ISRM Suggested Methods (1981) Suggested method for determining deformability of rock materials in uniaxial compression, Part 2 and ISRM (2007) Ulusay R, Hudson JA (eds) The complete ISRM suggested methods for rock characterization, testing and monitoring, 2007

The test results are presented in Appendix F.

5.3 Environmental laboratory testing of groundwater

Environmental testing, was conducted on selected environmental water samples by Chemtest at its laboratory in Newmarket, Suffolk.

Testing was carried out for a range of determinants, including:

- Metals

- Speciated total petroleum hydrocarbons (TPH)
- Speciated polycyclic aromatic hydrocarbons (PAH)
- BTEX compounds
- Phenols
- Cyanides
- Sulphate and sulphide
- pH

Results of environmental laboratory testing are presented in Appendix G.

6 GROUND CONDITIONS

6.1 General geology of the area

Published geological mapping indicate the superficial deposits underlying the site comprise glacial till. These deposits are underlain by greywackes and microconglomerates of the Red Island Formation.

6.2 Ground types encountered during investigation of the site

A summary of the ground types encountered in the exploratory holes is listed below, in approximate stratigraphic order:

- **Topsoil:** encountered typically in 300mm thickness across the site.
- **Glacial Till:** sandy gravelly clay, frequently with low cobble content, typically soft or firm in upper horizons, becoming stiffer with increasing depth.
- **Bedrock (Limestone):** Medium strong light grey thickly laminated limestone rockhead was encountered at a depth of 3.70m in RC01.

6.3 Groundwater

Details of the individual groundwater strikes, along with any relative changes in levels as works proceeded, are presented on the exploratory hole logs for each location.

Groundwater was encountered during light percussion boring through soil as water strikes at depths shown in Table 1 below.

Table 1. Groundwater strikes encountered during the ground investigation.

Location	Depth (mbgl)
BH04A	3.10

Groundwater was not noted during drilling at any of the other borehole locations. However, it should be noted that the casing used in supporting the borehole walls during drilling may have sealed out additional groundwater strikes and the possibility of encountering groundwater during excavation works should not be ruled out.

It should be noted that any groundwater strikes within bedrock may have been masked by the fluid used as the drilling flush medium.

Subsequent groundwater monitoring of the standpipe installations recorded water levels as shown in Table 2.

Table 2. Groundwater monitoring

Date	Water level (mbgl)	
	BH01A	BH04A
03/08/2022	1.45	2.36

Seasonal variation in groundwater levels should also be factored into design considerations, and continued monitoring of the two installed standpipes will give an indication of the seasonal variation in groundwater level which should be factored into design considerations.

7 DISCUSSION

7.1 Proposed construction

It is proposed to construct a new school building on the site with associated infrastructure. The FFL of the proposed building is 65.27mOD with the building expected to be cut into the existing slope.

No further details were available to Causeway Geotech at the time of preparing this report and any designs based on the recommendations or conclusions within this report should be completed in accordance with the current design codes, taking into account the variation and the specific details contained within the exploratory holes. Causeway Geotech were commissioned to provide a geotechnical report, and it is outwith our remit to advise on structure design.

7.2 Recommendations for construction

7.2.1 Summary

Based on the presence of stiff glacial till at relatively shallow depths across the footprint of the proposed building at the prosed FFL of 65.27mOD, the implementation of traditional shallow (spread) foundations (strip/pad) are considered suitable.

7.2.2 Soil strength parameters

When estimating the shear strength of fine soils (silt/clay), reference is made to the results of Standard Penetration Tests (SPT's) carried out within the boreholes. The undrained shear strength of fine soils can be estimated using the correlation developed by Stroud & Butler:

$$C_u = f_1 \times N$$

where f_1 is typically in the range 4 to 6. A median f_1 value of 5 is adopted for this report.

For granular soils (sand/gravel), a graphical relationship between SPT "N" value and angle of shearing resistance, φ, has been developed by Peck, Hanson and Thorburn. This is published in *Foundation Design and Construction* (Tomlinson, 2001) and is referenced in this report when deriving angles of shearing resistance for the gravel soils.

7.2.3 Foundations and ground floor construction

Foundations should transfer loading to below any Made Ground or subsoil. The recommended foundation construction and allowable bearing pressure (ABP) at the borehole locations are presented in Table 3.

Note: Given the large fall in elevation across the site and the proposed FFL of 65.27mOD and assuming a 1.20m build-up of the floor slab, foundations etc. recommendations have been provided at a depth of 64.00mOD, referred to as FFL+ in Table 3 below.

Table 3: Construction recommendations

Borehole	Ground Level (mOD)	Depth below EGL* to FFL+**	Estimated ABP (kPa)	Strata description	Foundation type	Ground floor construction	Groundwater
BH01A	67.35	3.35m	200	Stiff CLAY	Strip & pad	Ground bearing	Monitored to 65.90m mOD
BH02A	73.51	9.51m	250	Stiff CLAY ***	Strip & pad	Ground bearing	Not encountered
BH03A	65.94	1.94m	70	Soft CLAY	Strip & pad	Suspended	Not encountered
BH04A	70.02	6.02m	200	Stiff CLAY***	Strip & pad	Ground bearing	Monitored to 66.92m mOD
RC01	64.91	0.91m	100	Firm CLAY	Strip & pad	Ground bearing	Not encountered

*Existing Ground Level
**FFL+: Proposed finished floor level with 1.20m of build-up
***assumed to be stiff clay based on dynamic probe blows

Based on the findings of the ground investigation, spread foundations (strip/pad and trench fill) are considered suitable with estimated allowable bearing pressures between 70kPa and 250kPa at depths between 0.91m and 9.51m on stiff glacial till. It should be noted that in some instances e.g. BH02, the borehole did not reach the required depths, therefore recommendations are provided from the follow-on dynamic probe.

BH03A indicated a relatively low ABP of 70kPa at a depth of 64mOD, however higher ABP's can be achieved by extending the foundation to 62.94mOD into stiff clay.

The base of foundation excavations should be thoroughly inspected in accordance with the Earthworks Specification; any soft or loose soils should be removed with the resultant void backfilled with ST1 concrete or engineered backfill. A consistent bearing stratum should be provided for any building unit to limit differential settlements.

Given the generally fine grained/cohesive nature of the soils throughout the proposed formation levels, excavations for foundations are likely to be relatively stable. However, any instability can be minimised by battering the side slopes at 2 vertical to 1 horizontal and by limiting the duration that the excavation is open. Groundwater control, where required, will be possible by pumping from sumps formed in the base of excavations.

7.2.4 Floor slabs

Floor slabs should not bear directly onto Made Ground or soft soils. Consequently, the use of ground bearing floor slabs is considered appropriate following the removal of any surface Made Ground and soft clay layers and their replacement using well-graded well-compacted granular fill. However, a suspended floor slab should be adopted where the difference in levels of the proposed floor and the base of Made Ground/soft soils is greater than 600mm.

Given that at the proposed depths the ground conditions are relatively good, a ground bearing floor slab will be achievable.

7.2.5 Retaining walls

No details have been provided of any proposed retaining walls at the time of issuing this report, however given the proposed design intends for the building to be cut into the existing slope, it is highly likely a retaining wall 3+m in height will be required along the western perimeter of the site.

Any retaining structures will have to penetrate beneath the soft to firm clay strata and bear onto the underlying stiff clay or bedrock.

It is suggested that a piled wall may be the most practical construction method for retaining walls, as it will also provide a hydraulic cut-off, which will be important given the groundwater level in the boreholes was monitored to a level above FFL

A sheet piled or secant piled wall may be considered; it is recommended that a detailed design is carried out alongside a specialist piling contractor. Their design should allow for drainage within the wall to allow build-up of pore water pressures behind the wall.

7.2.6 Soil aggressivity

An assessment of the Aggressive Chemical Environment for Concrete (ACEC) was undertaken through reference to the Building Research Establishment (BRE) Special Digest 1 (2017).
As noted by BRE Special Digest 1, sulphates in the soil and groundwater are the chemical agents most likely to attack concrete. The extent to which sulphates affect concrete is linked to their concentrations, the type of ground, the presence of groundwater, the type of concrete and the form of construction in which concrete is used.

BRE Special Digest 1 identifies four different categories of site which require specific procedures for investigation for aggressive ground conditions:

- Sites not subjected to previous industrial development and not perceived as containing pyrite;
- Sites not subjected to previous industrial development and perceived as containing pyrite;
- Brownfield sites not perceived as containing pyrite;

- Brownfield sites perceived as containing pyrite.

For the purposes of this report the site was classified as not having been subject to previous industrial development and not perceived as containing pyrite.

The results of chemical tests (pH and water soluble sulphate contents) on soil samples indicate Design Sulphate Class DS-1 and ACEC Class AC-1s – reference Table C1 of BRE Special Digest 1 (Building Research Establishment, 2005). The Special Digest does not require any measures to protect underground concrete elements greater than 140mm thick.

7.2.7 Access roads, car parks and hard standing

Based on a summary of the CBR tests undertaken at the site, it is envisaged that the strata at the lower level of the site which was tested would be suitable for the placement of road make up layers. The area tested indicated a CBR of 7.2% at a depth of 0.5mbgl.

Table 2.1 of volume 7 section 2 of the Design Manual for Roads and Bridges (below), gives guidance on the average thickness of the pavement layers in relation to the CBR results. As can be seen, a CBR in excess of 5% requires a 340mm thick capping layer.

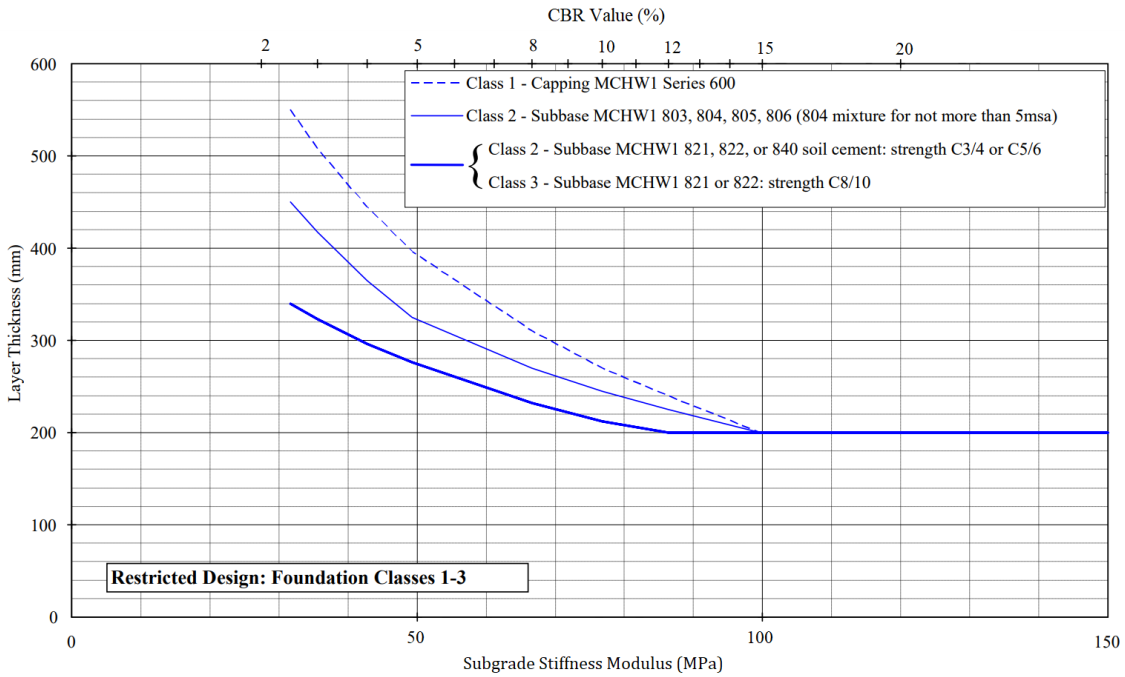


Table 2.1 (DMRB Vol.7 Sec2) 2009

It is recommended that further testing be undertaken during the course of construction works at intervals as set out in the Earthworks Specification, and should any areas indicate lower than expected value, the above plot should be used to determine the thicknesses of any capping or sub-base layers that may need to be placed in these areas.

