# Appendix 9.2 Ground Investigation and Geotechnical Interpretive Report (2023)

May 2025

McCutcheon Halley
CHARTERED PLANNING CONSULTANTS

**IGSL Ltd**

---

**Haggardstown**

---

# Ground Investigation & Geotechnical Interpretative Report



**Project No. 24490**

**May 2023**

**M7 Business Park**
**Naas**
**Co. Kildare**
**Ireland**

**T: +353 (45) 846176**
**E: info@igsl.ie**
**W: www.igsl.ie**

## DOCUMENT ISSUE REGISTER



| Distribution | Report Status | Revision | Date of Issue | Prepared By: | Approved By: |
|---|---|---|---|---|---|
| DOBA | Report, PDF by email | 0 | 26 May 2023 | J. Lawler BSc MSc PGeo EurGeol FGS | P. Quigley BEng CEng MICE MIEI FGS RoGEP Adviser |
| | | | | | |
| | | | | | |

## TABLE OF CONTENTS

## FIGURES



## TABLES

## APPENDICES



| | |
|---|---|
| Appendix 1 | - Soakaway Test Records, Pit Logs & Photographs |
| Appendix 2 | - Rock Excavation Pit Logs, Photographs & Rock Excavation Trial Report Sheets |
| Appendix 3 | - Rotary Core Drillhole Logs & Core Photographs |
| Appendix 4 | - Geophysical Survey Report |
| Appendix 5 | - Geotechnical Laboratory Results (Rock) |
| Appendix 6 | - Rock Reusability Test Results |
| Appendix 7 | - Chemical Laboratory Results (Rock) |
| Appendix 8 | - Exploratory Hole Location Plan |
| Appendix 9 | - Geological Cross Sections |
| Appendix 10 | - Simplified Petrographic Records |

**FOREWORD**
The following conditions and notes on the geotechnical site investigation procedures should be read in conjunction with this report.

**Standards**
The ground investigation works for this project (**Haggardstown**) have been carried out by IGSL in accordance with Eurocode 7 - Part 2: Ground Investigation & Testing (EN 1997-2:2007). This has been used together with complementary documents such as Engineers Ireland Specification for Ground Investigation (2nd Ed, 2016), BS 5930 (2015+A1:2020) and BS 1377 (Parts 1 to 9) and the following European Norms:

- EN 1997-2 Eurocode 7: 2007 – Geotechnical Design – Part 2: Ground Investigation & Testing
- EN ISO 22475-1:2006 Geotechnical Investigation and Sampling – Sampling Methods & Groundwater Measurements
- EN ISO 14688-1:2017 Geotechnical Investigation and Testing – Identification and Classification of Soil, Part 1: Identification and Description
- EN ISO 14688-2:2017 Geotechnical Investigation and Testing – Identification and Classification of Soil, Part 2: Principles for a classification
- EN ISO 14689-1:2017 Geotechnical Investigation and Testing – Identification, description & classification of rock

The Eurocode 7, Part 2 – Ground Investigation and Testing GI specification shall be read in conjunction with the Specification and Related Documents for Ground Investigation in Ireland, 2nd Edition, published by Engineers Ireland in 2016.

**Reporting**
No responsibility can be held by IGSL Ltd for ground conditions between exploratory hole locations. The engineering logs provide ground profiles and configuration of strata relevant to the investigation depths achieved and caution should be taken when extrapolating between exploratory points. No liability is accepted for ground conditions extraneous to the investigation points. Unless specifically stated, no account has been taken of possible subsidence due to mineral extraction, mining works or karstification below or close to the site.

This report has been prepared for DOBA Consulting Engineers and the information should not be used without their prior written permission. IGSL Ltd accepts no responsibility or liability for this document being used other than for the purposes for which it was intended.

**Boring Procedures**
Where required, 'shell and auger' or cable percussive boring technique is employed as defined by Section 6.3 of IS EN ISO 22475-1:2006. The boring operations, sampling and in-situ testing meet with the recommendations set out in IS EN 1997-2:2007 and BS 1377:1990 and EN ISO 22476-3:2005. The shell and auger boring technique allows for continuous sampling in clay and silt above the water table and sand and gravel below the water table (Table 2 of IS EN ISO 22475-1:2006).

It is highlighted that some disturbance and variation is unavoidable in particular ground (e.g. blowing sands, gravel / cobble dominant glacial deposits etc). Attention is drawn to this condition, whenever it is suspected. Where cobbles and boulders are recorded, no conclusion should be drawn concerning the size, presence, lithological nature, or numbers per unit volume of ground.

**In-Situ Testing**
Where required, Standard Penetration Tests (SPT's) are conducted strictly in accordance with Section 4.6 of IS EN 1997-2:2007. The SPT equipment (hammer energy test) has been calibrated in accordance with EN ISO 22476-3:2005 and the Energy Ratio ($E_r$). A calibration certificate is

available upon request. The $E_r$ is defined as the ratio of the actual energy $E_{meas}$ (measured energy during calibration) delivered to the drive weight assembly into the drive rod below the anvil, to the theoretical energy ($E_{theor}$) as calculated from the drive weight assembly. The measured number of blows (N) reported on the engineering logs are uncorrected. In sands, the energy losses due to rod length and the effect of the overburden pressure should be taken into account (see IS EN ISO 22476-3:2005).



**Soil Sampling**

Three categories of sampling methods are outlined in EN ISO 22475-1:2006. The categories are referenced A, B and C for any given ground conditions and are shown in Tables 1 and 2 of EN ISO 22475-1:2006. Reference should be made to EN 1997-2:2002 for guidelines on sample class and quality for strength and compressibility testing. Samples of quality classes 1 or 2 can only be obtained by using Category A sampling methods.

Class 1 thin wall undisturbed tube samples (UT100) were obtained in fine grained soils and strictly meet the requirements of EN 1997-2:2002 and EN ISO 22475-1:2006. Soil samples for laboratory tests are divided into five classes with respect to the soil properties that are assumed to remain unchanged during sampling, handling transport and storage. The minimum sample quality required for testing purposes to Eurocode 7 compatibility (EN 1997-2:2002) is shown in Table A.

**Table A – Details of Sample Quality Requirements**

| EN 1997 Clause | Test | Minimum Sample Quality Class |
|---|---|---|
| 5.5.3 | Water Content | 3 |
| 5.5.4 | Bulk Density | 2 |
| 5.5.5 | Particle Density | N/S |
| 5.5.6 | Particle Size Analysis | N/S |
| 5.5.7 | Consistency Limits | 4 |
| 5.5.8 | Density Index | N/S |
| 5.5.9 | Soil Dispersivity | N/S |
| 5.5.10 | Frost Susceptibility | N/S |
| 5.6.2 | Organic Content | 4 |
| 5.6.3 | Carbonate Content | 3 |
| 5.6.4 | Sulphate Content | 3 |
| 5.6.5 | pH | 3 |
| 5.6.6 | Chloride Content | 3 |
| 5.7 | Strength Index | 1 |
| 5.8 | Strength Tests | 1 |
| 5.9 | Compressibility Tests | 1 |
| 5.10 | Compaction Tests | N/S |
| 5.11 | Permeability | 2 |

N/S – not stated. Presume a representative sample of appropriate size.

Samples recovered from trial pits or trenches meet the requirements of IS EN ISO 22475-1. It is highlighted that unforeseen circumstances such as variations in geological strata may lead to lower quality sample classes being obtained.

**Groundwater**

The depth of entry of any influx of groundwater is recorded during the course of boring operations. However, the normal rate of boring does not usually permit the recording of an equilibrium level for any one water strike. Where possible, drilling is suspended for a period of twenty minutes to monitor the subsequent rise in water level. Groundwater conditions observed in the borings or pits are those appertaining to the period of investigation. It should be noted however, that groundwater levels are

subject to diurnal, seasonal and climatic variations and can also be affected by drainage conditions, tidal variations etc.



**Engineering Logging**

Soil and rock identification has been based on the examination of the samples recovered and conforms with IS EN ISO 14688-1:2017 and IS EN ISO 14688-2:2017. Rock weathering classification conforms to IS EN ISO 14689-1:2017 along with discontinuities (bedding planes, joints, cleavages, faults etc) as classified in Section 6.4 of IS EN ISO 14689-1:2017 and Annex C of same. Rock mechanical indices (TCR, SCR, RQD) are defined in accordance with IS EN ISO 22475-1:2006.

Where peat has been encountered, samples have been logged in accordance with the Von Post Classification (ref. Von Post, L. 1992. Sveriges Gologiska Undersoknings torvinventering och nogra av dess hittils vunna resultat (SGU peat inventory and some preliminary results) Svenska Mosskulturforeningens Tidskrift, Jonkoping, Swedden, 36, 1-37 and Hobbs N. B. Mire morphology and the properties of some British and foreign peats. QJEG, Vol. 19, 1986.

**Retention of Samples**

After satisfactory completion of all the scheduled laboratory tests on any sample, the remaining material will be discarded. Unless a period of retention of samples is agreed, it is our normal practice to discard all soil samples one month after submission of our final report.

## 1. INTRODUCTION

A ground investigation was carried out by IGSL Limited on behalf of DOBA Consulting Engineers, at a greenfield site in the townland of Haggardstown, 3.5 kilometres southeast of Dundalk, Co. Louth. It is understood that a new housing development is proposed for the lands. The site comprises two connected field enclosures, both accessed through an agricultural gate off Bóthar Maol which runs north of the site. The lands comprise a series of topographic knolls and intervening lower, less undulating field areas (Figure 1). Both fields appear not to have been used for arable purposes for at least a few years. During the investigation (March 2023) the fields comprised hummocky grassland throughout. The land is bound to the north by one-off dwellings along Bóthar Maol, to the west by Dundalk Golf Club and to the south and east by farmland and one-off private dwellings.



**Figure 1 – Site Location Plan** (perimeter outlined in white). The roughly circular, more elevated parts of the site can be seen omitted from agricultural use.


Retrieved from Google Earth Professional 04/2011

Levels ranged from 19m OD in the west to 7m OD in the northeast. Soak pit investigation locations were set out as per the DOBA drawing numbered “SK001” for Haggardstown, Dundalk. Micro-siting was performed for rotary core drillhole locations so that they would correspond to areas of shallow rock as highlighted in the Minerex Geophysics Report (Ref. 6680).

The investigation comprised rotary core drillholes, in situ soakaway testing (to BRE365) and rock excavation trial pits. A geophysical survey comprising seismic refraction methods was undertaken by Minerex Geophysics Limited. This was completed ahead of intrusive works commencing. The main objective of the geophysical survey was to determine the depth to rock across the site. The

investigations were executed in accordance with BS 5930, Code of Practice for Site Investigations (2015+A1:2020) and EN 1997-2 Eurocode 7 Part 2 Ground Investigation & Testing and supervised by an IGSL geotechnical engineer.



Rock samples were subject to chemical analyses tests (to EN1744) to assess total sulphur and acid soluble sulphate contents. Simplified petrography was performed on bulk samples to assess lithological type and inspect for evidence of sulphide (pyrite) oxidation. Rock reusability tests and strength tests were undertaken on bulk samples recovered from shallow trial pitting as well as on the recovered cores. This report presents an evaluation of the ground and groundwater conditions and an assessment of the key geotechnical issues. It presents the factual geotechnical data acquired from the 2023 investigation along with an interpretation of the data.

The exploratory hole locations are plotted on the site plan in Appendix 8. Two geological and geotechnical cross-sections and ground models have been prepared using the pit and rotary core drillhole findings. These are presented in Appendix 9.