The use of geosynthetics in the construction of paved areas, will be beneficial, particularly in areas of Made Ground. These could include a geosynthetic (e.g., a geogrid) at subgrade level with further benefit gained by incorporating further layer(s) within the capping/sub-base layer. Road design should be undertaken by a specialist earthworks contractor/designer.

8 REFERENCES

Geotechnical Society of Ireland (2016), Specification & Related Documents for Ground Investigation in Ireland.

IS EN 1997-2: 2007: Eurocode 7 - Geotechnical design - Part 2 Ground investigation and testing. National Standards Authority of Ireland.

BS 5930: 2015+A1:2020: Code of practice for ground investigations. British Standards Institution.

BS EN ISO 14688-1:2018: Geotechnical investigation and testing. Identification and classification of soil. Part 1 Identification and description.

BS EN ISO 14688-2:2018: Geotechnical investigation and testing. Identification and classification of soil. Part 2 Principles for a classification.

BS 1377: 1990: Methods of test for soils for civil engineering purposes. British Standards Institution.

BS EN ISO 14689-1:2018: Geotechnical investigation and testing. Identification and classification of rock. Identification and description.

BS EN ISO 22476-3:2005+A1:2011: Geotechnical investigation and testing. Field testing. Standard penetration test.

Building Research Establishment (2005) BRE Special Digest 1, Concrete in aggressive ground.

CAUSEWAY GEOTECH

APPENDIX A

SITE AND EXPLORATORY HOLE LOCATION PLANS

CAUSEWAY GEOTECH

Project No.:	22-0788	**Client:**	Cavan and Monaghan Education and Training Board (CMETB)
Project Name:	Royal School Cavan Permanent Works	**Client's Representative:**	Collins Boyd

Legend Key

Title:

Site Location Plan

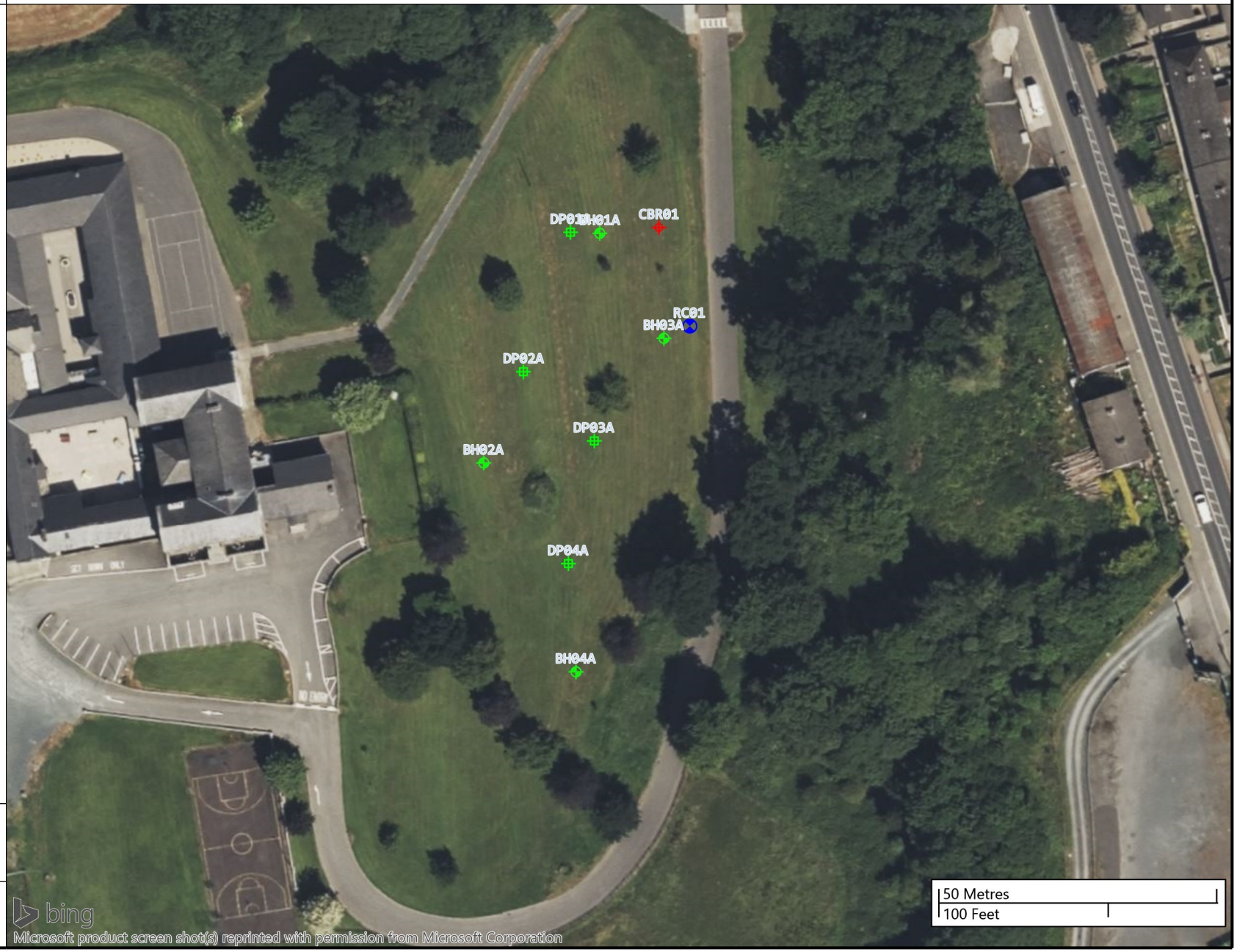
Last Revised:	**Scale:**
20/07/2022	1:5000

CAUSEWAY GEOTECH

Project No.:	22-0788	**Client:**	Cavan and Monaghan Education and Training Board (CMETB)
Project Name:	Royal School Cavan Permanent Works	**Client's Representative:**	Collins Boyd Engineering

Legend Key

- Locations By Type - DCP
- Locations By Type - DP
- Locations By Type - DS
- Locations By Type - RC



Title:
Exploratory Hole Location Plan

Last Revised:	**Scale:**
05/08/2022	1:1000

CAUSEWAY GEOTECH

APPENDIX B

BOREHOLE LOGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
22-0788	Royal School Cavan Permanent Works	BH01A
	Client: Cavan and Monaghan Education and Training Board (CMETB)	
	Client's Rep: Collins Boyd Engineering	

Method	Plant Used	Top (m)	Base (m)	Coordinates	Final Depth:	Start Date:	Driller:	Sheet 1 of 1
Dynamic Sampling	Dando Terrier	0.00	4.45	641938.34 E 804141.34 N	4.45 m	28/07/2022	JFSC	Scale: 1:50
					Elevation: 67.35 mOD	**End Date:** 28/07/2022	**Logger:** SR	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
0.30 - 1.20	B4				67.05	0.30		TOPSOIL with occasional rootlets and fragments of porcelain.		
1.20 - 1.65	D1							Firm brown sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subangular of various lithologies.		
1.20 - 1.65	SPT (S)	N=12 (0,1/1,3,4,4) Hammer SN = 0696	0.00	Dry						
1.50 - 2.80	B5				65.85	1.50		Firm becoming stiff brown sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subangular of various lithologies.		
2.00 - 2.45	D2									
2.00 - 2.45	SPT (S)	N=45 (1,1/14,18,10,3) Hammer SN = 0696	0.00	Dry						
2.80 - 4.00	B6				64.55	2.80		Stiff grey sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subangular of various lithologies.		
3.00 - 3.45	D3									
3.00 - 3.45	SPT (S)	N=20 (3,4/4,5,5,6) Hammer SN = 0696	0.00	Dry						
4.00 - 4.45	SPT (C)	N=25 (3,7/6,4,7,8) Hammer SN = 0696	0.00	Dry						
					62.90	4.45		End of Borehole at 4.45m		

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)

Casing Details

To (m)	Diameter

Remarks

Inspection pit hand dug to 1.20m.
No groundwater encountered.

Termination Reason

Terminated due to borehole collapse.

Last Updated

05/08/2022

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
22-0788	Royal School Cavan Permanent Works	BH02A
	Client: Cavan and Monaghan Education and Training Board (CMETB)	
	Client's Rep: Collins Boyd Engineering	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Dynamic Sampling	Dando Terrier	0.00		641917.64 E 804099.67 N

Final Depth:	3.35 m	**Start Date:**	29/07/2022	**Driller:**	JFSC
Elevation:	73.51 mOD	**End Date:**	29/07/2022	**Logger:**	SR

Sheet 1 of 1
Scale: 1:50
FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
								TOPSOIL with occasional rootlets.		
0.30 - 1.30	B3				73.21	0.30		Firm brown sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subangular of various lithologies.		
1.20 - 1.65	D1									
1.20 - 1.65	SPT (S)	N=3 (1,1/0,1,1,1) Hammer SN = 0696	0.00	Dry	72.21	1.30		Very soft brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
1.30 - 1.70	B4				71.81	1.70		Loose brown silty fine to coarse SAND.		
1.70 - 2.00	B5									
2.00 - 2.45	D2				71.51	2.00		Firm locally stiff brown sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subangular of various lithologies.		
2.00 - 3.35	B6									
2.00 - 2.45	SPT (S)	N=21 (2,2/4,3,6,8) Hammer SN = 0696	0.00	Dry						
2.90 - 3.35	SPT (C)	N=14 (6,6/6,3,3,2) Hammer SN = 0696	0.00	Dry						
					70.16	3.35		End of Borehole at 3.35m		

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)

Casing Details

To (m)	Diameter

Remarks

Inspection pit hand dug to 1.20m.
No groundwater encountered.