## 2. FIELDWORK

### 2.1 General

The fieldworks were undertaken in March 2023 and comprised the following:

- Soakaway Tests (to BRE 365) (12 No.)
- Rock Excavation Trial Pits (2 No.)
- Rotary Core Drillholes (4 No.)
- Geophysical Survey
- Surveying of Exploratory Hole Locations

### 2.2 Soakaway Tests (to BRE 365)

Twelve number infiltration tests were performed to assess the suitability of the sub-soils for dispersion of storm water through a soakaway system. The infiltration tests were each performed in accordance with BRE Digest 365 'Soakaway Design'. To obtain a measure of the infiltration rate of the sub-soils, water was poured into each test pit, with records taken of the fall in water level against time. Following the first soak cycle, the procedure was repeated to ensure saturation of the sub-soils. The infiltration rate is the volume of water dispersed per unit of exposed area per unit of time, and is generally expressed as metres / minute or metres / second. Designs are based on the slowest infiltration rate, which is generally calculated from the final soak cycle. The soakaway design logs are presented in Appendix 1 along with pit logs and photographs.

### 2.3 Rock Excavation Trial Pits

Trial pitting was undertaken at two locations to both establish depth to rockhead and to acquire bulk samples of the soil and shallow rock. The locations were set out based on the findings of the Minerex Geophysics report. It depicted where shallow rock was most likely to be found. The trial pits were excavated, logged and sampled under the direction of an IGSL geotechnical engineer in accordance with BS 5930 (2015+A1:2020). Bulk disturbed samples (typically 20 to 30kg) were taken as the pits progressed. Larger one tonne sacks were used to remove shallow-excavated rock samples from site for use in rock reusability testing.

The trial pits were backfilled with the as-dug arisings and reinstated to the satisfaction of IGSL's site geotechnical engineer. The trial pit logs and photographs are presented in Appendix 2 and include descriptions of the soils encountered, groundwater conditions and stability of the pit sidewalls. Rock Excavation Trial Report Sheets also feature. These inform on the excavatability / rate of excavation documented during rock removal.

### 2.4 Rotary Core Drillholes

Rotary core drilling was carried out at four locations using a tracked Beretta T44 top-drive rig. Symmetrex drilling was utilised within the overlying superficial deposits with coring techniques used in the underlying bedrock once encountered. Standard Penetration Tests (SPT's) were performed in the overburden strata with the resulting blowcounts presented on the logs. Once having encountered bedrock, subsequent rotary drilling produced 78mm diameter cores. Bedrock was described generally as fresh to locally slightly weathered, strong to moderately weak, medium to thinly bedded, greenish blue fine grained interbedded SANDSTONE / SILTSTONE (Greywacke sandstone with siltstone).

The cores were placed in 3m capacity timber boxes and logged by an IGSL engineering geologist. This included photography of the cores with a digital camera. Where rock core was recovered, a graphic fracture log is also presented alongside the mechanical indices. This illustrates the fracture state of the rock cores and allows easy identification of highly fractured / non-intact zones and discontinuity spacings. It should be noted that no correction for dip of the joints has been made and that the spacings shown are successive joint / core intersections within the core.
Groundwater monitoring standpipes were installed in three of the four drillholes on site. The standpipes consisted of 50mm diameter HDPE pipework with proprietary 1mm slots and

incorporated a pea gravel filter pack and cement / bentonite grout seal. Headwork covers were concreted in place.



Rock logging records are presented on the corehole logs in Appendix 3. These logs include engineering geological descriptions and details of the bedding / discontinuities and mechanical indices (TCR, SCR and RQD's) for each core run. Core photographs are also presented in Appendix 3 and these illustrate the structure and fracture state of the bedrock.

**2.5 Geophysical Survey**

A seismic refection (*p*-wave) survey was conducted by Minerex Geophysics Limited. Ground models were formed based on the soundings returned from the survey. The *p*-wave seismic velocity is closely linked to the density of subsurface materials and to parameters like compaction, stiffness, strength and rock quality. The higher the density of the subsurface materials the higher the seismic velocity. For rock, the seismic velocity is higher when the rock is stronger, less weathered and has a higher quality. If the rock is more weathered, broken, fractured, fissured then the seismic velocity will be reduced compared to that of intact fresh rock. The Minerex report is presented in Appendix 4.

**2.6 Surveying of Exploratory Hole Locations**

Following completion of the exploratory works, surveying was carried out using GPS techniques. Co-ordinates (x, y) were measured to Irish National Grid and ground levels (z) established to Malin Head. The co-ordinates and ground levels are shown on the exploratory hole logs with locations shown on the exploratory hole plan in Appendix 8.

## 3. LABORATORY TESTING

Geotechnical laboratory testing was carried out at IGSL's INAB-accredited laboratory in accordance with BS1377; British Standard Methods of Test for Soils for Civil Engineering Purposes; British Standards Institute:1990.

Point load strength index (PLSI) tests were conducted on selected core samples. These are presented in Appendix 5. Rock reusability tests were also carried out with Flakiness, Water Absorption, Slake Durability, LA Abrasion and Magnesium Sulfate Soundness testing all being performed. The above testing is presented in Appendix 6. Additionally, chemical analysis tests on shallow rock samples (i.e. water soluble sulphate, total sulphur & acid soluble sulphate to EN1744) feature in Appendix 7.

The simplified petrographic analysis conducted on bulk samples are enclosed in Appendix 10.

## 4. DESK STUDY

The site comprises two connected field enclosures separated by a mature hedgerow. There are a number of topographic knolls which are present in both the western and eastern field. They form prominent local peaks. The Lidar view (Figure 2B) clearly depicts the individual knolls. Geophysical traverses found that they generally correspond to local bedrock highs.