Termination Reason

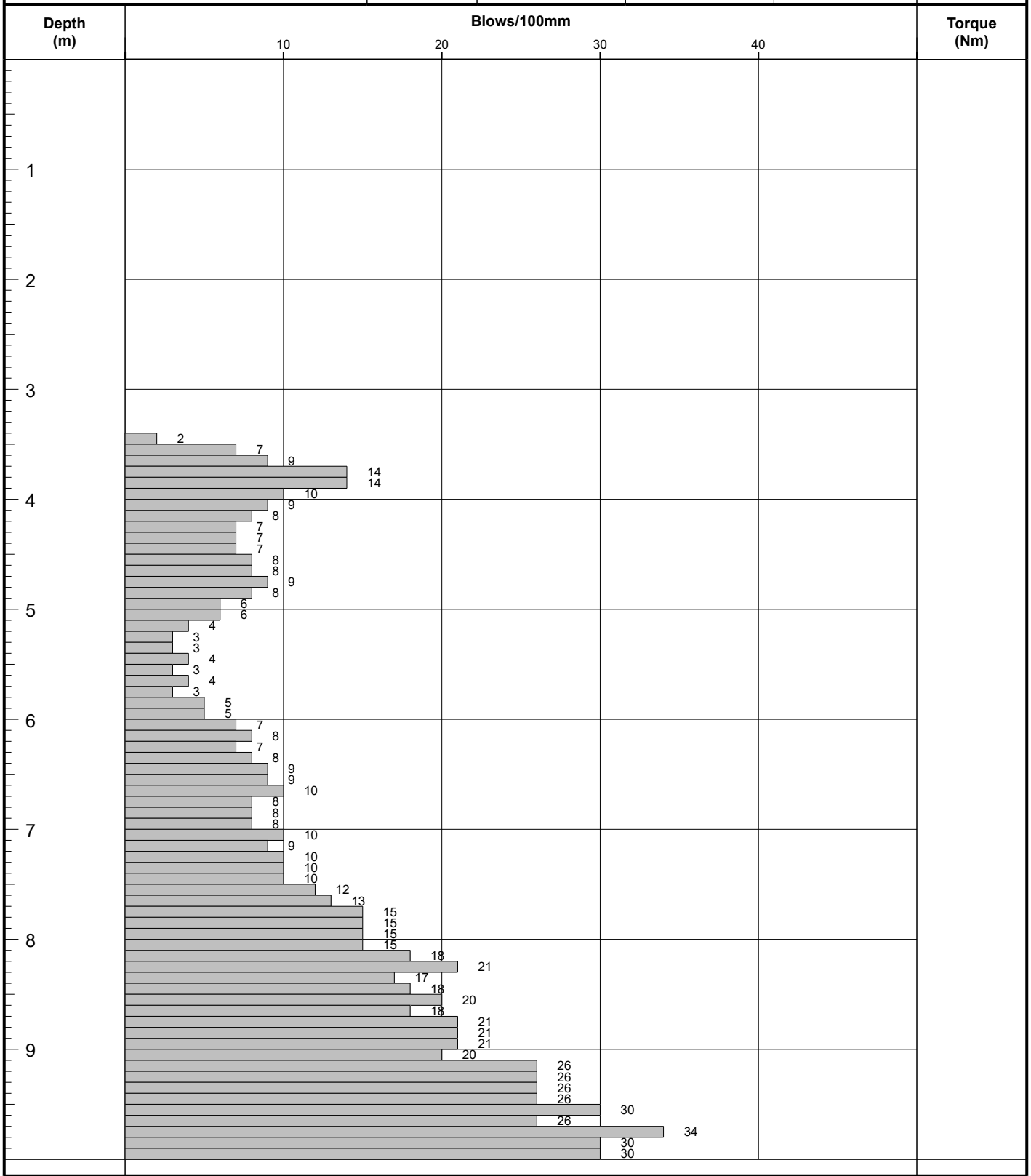
Terminated at refusal of sampler. Continued by dynamic probe.

Last Updated

05/08/2022

AGS

CAUSEWAY GEOTECH	**Project No.** 22-0788	**Project Name:** Royal School Cavan Permanent Works			**Probe ID** BH02ADP
	Coordinates 641917.64 E 804099.67 N	**Client:** Cavan and Monaghan Education and Training Board (CMETB)			
Method: Dynamic Probing		**Client's Representative:** Collins Boyd Engineering			Sheet 1 of 2 Scale: 1:50
Probe Type: DPSH-B	**Elevation** 73.51 mOD	**Final Depth:** 10.20	**Date:** 29/07/2022	**Operator:** JFSC	FINAL

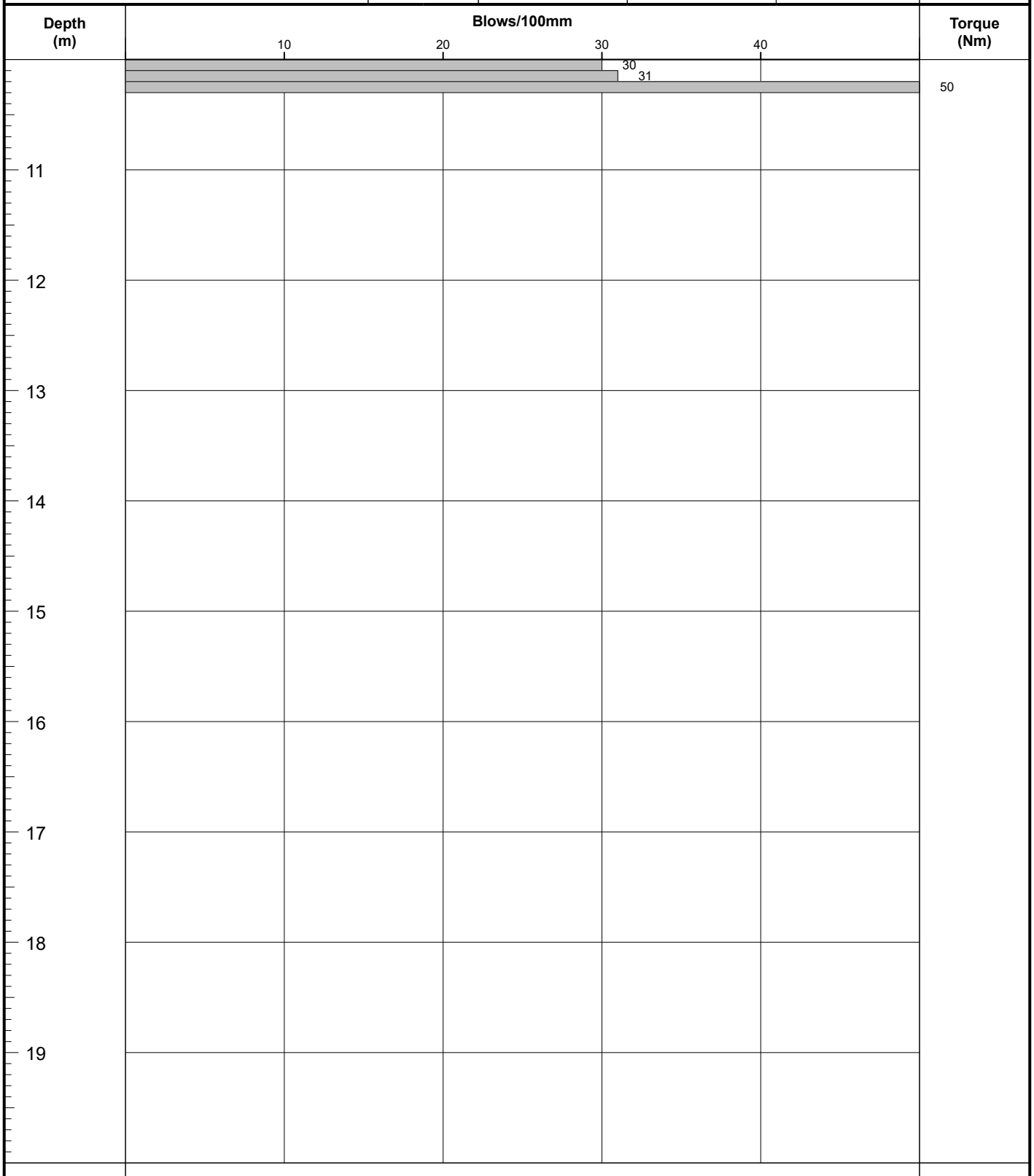


Fall Height: 750 mm	**Remarks**		
Hammer Mass: 64 kg			
Cone Diameter: 51 mm	**Termination Reason** Terminated on refusal.	**Last Updated** 05/08/2022	AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Probe ID
22-0788	Royal School Cavan Permanent Works	BH02ADP
Coordinates	**Client:**	
641917.64 E	Cavan and Monaghan Education and Training Board (CMETB)	
804099.67 N	**Client's Representative:** Collins Boyd Engineering	Sheet 2 of 2
		Scale: 1:50

Method:	Elevation	Final Depth:	Date:	Operator:	
Dynamic Probing	73.51 mOD	10.20	29/07/2022	JFSC	FINAL
Probe Type: DPSH-B					



Fall Height: 750 mm	Remarks	
Hammer Mass: 64 kg		
Cone Diameter: 51 mm	**Termination Reason** Terminated on refusal.	**Last Updated** 05/08/2022

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
22-0788	Royal School Cavan Permanent Works	BH03A
	Client: Cavan and Monaghan Education and Training Board (CMETB)	
	Client's Rep: Collins Boyd Engineering	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Dynamic Sampling	Dando Terrier	0.00	4.40	641950.05 E 804122.48 N

Final Depth:	Start Date:	Driller:	Sheet 1 of 1
4.40 m	29/07/2022	JFSC	Scale: 1:50
Elevation: 65.94 mOD	**End Date:** 29/07/2022	**Logger:** SR	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
								TOPSOIL with occasional rootlets.		
0.30 - 1.20	B4				65.64	0.30		Firm brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
1.20 - 1.65	D1				64.74	1.20		Soft brown sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subrounded of various lithologies.		
1.20 - 2.20	B5									
1.20 - 1.65	SPT (S)	N=4 (4,1/1,1,1,1) Hammer SN = 0696	0.00	Dry						
2.00 - 2.45	D2									
2.00 - 2.45	SPT (S)	N=7 (2,1/1,1,2,3) Hammer SN = 0696	0.00	Dry						
2.20 - 3.40	B6									
3.00 - 3.45	D3				62.94	3.00		Stiff brown sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subrounded of various lithologies.		
3.00 - 3.45	SPT (S)	N=17 (2,3/3,4,5,5) Hammer SN = 0696	0.00	Dry						
3.40 - 3.95	B7				62.54	3.40		Stiff grey slightly sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subrounded of various lithologies.		
3.95 - 4.40	SPT (C)	N=50 (4,10/50 for 297mm) Hammer SN = 0696	0.00	Dry						
					61.54	4.40		End of Borehole at 4.40m		

Water Strikes				Casing Details	
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	To (m)	Diameter

Remarks

Inspection pit hand dug to 1.20m.
No groundwater encountered.

Termination Reason

Terminated at refusal of sampler. Continued by dynamic probe.

Last Updated

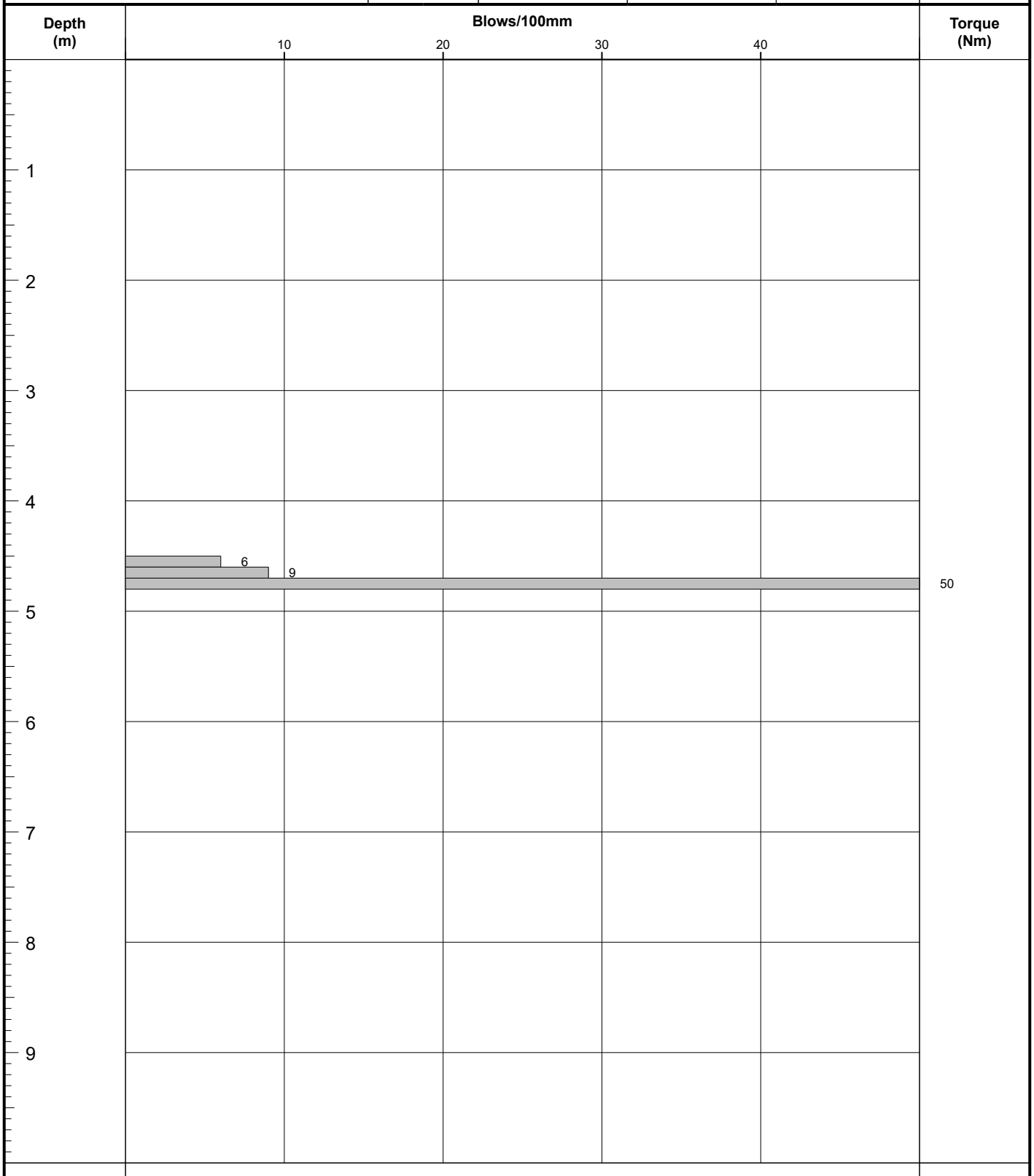
05/08/2022

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Probe ID
22-0788	Royal School Cavan Permanent Works	BH03ADP
Coordinates	**Client:**	
641950.05 E	Cavan and Monaghan Education and Training Board (CMETB)	
804122.48 N	**Client's Representative:** Collins Boyd Engineering	Sheet 1 of 1
		Scale: 1:50

Method:	Elevation	Final Depth:	Date:	Operator:	
Dynamic Probing	65.94 mOD	4.70	29/07/2022	JFSC	FINAL
Probe Type: DPSH-B					



Fall Height: 750 mm	Remarks	
Hammer Mass: 64 kg		
Cone Diameter: 51 mm	**Termination Reason** Terminated on refusal.	**Last Updated** 05/08/2022

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
22-0788	Royal School Cavan Permanent Works	BH04A
	Client: Cavan and Monaghan Education and Training Board (CMETB)	
	Client's Rep: Collins Boyd Engineering	

Method	Plant Used	Top (m)	Base (m)	Coordinates	Final Depth:	Start Date:	Driller:	
Dynamic Sampling	Dando Terrier	0.00	4.25	641934.66 E 804062.08 N	4.25 m	28/07/2022	JFSC	Sheet 1 of 1 Scale: 1:50
					Elevation: 70.02 mOD	End Date: 28/07/2022	Logger: SR	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
								TOPSOIL with occasional rootlets.		
0.30 - 1.00	B4				69.72	0.30		Firm brown sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subangular of various lithologies.		
1.00 - 2.10	B5				69.02	1.00				
1.20 - 1.65	D1							Soft becoming firm brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
1.20 - 1.65	SPT (S)	N=8 (1,2/2,2,2,2) Hammer SN = 0696	0.00	Dry						
2.00 - 2.45	D2									
2.00 - 2.45	SPT (S)	N=12 (2,2/3,3,3,3) Hammer SN = 0696	0.00	Dry	67.92	2.10		Firm dark grey sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
2.10 - 2.90	B6									
2.90 - 3.50	B7				67.12	2.90		Medium dense brownish grey gravelly silty fine to coarse SAND. Gravel is subangular to subrounded fine to coarse.	▼	
3.00 - 3.45	D3									
3.00 - 3.45	SPT (S)	N=29 (4,6/6,9,8,6) Hammer SN = 0696	0.00	Dry						
		Water strike at 3.10m			66.52	3.50		Stiff dark grey sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
3.50 - 4.00	B8									
4.00 - 4.39	SPT (C)	N=50 (3,2/50 for 245mm) Hammer SN = 0696	0.00	3.10						
					65.77	4.25		End of Borehole at 4.25m		

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
3.10	0.00	20	3.10

Casing Details

To (m)	Diameter

Remarks

Inspection pit hand dug to 1.20m.

Termination Reason

Terminated due to borehole collapse.

Last Updated

05/08/2022

AGS

CAUSEWAY GEOTECH

Project No.	Project Name	Borehole ID
22-0788	Royal School Cavan Permanent Works	RC01

Client: Cavan and Monaghan Education and Training Board (CMETB)

Client's Rep Collins Boyd Engineering

Method	Plant Used	Top (m)	Base (m)
Rotary Drilling	Comacchio 205	0.00	3.70
Rotary Coring	Comacchio 205	3.70	6.70

Coordinates
641954.71 E
804124.73 N

Final Depth: 6.70 m **Start Date:** 28/07/2022 **Driller:** JA

Elevation: 64.91 mOD **End Date:** 28/07/2022 **Logger:** EM

Sheet 1 of 1
Scale: 1:40

FINAL

Depth (m)	Samples / Field Records	TCR	SCR	RQD	FI	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
0.00	02-08-2022					0.00	0.00	64.76	0.15		TOPSOIL.		
								64.61	0.30		MADE GROUND: Light brown gravelly clayey SAND. (Driller's description).		
											Firm sandy gravelly CLAY. (Driller's description).		
								63.01	1.90		Very stiff dark brown sandy CLAY. (Driller's description).		
								62.81	2.10		Dense dark grey sandy clayey GRAVEL. (Driller's description).		
2.50 - 2.95	SPT(C) N=36 (4,6/12,5,6,13) Hammer SN = 0200					2.50	0.00						
								61.41	3.50		Grey weathered LIMESTONe. (Driller's Description).		
								61.21	3.70		Medium strong light grey indistinctly thickly laminated LIMESTONE with white calcite veins at various orientations (up to 5mm thick). Slightly reduced strength with clay deposits and discolouration on some fracture surfaces. Discontinuities: 1. 45 degree bedding fractures, widely spaced (250/600/1000), planar, smooth with patchy brownish red staining on some fracture surfaces and occasional patchy grey clay deposits (<2mm thick) on few fracture surfaces. 2. 60 degree joint at 5.10m, planar, smooth, clean.		
		100	100	40	4								
5.20													
		100	98	76	20						*6.15-6.30m: Bed of weak mudstone*		
					5								
6.70								58.21	6.70		End of Borehole at 6.70m		
		TCR	SCR	RQD	FI								

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)

Remarks
Inspection pit hand dug to 1.20m.

Casing Details

To (m)	Diam (mm)
3.70	127

Core Barrel
T2-101

Flush Type
Water

Termination Reason
Terminated at scheduled depth. Terminated on Engineer's instruction.

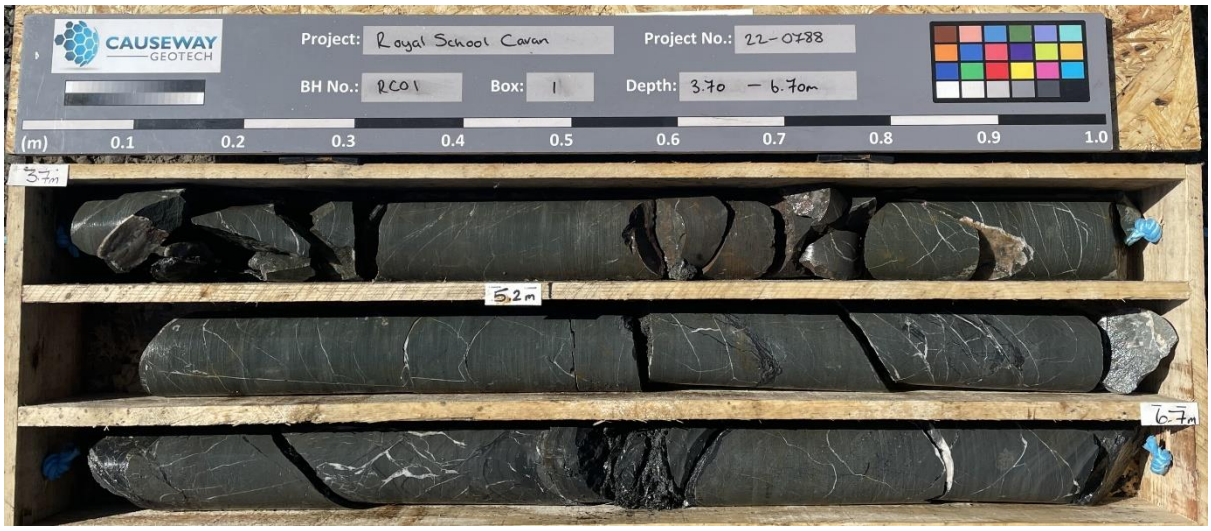
Last Updated
05/08/2022

AGS

CAUSEWAY GEOTECH

APPENDIX C

CORE PHOTOGRAPHS



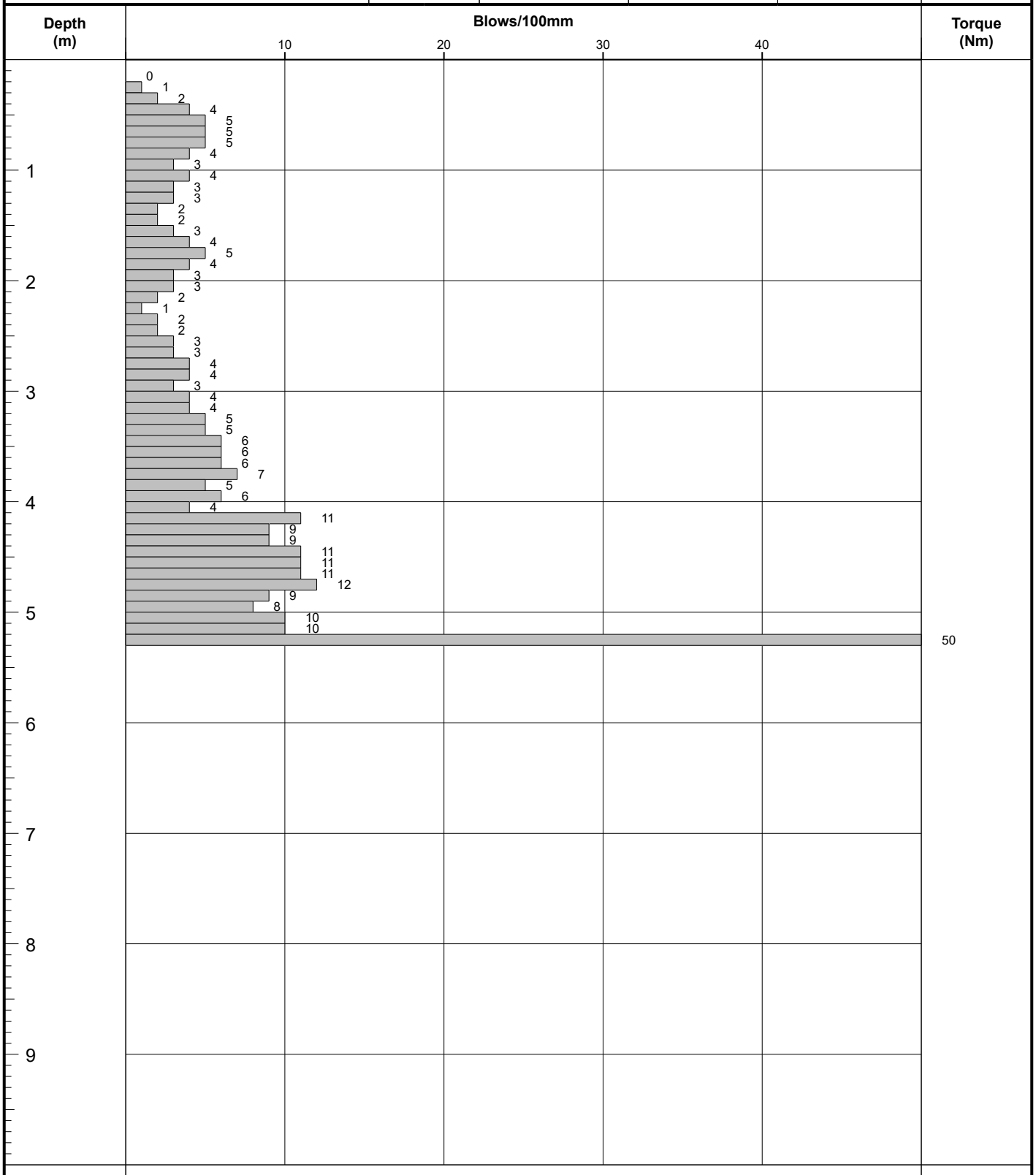
RC01 Box 1 (3.70m-6.70m)