**Figure 2A & 2B – Google Earth Professional view of site and environs dated 04/2011. Lidar view of site retrieved from the GSI Open Topographic Data Viewer**


**Fig 2A**


**Fig 2B**

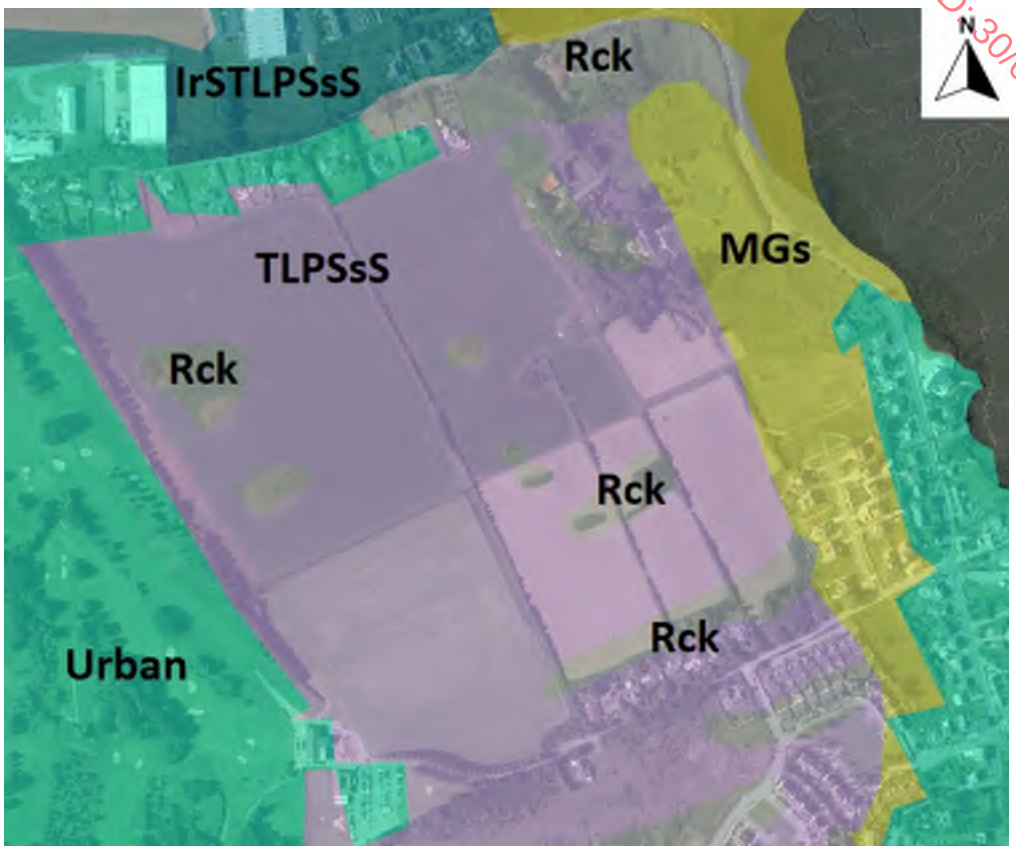
Figure 3 illustrates the appearance initially in ca. 2005 of what appears to be construction and demolition rubble in the southeastern corner of the site. By 2007, the rubble pile appears to have been reduced in area. However, by 2011 it has grown in areal extent but is largely covered in vegetation. Later images show the heap of material has disappeared. Its appearance may be related to an episode of building / renovation nearby.


**Figure 3 – Google Earth Professional images dated 11/2005, 06/2007 and 04/2011 showing what appears to be tipped C&D waste in the south eastern corner of the east field.**

The Quaternary Soils map indicates the presence of both glacial till derived from Lower Palaeozoic sandstones and shales and bedrock outcrop / subcrop (Figure 4).



**Figure 4 – Quaternary Soils Plot for Haggardstown Site**




| | | |
|---|---|---|
| **Map Key** | **Urban** | - Urbanised Area (non-classified) |
| | **MGs** | - Marine gravel and sands (often raised) |
| | **IrSTLPSsS** | - Irish Sea Till derived from Lower Palaeozoic sandstones and shales |
| | **TLPSsS** | - Till derived from Lower Palaeozoic sandstones and shales |
| | **Rck** | - Bedrock outcrop / subcrop |

Reference to the GSI map for the area (Figure 5, 1:100,000 Solid Geology series) shows that the site is underlain by the Silurian Llandovery-aged Clontail Formation. The rock formation consists of green-grey, medium to thickly bedded, coarse and very fine grained greywackes, with dark grey, thinly bedded, poorly graded, quartzose fine sandstone to siltstone units. No actual outcrops were found on site but excavation did reveal rockhead within the upper metre in certain areas. The findings of rotary drilling and rock excavation trial pits are dealt with in more detail in Section 5.2.