CAUSEWAY GEOTECH

APPENDIX D

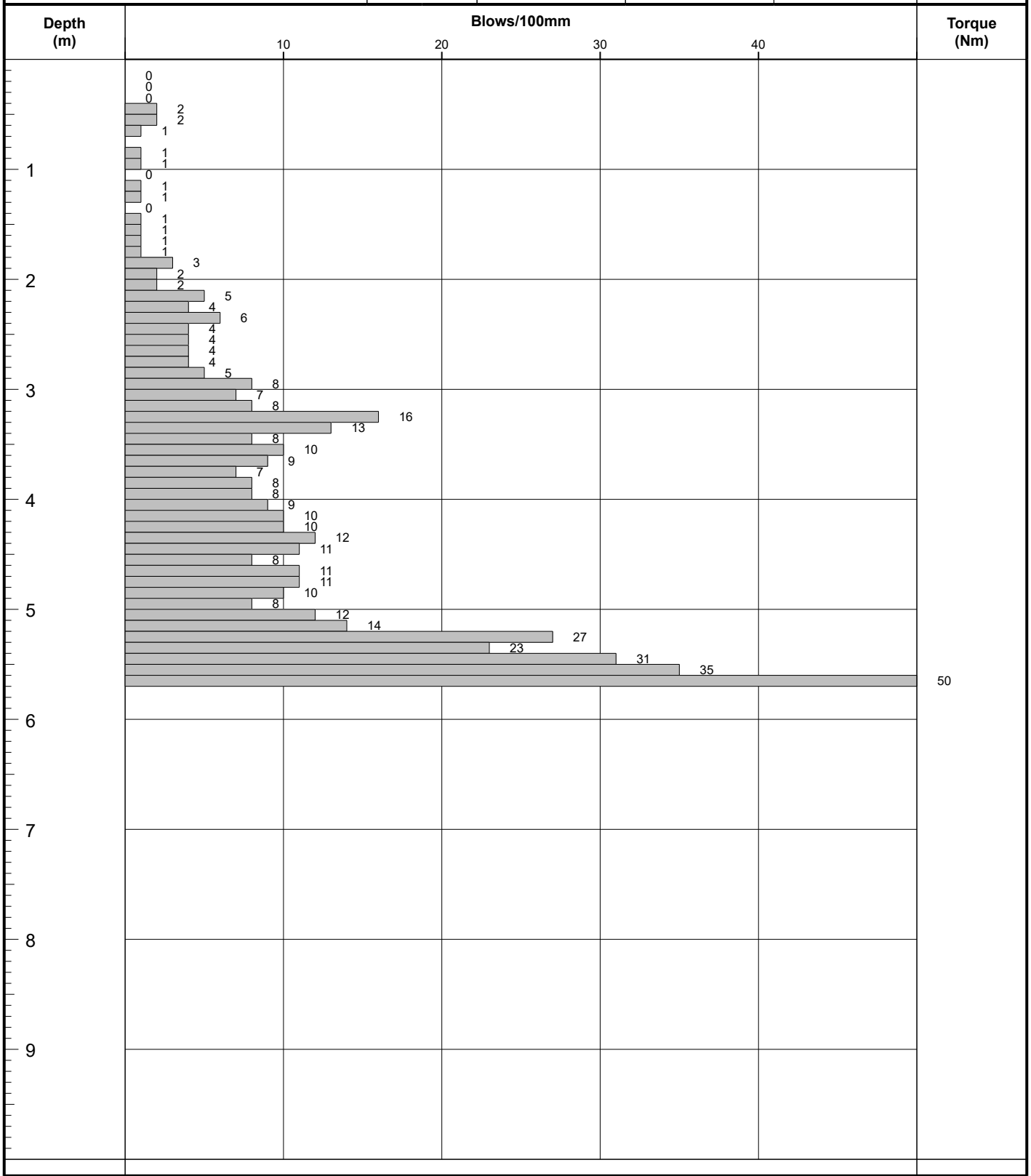
DYNAMIC PROBE LOGS

CAUSEWAY GEOTECH	**Project No.** 22-0788	**Project Name:** Royal School Cavan Permanent Works			**Probe ID** DP01A
	Coordinates 641933.07 E 804141.49 N	**Client:** Cavan and Monaghan Education and Training Board (CMETB)			
Method: Dynamic Probing		**Client's Representative:** Collins Boyd Engineering			Sheet 1 of 1 Scale: 1:50
Probe Type: DPSH-B	**Elevation** 68.64 mOD	**Final Depth:** 5.20	**Date:** 28/07/2022	**Operator:** JFSC	FINAL



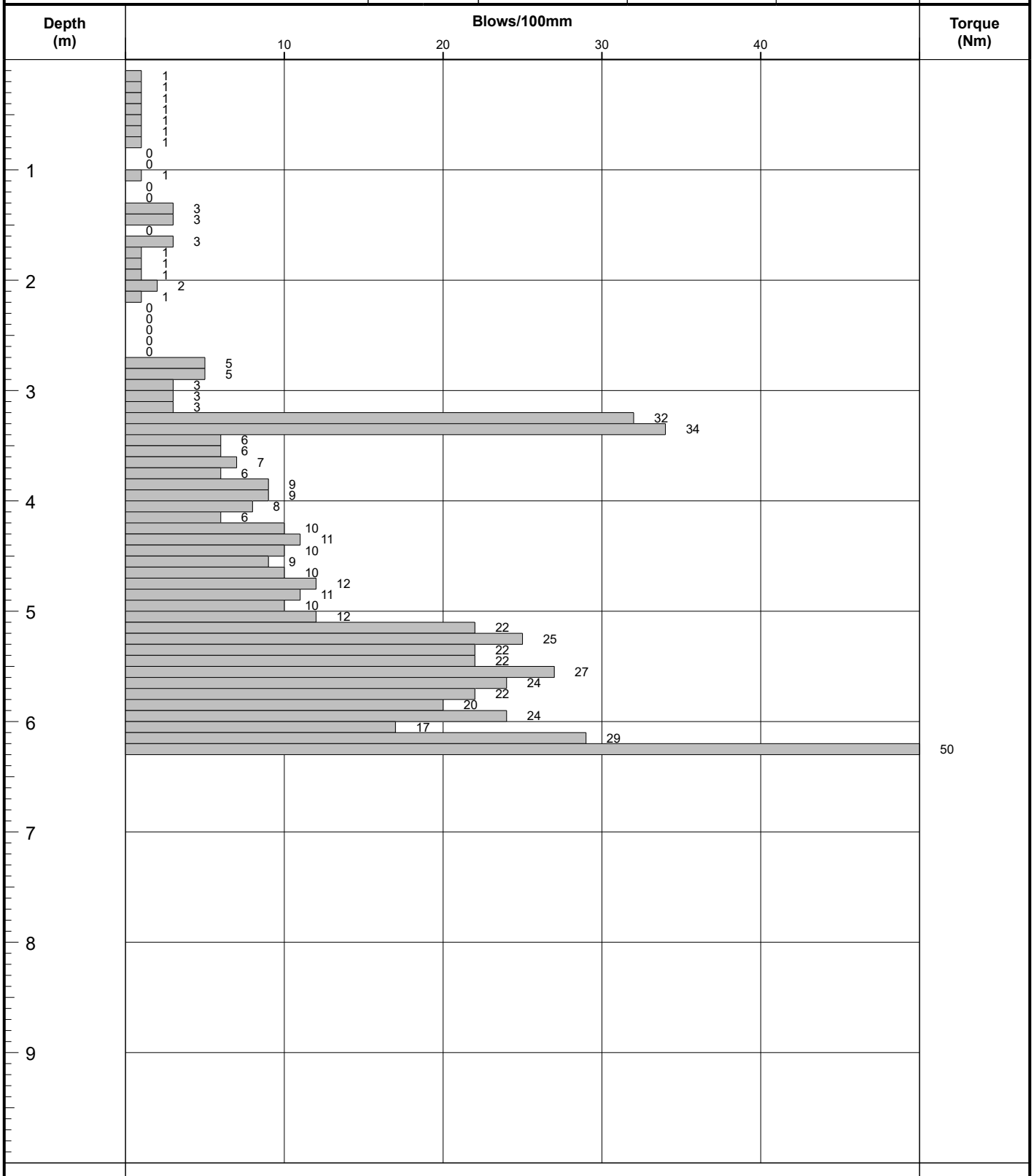
Fall Height: 750 mm	**Remarks**	
Hammer Mass: 64 kg	**Termination Reason**	**Last Updated**
Cone Diameter: 51 mm	Terminated on refusal.	05/08/2022

CAUSEWAY GEOTECH	**Project No.** 22-0788	**Project Name:** Royal School Cavan Permanent Works			**Probe ID** DP02A
	Coordinates 641924.78 E 804116.22 N	**Client:** Cavan and Monaghan Education and Training Board (CMETB)			
Method: Dynamic Probing		**Client's Representative:** Collins Boyd Engineering			Sheet 1 of 1 Scale: 1:50
Probe Type: DPSH-B	**Elevation** 72.08 mOD	**Final Depth:** 5.60	**Date:** 29/07/2022	**Operator:** JFSC	FINAL



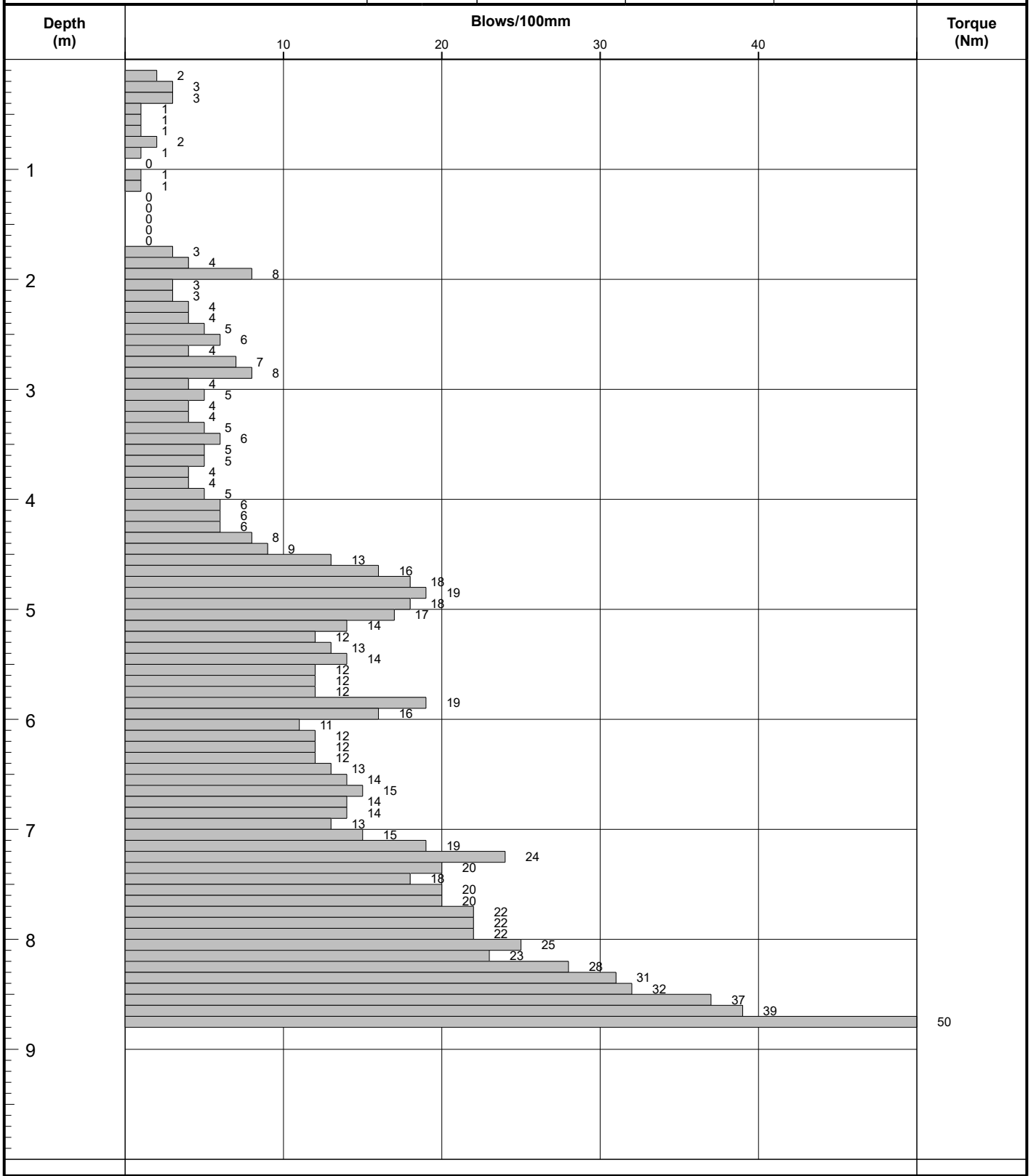
Fall Height: 750 mm	**Remarks**		
Hammer Mass: 64 kg			
Cone Diameter: 51 mm	**Termination Reason** Terminated on refusal.	**Last Updated** 05/08/2022	AGS

CAUSEWAY GEOTECH	**Project No.** 22-0788	**Project Name:** Royal School Cavan Permanent Works			**Probe ID** DP03A
	Coordinates 641937.61 E 804103.83 N	**Client:** Cavan and Monaghan Education and Training Board (CMETB)			
Method: Dynamic Probing		**Client's Representative:** Collins Boyd Engineering			Sheet 1 of 1 Scale: 1:50
Probe Type: DPSH-B	**Elevation** 70.05 mOD	**Final Depth:** 6.20	**Date:** 28/07/2022	**Operator:** JFSC	FINAL



Fall Height: 750 mm	**Remarks**	
Hammer Mass: 64 kg	**Termination Reason**	**Last Updated**
Cone Diameter: 51 mm	Terminated on refusal.	05/08/2022

CAUSEWAY GEOTECH	**Project No.** 22-0788	**Project Name:** Royal School Cavan Permanent Works			**Probe ID** DP04A
	Coordinates 641933.14 E 804081.62 N	**Client:** Cavan and Monaghan Education and Training Board (CMETB)			
Method: Dynamic Probing		**Client's Representative:** Collins Boyd Engineering			Sheet 1 of 1 Scale: 1:50
Probe Type: DPSH-B	**Elevation** 71.34 mOD	**Final Depth:** 8.70	**Date:** 28/07/2022	**Operator:** JFSC	FINAL



Fall Height: 750 mm	**Remarks**		
Hammer Mass: 64 kg			
Cone Diameter: 51 mm	**Termination Reason** Terminated on refusal.	**Last Updated** 05/08/2022	AGS

CAUSEWAY GEOTECH

APPENDIX E

INDIRECT IN-SITU CBR TEST RESULTS

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project Number	22-0788
Project Name	Royal School Cavan Permanent Works
Site Location	

Test Number	CBR01	**Date Tested**	01/07/2022
Depth bgl (m)	0.00	**Weather**	

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4.
CBR calculated using the TRL equation: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) iaw IAN 73/06 Rev 1 2009.

Surface preparation	Description of surface material at test depth
N/A	

top / base of layer (mm)	mm/ blow	CBR (%)
0	115	2
115		
115	65	3.7
375		
375	35	7.2
720		
720	24	10
840		
840	30	8.3
900		

CBR Range	Min: 2 Max: 10	The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value.

Deviation(s) from standard procedure	None

Observations and comments	

Approved Name and Appointment		
Darren O'Mahony Director		July 2022

CAUSEWAY GEOTECH

APPENDIX F

GEOTECHNICAL LABORATORY TEST RESULTS

CAUSEWAY GEOTECH

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Registered in Ireland.
Company Number: 633786

www.causewaygeotech.com

SOIL AND ROCK SAMPLE ANALYSIS
LABORATORY TEST REPORT

14 July 2022

Project Name:	Royal School Cavan Permanent Works
Project No.:	22-0788
Client:	Cavan and Monaghan Education & Training Board (CMETB)
Engineer:	Collins Boyd

We are pleased to attach the results of laboratory testing carried out for the above project. This memo and its attachments constitute a report of the results of tests as detailed in the Contents page(s). This testing was performed between 01/07/2022 and 14/07/2022.

The attached results complete the testing requested and we would therefore wish to confirm that samples will be retained without charge for a period of 28 days from the above date after which they will be appropriately disposed of unless we receive written instructions to the contrary prior to that date.

We trust our report meets with your approval but if you have any queries or require additional information, please do not hesitate to contact the undersigned.

Stephen Watson

Laboratory Manager

Signed for and on behalf of Causeway Geotech Ltd

Project Name: Royal School Cavan Permanent Works

Report Reference: Schedule 1

The table below details the tests carried out, the specifications used, and the number of tests included in this report. The results contained in this report relate to the sample(s) as received

Tests marked with* in this report are not United Kingdom Accreditation Service (UKAS) accredited and are not included in Causeway Geotech Limited's scope of UKAS Accreditation Schedule of Tests. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	No. of results included in the report
SOIL	Moisture Content of Soil	BS 1377-2: 1990: Cl 3.2	1
SOIL	Liquid and Plastic Limits of soil-1 point cone penetrometer method	BS 1377-2: 1990: Cl 4.4, 5.3 & 5.4	1
SOIL	Particle size distribution - wet sieving	BS 1377-2: 1990: Cl 9.2	1
SOIL	Particle size distribution - sedimentation hydrometer method	BS 1377-2: 1990: Cl 9.5	1

SUB-CONTRACTED TESTS

In agreement with Client, the following tests were conducted by an approved sub-contractor. All sub-contracting laboratories used are UKAS accredited.

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	No. of results included in the report
SOIL – Subcontracted to Eurofins Chemtest Ltd *(UKAS 2183)*	pH Value of Soil		1
SOIL – Subcontracted to Eurofins Chemtest Ltd *(UKAS 2183)*	Sulphate Content water extract		1
SOIL – Subcontracted to Eurofins Chemtest Ltd *(UKAS 2183)*	BRE Test - Suite D		1

CAUSEWAY GEOTECH

Summary of Classification Test Results

Project No.: 22-0788

Project Name: Royal School Cavan Permanent Works

Hole No.	Sample Ref	Sample Top	Sample Base	Sample Type	Specimen Description	Density bulk Mg/m3	Density dry Mg/m3	w %	Passing 425µm %	LL %	PL %	PI %	Particle density Mg/m3	Casagrande Classification
BH02	2	1.70	2.00	B	Brown sandy gravelly silty CLAY.			9.6	71	28 -1pt	14	14		CL

All tests performed in accordance with BS1377:1990 unless specified otherwise

LAB 01R Version 6

Key

Density test | Linear measurement unless : | wd - water displacement | wi - immersion in water

Liquid Limit | 4pt cone unless : | cas - Casagrande method | 1pt - single point test

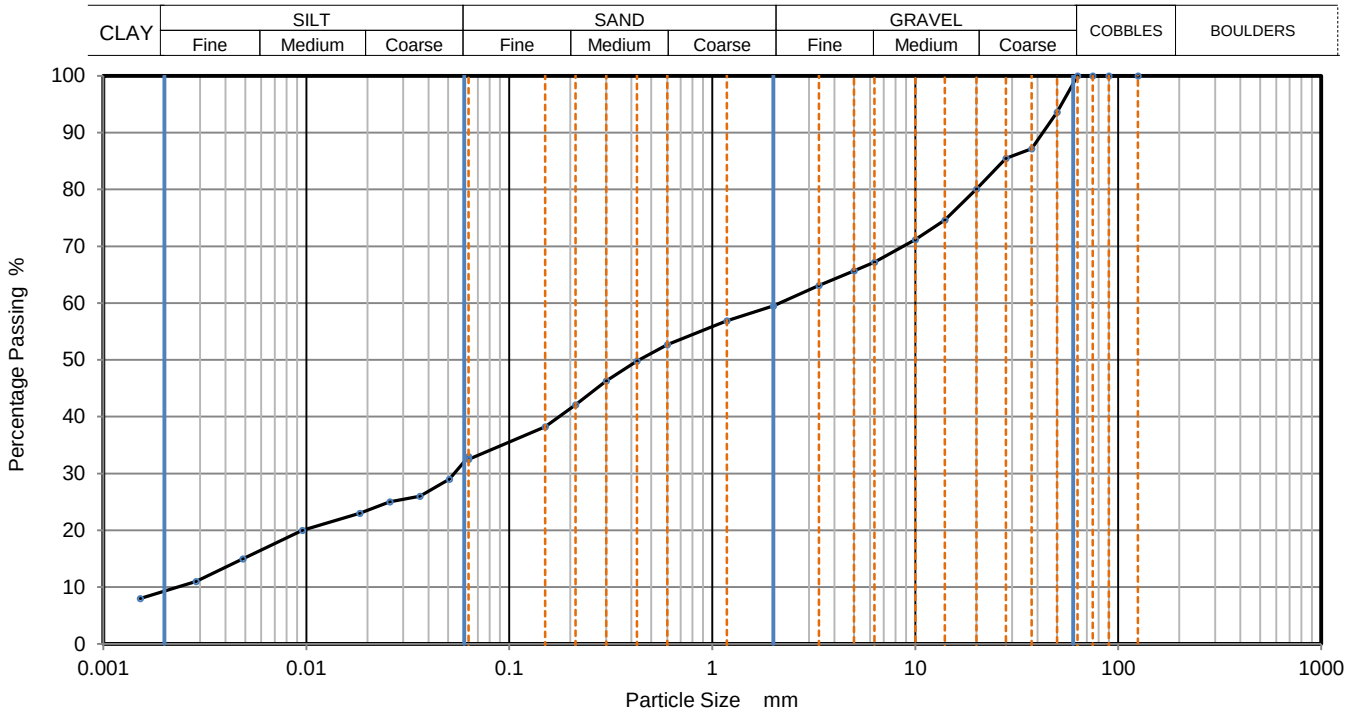
Particle density | sp - small pyknometer | gj - gas jar