**Figure 5 - Bedrock Geological Map for the Haggardstown Site** (retrieved from GSI website)


**Key:** **RK** = Clontail Formation
Hatched areas denote rock outcrop / subcrop

## 5. GROUND CONDITIONS & GROUNDWATER

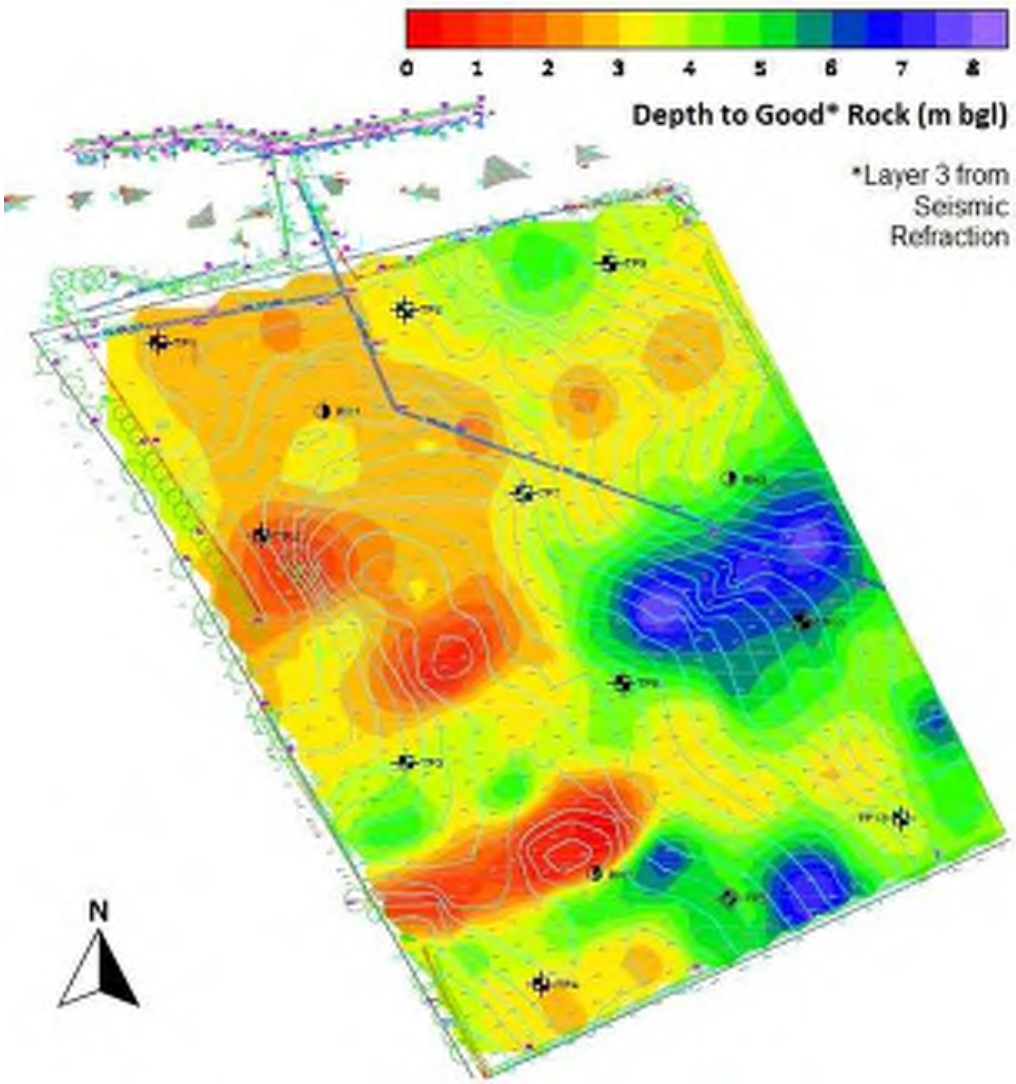
### 5.1 Ground Profile – Superficial Deposits

The following is a summary of the ground conditions encountered across the ca. 45 acre site. The summary is presented in two parts. The works to the west of the dividing hedgerow comprise 'Area 1 – Upper Field'. The field to the east of the hedgerow is termed 'Area 2 – Lower Field'.

#### 5.1.1 Area 1 - Upper Field

In the western, upper field, there are at least three discrete topographic knolls which flank the western extent of the site, nearing the boundary with Dundalk Golf Club. The Minerex seismic refraction survey highlights these areas and suggests rock is near (0-1m) the surface in each case. They can be seen in Figure 6 highlighted as red areas.

**Figure 6 – Geophysical plot showing depth to good rock in Area 1.** 'Good rock' is defined as the seismic refraction signature of Layer 3 as defined in the Minerex Report (See Table 6). Adapted from Minerex Report Ref. 6680.




The following details the findings of pitting in the area with a view to describing the stratigraphy of superficial sediments which blanket the near surface rock.

**TOPSOIL**

- A soft to firm brown slightly sandy silty CLAY topsoil layer with frequent rootlets was observed in each of pits BRE08-BRE12 to a depth of 0.30m. In rock excavation trial pit, REXTP01, a thickness of 400mm was logged. Given that the fields were formerly used for arable purposes, a plough depth of ca. 300-400mm would not be unremarkable.

**GLACIAL DEPOSITS**

- For the most part, the positioning of the BRE soak pits was to correspond to areas which had the thickest soil cover. For this reason, the pits generally avoided the areas of extremely shallow bedrock. Each of the five BRE pits, beneath topsoil, unearthed a layer of firm brown, occasionally orangish brown (BRE12), sandy gravelly CLAY with a medium cobble content. This extended to a depth of between 0.80m and 1.0m in each of the pits.

- Beyond ca. 1.0m was described a stratum of firm very gravelly sandy silty CLAY with a medium to high cobble content. This extended to pit base in both BRE08 and BRE09 where no rock was found to depths of 2.40m and 2.50m bgl. Interestingly, both pits were located in an area which the geophysics depth to rock plot suggests 5 to 7m to 'good rock' (centrally located blue and green zone in Figure 6).

- Each of the remaining three pits (BRE10, 11 & 12) encountered rockhead or 'possible rockhead' at depths of 1.60m, 1.70m and 2.20m bgl. In BRE10, from 1.60m bgl, rock was described as angular Gravel- and Cobble-, occasionally boulder-sized fragments of medium strong grey green rarely purple Greywacke SANDSTONE / SILTSTONE. In the other two pits, the rock was logged as a clayey GRAVEL with a high cobble content. This description suggests a more highly weathered grade of rock.

**UPPER ROCK**

- Rock excavation trial pit REXTP01 was constructed at the top of the northernmost elevated knoll. The location was selected to correspond with what was identified in the geophysics report as an area with near surface rock. Directly beneath the topsoil, rock was exposed at 0.40m. It was described as angular Gravel-, Cobble- and Boulder-sized fragments (up to 400mm) of medium strong grey green rarely purple fine grained thinly laminated to thinly bedded Greywacke Sandstone and Siltstone. Weathering degraded the rock into weak to extremely weak rock mass in places. The discontinuity spacing, where extremely closely spaced, added to the weathered weak appearance. In each of the three lifts used to extricate rock, the rock was observed as 'distinctly weathered to destructured'. A sample of rock was taken from 0.95m depth. The hole was progressed from 0.40m to 1.25m bgl using a 1T hydraulic breaker.

**Figures 7A – 7F Photographs taken pitside during trial excavation in Area 1. Fig 7A** Sidewall photo of BRE08 Topsoil to 300mm, underlain by a firm brown sandy gravelly cobbly CLAY to 1.0m in turn underlain by a firm very gravelly sandy silty CLAY with a medium to high cobble content to an end depth of 2.40m (12.97m OD). **Fig 7B** Spoil **Fig 7C** Sidewall profile of BRE10 showing rock in base from 1.60m (15.35m OD) to eventual end depth of 2.10m (14.85m OD). **Fig 7D** Spoil **Fig 7E** Rock exposed in REXTP01 from 400mm bgl. **Fig 7F** Platy tabular SANDSTONE/SILTSTONE rock recovered from hydraulic breaking in REXTP01.



**Fig 7A**

**Fig 7B**

**Fig 7C**

**Fig 7D**

**Fig 7E**

**Fig 7F**

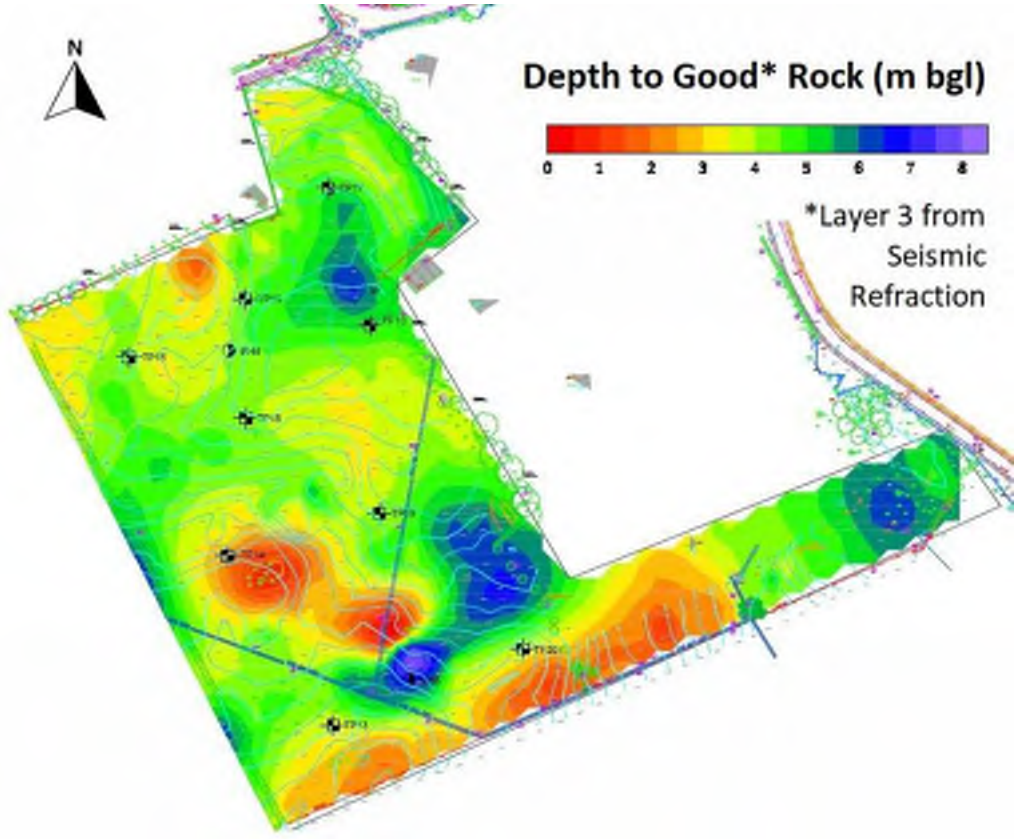
### 5.1.2 Area 2 – Lower Field

Ground levels range from ca. 14.7m OD atop the knoll in the central portion of Area 1 (location of RC03 & REXTP02) to a low of 6.80m OD (location of SA03) in the northeast. The highest topographic point also corresponds to the area interpreted by Minerex as having the shallowest bedrock (Figure 8). The intrusive works completed in this area included seven BRE soak pits pits, one rock excavation trial pit and two rotary coreholes.

**TOPSOIL**

- Topsoil ranges in thickness from 0.20m to 0.40m across the area. It was described variably as a soft grey brown to brown slightly sandy SILT to a soft to firm sandy silty CLAY. Rootlets were frequent.

**Figure 8 – Geophysical plot showing depth to good rock in Area 2.** 'Good rock' is defined as the seismic refraction signature of Layer 3 as defined in the Minerex Report (See Table 6). Adapted from Minerex Report Ref. 6680.




**GLACIAL DEPOSITS**

- As with the pits in the Area 1 (upper field), there is an initial stratum underlying the Topsoil which is described as a firm brown sandy gravelly CLAY with a medium cobble content. The soil is described also as a firm brownish yellow sandy clayey SILT (BRE01).

- From a depth of between 1.10m and 1.50m, the upper subsoil passes to a firm brown very gravelly sandy CLAY with a medium to high cobble content. This stratum extends to the pit base in each of BRE01 (2.50m / 6.50m OD), BRE02 (2.45m / 5.91m OD), BRE04 (2.50m / 10.72m OD), BRE05 (2.50m / 11.62m OD) and BRE06 (2.50m / 7.60m OD).