Date Printed: 14/07/2022

Approved By: Stephen.Watson

UKAS TESTING 10122

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION				Job Ref		22-0788
					Borehole/Pit No.		BH02
Site Name	Royal School Cavan Permanent Works				Sample No.		2
Specimen Description	Brown sandy gravelly silty CLAY.				Sample Depth (m)	Top	1.70
						Base	2.00
Specimen Reference	6	Specimen Depth	1.7	m	Sample Type		B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5				KeyLAB ID		Caus202207016



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	33
90	100	0.05065	29
75	100	0.03625	26
63	100	0.02579	25
50	94	0.01834	23
37.5	87	0.00958	20
28	86	0.00487	15
20	80	0.00286	11
14	75	0.00152	8
10	71		
6.3	67		
5	66		
3.35	63		
2	60		
1.18	57		
0.6	53	Particle density	(assumed)
0.425	50	2.65	Mg/m3
0.3	46		
0.212	42		
0.15	38		
0.063	33		

Dry Mass of sample, g: 6252

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	40.5
Sand	27.0
Silt	23.4
Clay	9.1

Grading Analysis		
D100	mm	
D60	mm	2.13
D30	mm	0.0528
D10	mm	0.00241
Uniformity Coefficient		890
Curvature Coefficient		0.54

Remarks

Preparation and testing in accordance with BS1377-2 :1990 unless noted below

Approved
Stephen.Watson

LAB 05R - Version 6

UKAS TESTING 10122

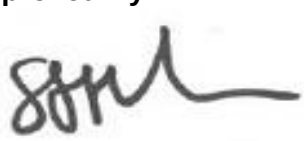
Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.:	22-25512-1
Initial Date of Issue:	11-Jul-2022
Client	Causeway Geotech Ltd
Client Address:	8 Drumahiskey Road Balnamore Ballymoney County Antrim BT53 7QL
Contact(s):	Carin Cornwall Colm Hurley Darren O'Mahony Gabriella Horan Joe Gervin John Cameron Lucy Newland Martin Gardiner Matthew Gilbert Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen Watson Stuart Abraham Thomas McAllister
Project	22-0788 Royal School Cavan Permanent Works

Quotation No.:		**Date Received:**	06-Jul-2022
Order No.:		**Date Instructed:**	06-Jul-2022
No. of Samples:	2		
Turnaround (Wkdays):	7	**Results Due:**	14-Jul-2022
Date Approved:	11-Jul-2022		

Approved By:



Details: Stuart Henderson, Technical Manager

Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Results - Soil

Project: 22-0788 Royal School Cavan Permanent Works

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-25512	22-25512
Quotation No.:			**Chemtest Sample ID.:**		1462970	1462971
Order No.:			Client Sample Ref.:		1	1
			Sample Location:		BH01	BH02
			Sample Type:		SOIL	SOIL
			Top Depth (m):		0.70	0.70
			Date Sampled:		05-Jul-2022	05-Jul-2022
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
Moisture	N	2030	%	0.020	17	19
pH	U	2010		4.0		8.5
pH (2.5:1)	N	2010		4.0	8.9	
Magnesium (Water Soluble)	N	2120	g/l	0.010	< 0.010	
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010	< 0.010
Total Sulphur	U	2175	%	0.010	0.048	
Chloride (Water Soluble)	U	2220	g/l	0.010	< 0.010	
Nitrate (Water Soluble)	N	2220	g/l	0.010	< 0.010	
Sulphate (Acid Soluble)	U	2430	%	0.010	< 0.010	

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2175	Total Sulphur in Soils	Total Sulphur	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2220	Water soluble Chloride in Soils	Chloride	Aqueous extraction and measuremernt by 'Aquakem 600' Discrete Analyser using ferric nitrate / mercuric thiocyanate.
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

CAUSEWAY GEOTECH

HEAD OFFICE
Causeway Geotech Ltd
8 Drumahiskey Road
Ballymoney
Co. Antrim, N. Ireland, BT53 7QL
NI: +44 (0)28 276 66640
Registered in Northern Ireland.
Company Number: NI610766

REGIONAL OFFICE
Causeway Geotech (IRL) Ltd
Unit 1 Fingal House
Stephenstown Industrial Estate
Balbriggan, Co Dublin, Ireland, K32 VR66
ROI: +353 (0)1 526 7465
Registered in Ireland.
Company Number: 633786

www.causewaygeotech.com

SOIL AND ROCK SAMPLE ANALYSIS
LABORATORY TEST REPORT

2 August 2022

Project Name:	Royal School Cavan Permanent Works
Project No.:	22-0788
Client:	Cavan and Monaghan Education & Training Board (CMETB)
Engineer:	Collins Boyd

We are pleased to attach the results of laboratory testing carried out for the above project. This memo and its attachments constitute a report of the results of tests as detailed in the Contents page(s). This testing was performed between 31/07/2022 and 02/08/2022.

The attached results complete the testing requested and we would therefore wish to confirm that samples will be retained without charge for a period of 28 days from the above date after which they will be appropriately disposed of unless we receive written instructions to the contrary prior to that date.

We trust our report meets with your approval but if you have any queries or require additional information, please do not hesitate to contact the undersigned.

Stephen Watson

Laboratory Manager

Signed for and on behalf of Causeway Geotech Ltd

Project Name: Royal School Cavan Permanent Works

Report Reference: Schedule 2

The table below details the tests carried out, the specifications used, and the number of tests included in this report. The results contained in this report relate to the sample(s) as received

Tests marked with* in this report are not United Kingdom Accreditation Service (UKAS) accredited and are not included in Causeway Geotech Limited's scope of UKAS Accreditation Schedule of Tests. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	No. of results included in the report
ROCK	Uniaxial Compressive Strength (UCS)*	ISRM Suggested Methods -Rock Characterization Testing and Monitoring, Ed. E T Brown - 1981	1

UNIAXIAL COMPRESSION TEST ON ROCK - SUMMARY OF RESULTS

Project No.	Project Name
22-0788	Royal School Cavan Permanent Works

Hole No.	Sample				Rock Type	Specimen Dimensions2			Bulk Density2	Water Content 1	Uniaxial Compression3			Remarks
	Ref	Top	Base	Type		Dia. mm	Length mm	H/D	Mg/m3	%	Condition	Mode of failure	UCS MPa	
RC01	1	5.00	5.25	C	LIMESTONE	82.2	177.3	2.2	2.74	0.4	as received	S	0.9	

Notes

1 ISRM p87 test 1, water content at 105 ± 3 oC, specimen as tested for UCS

2 ISRM p86 clause (vii), Caliper method used for determination of bulk volume and derivation of bulk density

3 ISRM p153 part 1, determination of Uniaxial Compressive Strength (UCS) of Rock Materials

above notes apply unless annotated otherwise in the remarks

Mode of failure :

S - Single shear MS - multiple shear

AC - Axial cleavage F - Fragmented

Test Specification	Date Printed	Approved By	Table
International Society for Rock Mechanics, The complete ISRM suggested methods for Rock Characterization Testing and Monitoring, 2007	08/02/2022 00:00	Stephen.Watson	1 sheet 1

CAUSEWAY GEOTECH

APPENDIX G

ENVIRONMENTAL LABORATORY TEST RESULTS

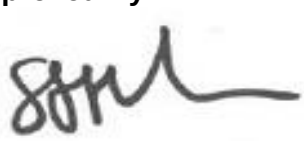
Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.:	22-30018-1
Initial Date of Issue:	17-Aug-2022
Client	Causeway Geotech Ltd
Client Address:	8 Drumahiskey Road Balnamore Ballymoney County Antrim BT53 7QL
Contact(s):	Colm Hurley Darren O'Mahony Gabriella Horan Joe Gervin John Cameron Lucy Newland Martin Gardiner Matthew Gilbert Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen Watson Stuart Abraham Thomas McAllister Rachel White
Project	22-0788 Royal School Cavan Permanent Work

Quotation No.:		**Date Received:**	08-Aug-2022
Order No.:		**Date Instructed:**	09-Aug-2022
No. of Samples:	1		
Turnaround (Wkdays):	7	**Results Due:**	17-Aug-2022
Date Approved:	17-Aug-2022		

Approved By:



Details: Stuart Henderson, Technical Manager

Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Results - Water

Project: 22-0788 Royal School Cavan Permanent Work

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-30018
Quotation No.:			**Chemtest Sample ID.:**		1483199
			Sample Location:		BH01A
			Sample Type:		WATER
			Top Depth (m):		1.45
			Bottom Depth (m):		3.32
			Date Sampled:		03-Aug-2022
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
pH	U	1010		N/A	7.6
Alkalinity (Total)	U	1220	mg/l	10	370
Sulphate	U	1220	mg/l	1.0	46
Cyanide (Total)	U	1300	mg/l	0.050	< 0.050
Cyanide (Free)	U	1300	mg/l	0.050	< 0.050
Thiocyanate	U	1300	mg/l	0.50	< 0.50
Sulphide	U	1325	mg/l	0.050	[B] < 0.050
Arsenic (Dissolved)	U	1455	µg/l	0.20	1.2
Boron (Dissolved)	U	1455	µg/l	10.0	180
Cadmium (Dissolved)	U	1455	µg/l	0.11	< 0.11
Chromium (Dissolved)	U	1455	µg/l	0.50	< 0.50
Copper (Dissolved)	U	1455	µg/l	0.50	< 0.50
Mercury (Dissolved)	U	1455	µg/l	0.05	< 0.05
Nickel (Dissolved)	U	1455	µg/l	0.50	23
Lead (Dissolved)	U	1455	µg/l	0.50	< 0.50
Selenium (Dissolved)	U	1455	µg/l	0.50	< 0.50
Zinc (Dissolved)	U	1455	µg/l	2.5	< 2.5
Chromium (Hexavalent)	U	1490	µg/l	20	[B] < 20
Aliphatic TPH >C5-C6	N	1675	µg/l	0.10	< 0.10
Aliphatic TPH >C6-C8	N	1675	µg/l	0.10	< 0.10
Aliphatic TPH >C8-C10	N	1675	µg/l	0.10	< 0.10
Aliphatic TPH >C10-C12	N	1675	µg/l	0.10	< 0.10
Aliphatic TPH >C12-C16	N	1675	µg/l	0.10	< 0.10
Aliphatic TPH >C16-C21	N	1675	µg/l	0.10	< 0.10
Aliphatic TPH >C21-C35	N	1675	µg/l	0.10	< 0.10
Aliphatic TPH >C35-C44	N	1675	µg/l	0.10	< 0.10
Total Aliphatic Hydrocarbons	N	1675	µg/l	5.0	< 5.0
Aromatic TPH >C5-C7	N	1675	µg/l	0.10	< 0.10
Aromatic TPH >C7-C8	N	1675	µg/l	0.10	< 0.10
Aromatic TPH >C8-C10	N	1675	µg/l	0.10	< 0.10
Aromatic TPH >C10-C12	N	1675	µg/l	0.10	< 0.10
Aromatic TPH >C12-C16	N	1675	µg/l	0.10	< 0.10
Aromatic TPH >C16-C21	N	1675	µg/l	0.10	< 0.10
Aromatic TPH >C21-C35	N	1675	µg/l	0.10	< 0.10
Aromatic TPH >C35-C44	N	1675	µg/l	0.10	< 0.10
Total Aromatic Hydrocarbons	N	1675	µg/l	5.0	< 5.0
Total Petroleum Hydrocarbons	N	1675	µg/l	10	< 10
Benzene	U	1760	µg/l	1.0	< 1.0
Toluene	U	1760	µg/l	1.0	< 1.0