- In the case of both trial pits BRE03 and BRE07, both encountered 'Possible Weathered Rock'. BRE03 intercepted a layer of light brown silty clayey cobbly GRAVEL from 2.10m (4.74m OD) to eventual pit end depth at 2.30m (4.54m OD). Equally, in BRE07 at the shallower depth of 1.40m (9.37m OD) a similar upper rockhead material was found. The pit was ended at 1.60m (9.17m OD).

**UPPER ROCK**

- Pit REXTP02 was positioned to the side of a central knoll where shallow rock depth was anticipated. Topsoil persisted to 0.20m, with a firm brown sandy gravelly CLAY to 0.50m. At this point, rockhead was exposed. It was recorded as 'angular GRAVEL-, COBBLE- and BOULDER-sized fragments (up to 500mm) of medium strong grey green fine grained thickly laminated to thinly bedded Greywacke Siltstone / Sandstone'. A reduction in strength to very weak was observed where laminations existed, allied with brown penetrative discolouration.

- As with REXTP01, zones of extremely closely spaced discontinuities existed in the rock where weaker platy fragments were often generated.

- REXTP02 was terminated at 1.40m, with hydraulic breaking having been deployed from 0.50m.

**Figure 9 – Hydraulic breaking in REXTP02**

**Figures 10A – 10F Photographs taken pitside during trial excavation in Area 2. Fig 10A** Sidewall photo of BRE01 Topsoil over a firm brownish yellow SILT to 1.50m underlain by a firm brown very sandy silty gravelly CLAY with a medium cobble content to an end depth of 2.50m (6.50m OD). **Fig 10B** Spoil **Fig 10C** Sidewall profile of BRE05 to pit base of 2.50m (11.62m OD). **Fig 10D** Spoil **Fig 10E** Rock exposed in REXTP02 from 500mm bgl. **Fig 10F** Variable sized fragments (up to 500mm) of SANDSTONE/SILTSTONE rock recovered from hydraulic breaking in REXTP02.



**Fig 10A**

**Fig 10B**

**Fig 10C**

**Fig 10D**

**Fig 10E**

**Fig 10F**

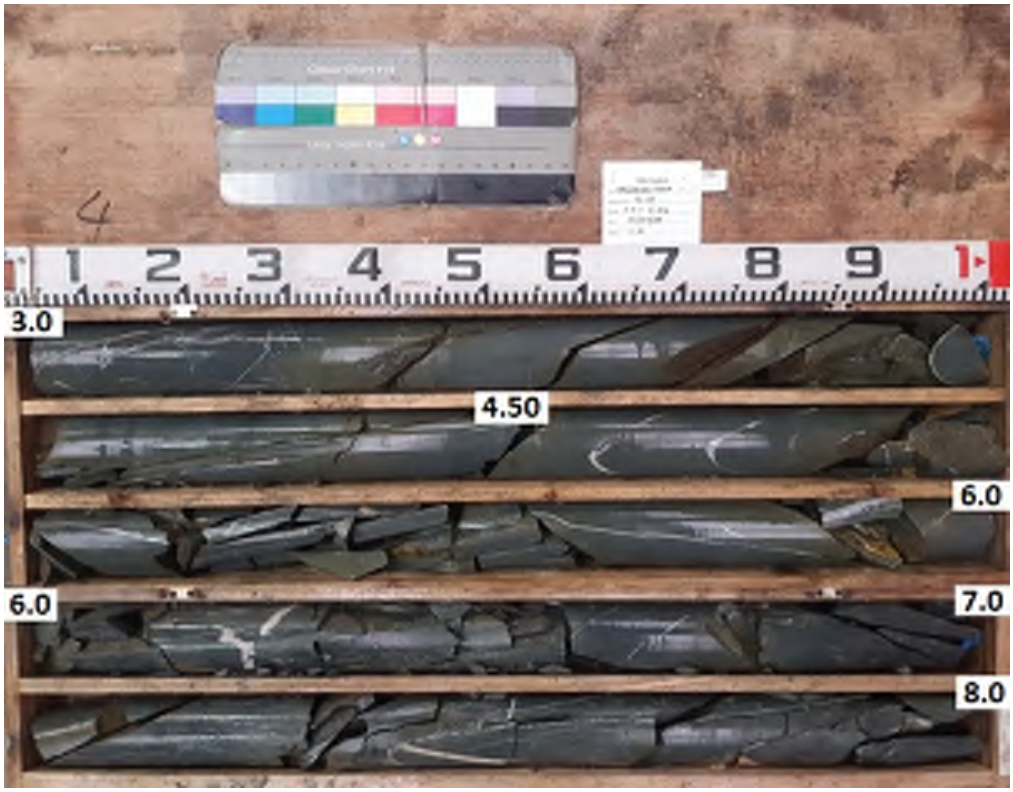
### 5.2 Bedrock

As noted in Section 4, the GSI map for the area (Figure 5, 1:100,000 Solid Geology series) shows the site is underlain by the Clontail Formation. The rock formation consists of green-grey, medium to thickly bedded, coarse and very fine grained greywackes, with dark grey, thinly bedded, poorly graded, quartzose fine sandstone to siltstone units.

Rotary coring was undertaken at four locations, two in Area 1 (Upper Field) and two in Area 2 (Lower Field). The four locations were chosen so that depth to shallow bedrock, as interpreted by the geophysical survey, could be confirmed. In addition to coring, rock excavation trial pits were opened in both fields, again targeted at areas where shallow rock was interpreted in the Minerex Geophysics report. Bedrock was intercepted at high levels in both pits - at 400mm and at 500mm below ground level. The two rock pit locations (REXTP_) were both positioned on topographic highs.

Recovered cores were logged as fresh to very locally slightly weathered, strong to moderately weak, thickly to thinly bedded, greenish blue, fine-grained, interbedded SANDSTONE/SILTSTONE (Greywacke sandstone with siltstone layers) (Figure 11).