Results - Water

Project: 22-0788 Royal School Cavan Permanent Work

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-30018
Quotation No.:			**Chemtest Sample ID.:**		1483199
			Sample Location:		BH01A
			Sample Type:		WATER
			Top Depth (m):		1.45
			Bottom Depth (m):		3.32
			Date Sampled:		03-Aug-2022
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
Ethylbenzene	U	1760	µg/l	1.0	< 1.0
m & p-Xylene	U	1760	µg/l	1.0	< 1.0
o-Xylene	U	1760	µg/l	1.0	< 1.0
Naphthalene	U	1800	µg/l	0.10	< 0.10
Acenaphthylene	U	1800	µg/l	0.10	< 0.10
Acenaphthene	U	1800	µg/l	0.10	< 0.10
Fluorene	U	1800	µg/l	0.10	< 0.10
Phenanthrene	U	1800	µg/l	0.10	< 0.10
Anthracene	U	1800	µg/l	0.10	< 0.10
Fluoranthene	U	1800	µg/l	0.10	< 0.10
Pyrene	U	1800	µg/l	0.10	< 0.10
Benzo[a]anthracene	U	1800	µg/l	0.10	< 0.10
Chrysene	U	1800	µg/l	0.10	< 0.10
Benzo[b]fluoranthene	U	1800	µg/l	0.10	< 0.10
Benzo[k]fluoranthene	U	1800	µg/l	0.10	< 0.10
Benzo[a]pyrene	U	1800	µg/l	0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	1800	µg/l	0.10	< 0.10
Dibenz(a,h)Anthracene	U	1800	µg/l	0.10	< 0.10
Benzo[g,h,i]perylene	U	1800	µg/l	0.10	< 0.10
Total Of 16 PAH's	U	1800	µg/l	2.0	< 2.0
Total Phenols	U	1920	mg/l	0.030	< 0.030

Deviations

In accordance with UKAS Policy on Deviating Samples TPS 63. Chemtest have a procedure to ensure 'upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s)'. This policy and the respective holding times applied, can be supplied upon request.The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised.

Sample:	Sample Ref:	Sample ID:	Sample Location:	Sampled Date:	Deviation Code(s):	Containers Received:
1483199			BH01A	03-Aug-2022	B	Coloured Winchester 1000ml
1483199			BH01A	03-Aug-2022	B	EPA Vial 40ml
1483199			BH01A	03-Aug-2022	B	Microbial Bottles 500ml
1483199			BH01A	03-Aug-2022	B	Plastic Bottle 1000ml

Test Methods

SOP	Title	Parameters included	Method summary
1010	pH Value of Waters	pH	pH Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1300	Cyanides & Thiocyanate in Waters	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Continuous Flow Analysis.
1325	Sulphide in Waters	Sulphides	Automated colorimetric analysis by 'Aquakem 600' Discrete Analyser using N,N–dimethyl-pphenylenediamine.
1455	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1490	Hexavalent Chromium in Waters	Chromium [VI]	Automated colorimetric analysis by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
1675	TPH Aliphatic/Aromatic split in Waters by GC-FID(cf. Texas Method 1006 / TPH CWG)	Aliphatics: >C5–C6, >C6–C8, >C8– C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Pentane extraction / GCxGC FID detection
1760	Volatile Organic Compounds (VOCs) in Waters by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics. (cf. USEPA Method 8260)	Automated headspace gas chromatographic (GC) analysis of water samples with mass spectrometric (MS) detection of volatile organic compounds.
1800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Waters by GC-MS	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenz[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Pentane extraction / GCMS detection
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
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I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

CAUSEWAY GEOTECH

APPENDIX H

SPT HAMMER ENERGY MEASUREMENT REPORT

Southern Testing
Environmental & Geotechnical

SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

Southern Testing
Unit 11
Charlwoods Road
East Grinstead
West Sussex
RH19 2HU

SPT Hammer Ref:	0200
Test Date:	12/02/2022
Report Date:	14/02/2022
File Name:	0200.spt
Test Operator:	NPB

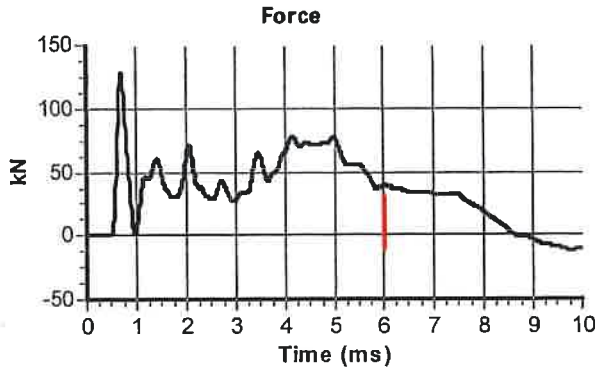
Instrumented Rod Data

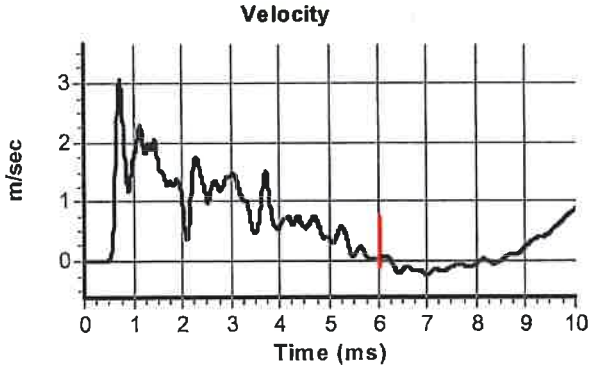
Diameter d_r (mm):	54
Wall Thickness t_r (mm):	6.0
Assumed Modulus E_a (GPa):	200
Accelerometer No.1:	64786
Accelerometer No.2:	64789

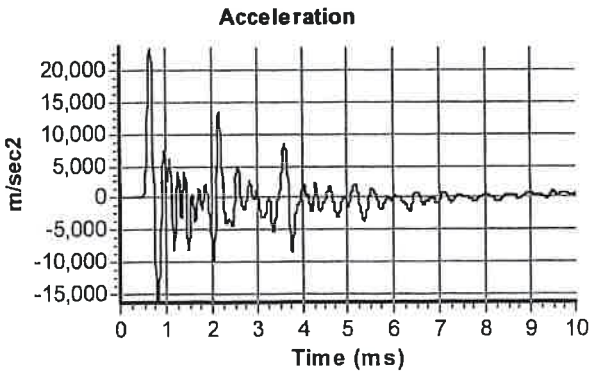
SPT Hammer Information

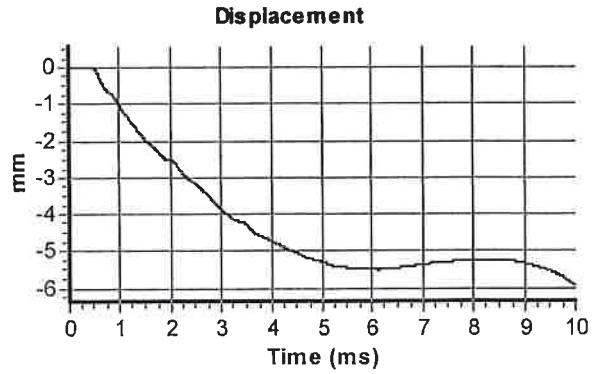
Hammer Mass m (kg):	63.0
Falling Height h (mm):	760
SPT String Length L (m):	12.0

Comments / Location
CAUSEWAY









Calculations

Area of Rod A (mm2):	905
Theoretical Energy E_{theor} (J):	473
Measured Energy E_{meas} (J):	291

Energy Ratio E_r (%): **61**

N Burrows

Signed: N Burrows
Title: FOC Manager

The recommended calibration interval is 12 months

Southern Testing
Environmental & Geotechnical

SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

Southern Testing
Unit 11
Charlwoods Road
East Grinstead
West Sussex
RH19 2HU

SPT Hammer Ref:	T5
Test Date:	12/02/2022
Report Date:	14/02/2022
File Name:	T5.spt
Test Operator:	NPB

Instrumented Rod Data

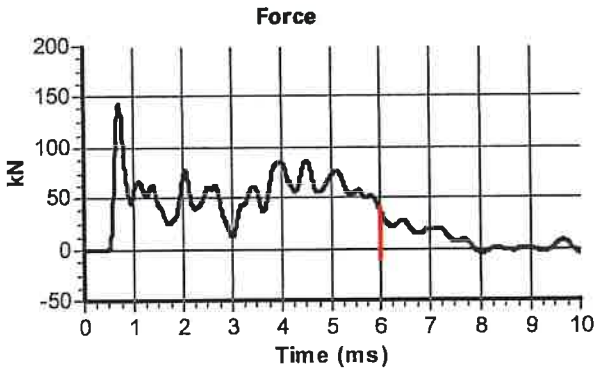
Diameter d_r (mm):	54
Wall Thickness t_r (mm):	6.0
Assumed Modulus E_a (GPa):	200
Accelerometer No.1:	64786
Accelerometer No.2:	64789

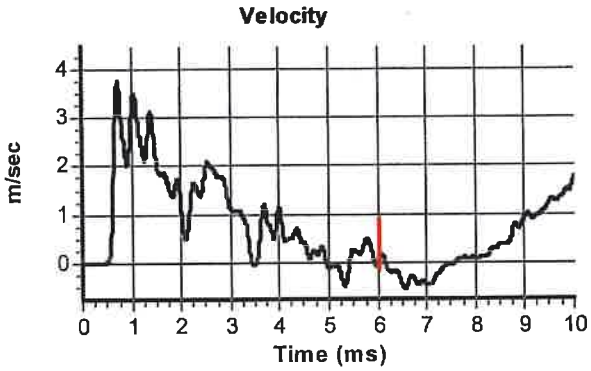
SPT Hammer Information

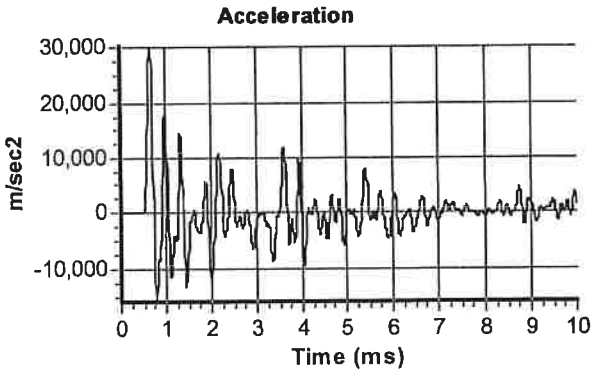
Hammer Mass m (kg):	63.0
Falling Height h (mm):	760
SPT String Length L (m):	12.0

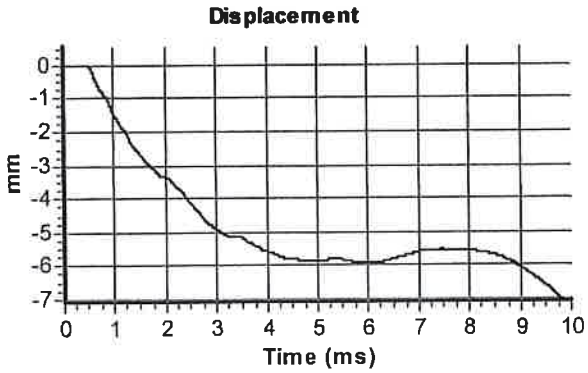
Comments / Location
CAUSEWAY

Asset No 0490









Calculations

Area of Rod A (mm2):	905
Theoretical Energy E_{theor} (J):	473
Measured Energy E_{meas} (J):	359

Energy Ratio E_r (%): **76**

N Burrows

Signed: N Burrows
Title: FOC Manager

The recommended calibration interval is 12 months