**Figure 11 – Bedrock cores from RC01**



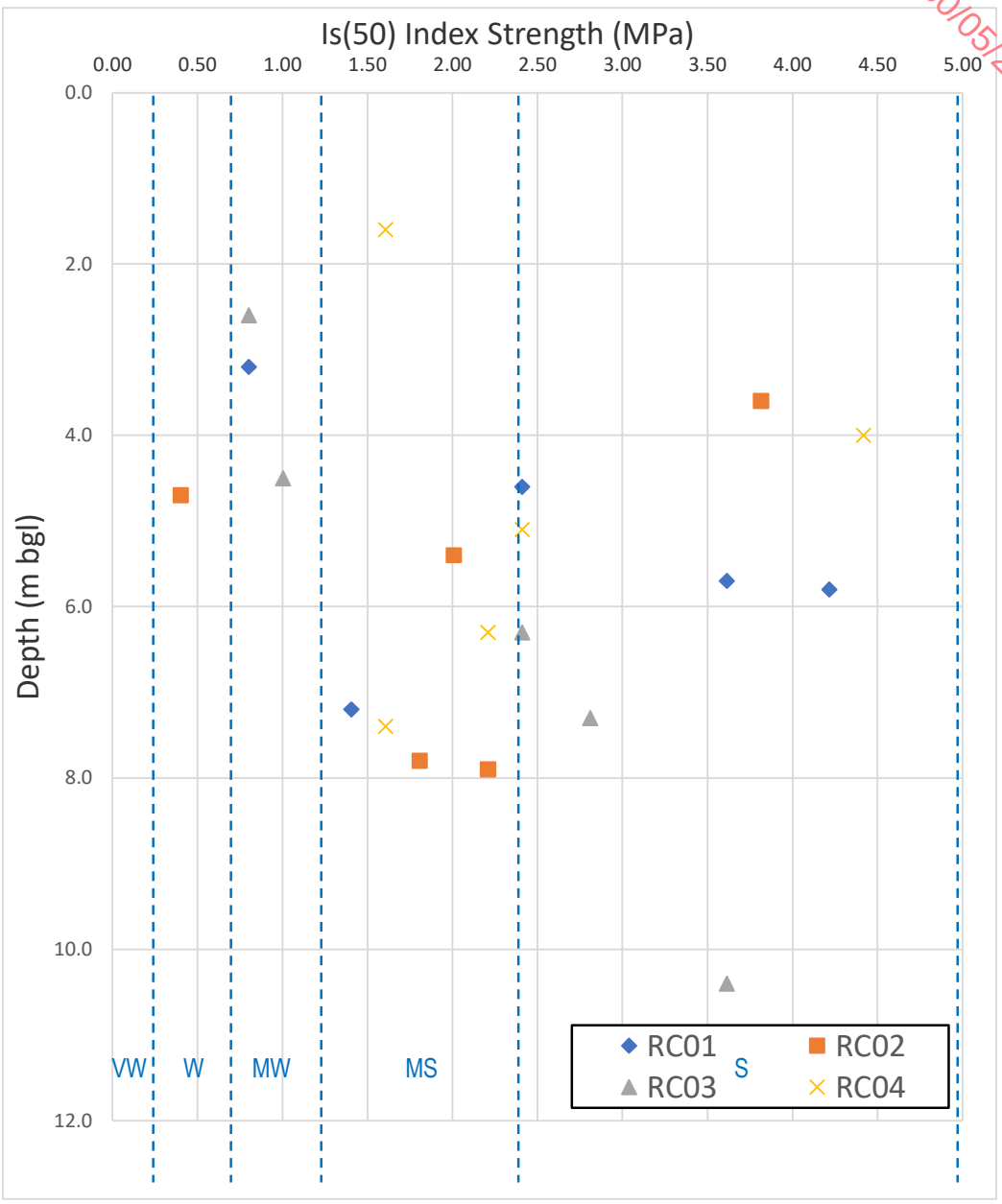

Discontinuity spacings in the rotary cores ranged from widely (600 to 2000mm) to closely (60 to 200mm) spaced, generally medium (200 to 600mm) to closely spaced. The discontinuity surfaces are typically smooth to locally rough, planar to locally curviplanar. Apertures are tight to locally open, occasionally exhibiting clay smearing. Quartz veins are noted occasionally. Dips are 70-80° and locally 20-30°.

The point load strength index (PLSI) test data produced $I_s(50)$ values ranging from 0.4 to 4.4 MPa, with a mean value of 2.28 MPa. The strengths when plotted show a broad scatter but are chiefly

placed in the centre of the PLSI chart (Figure 12), corroborating the largely medium strong strengths recorded in core logging.



**Figure 12 – $I_s(50)$ strengths obtained from diametrial Point Load Strength Index testing**




VW = Very Weak, W = Weak, MW = Moderately Weak, MS = Medium Strong, S = Strong (ISO 14689:2017 (E))

Using a correlation factor (K) of 20 to assess compressive strength, this suggests a characteristic strength envelope in the order of 8 to 88 MPa and categorizes the bedrock as weak (5 to 12.5 MPa) to strong (50 to 100MPa). The visual strength descriptors determined during engineering geological logging marry well with the overall plot scatter in Figure 12.

ISO 14689:2017 (E) rock strength parameters are drawn on Figure 12 to allow correlation between UCS and Point Load Strength tests. A correlation factor (K) of 20 was used to plot the ISO 14689:2017 (E) MPa strength divisions on the Point Load strength ($I_s(50)$) plot.

The two rock excavation pits were undertaken with the purpose of meeting shallow rockhead to acquire sample for rock reusability testing. The material sourced from both pits was largely destructured and distinctly weathered. Rockhead was proven at 400mm in REXTP01 (19.59m OD) and at 500mm in REXTP02 (14.17m OD). Pits were extended to depths of 1.25m and 1.40m bgl with samples recovered from 0.95m and 1.0m bgl depth respectively.



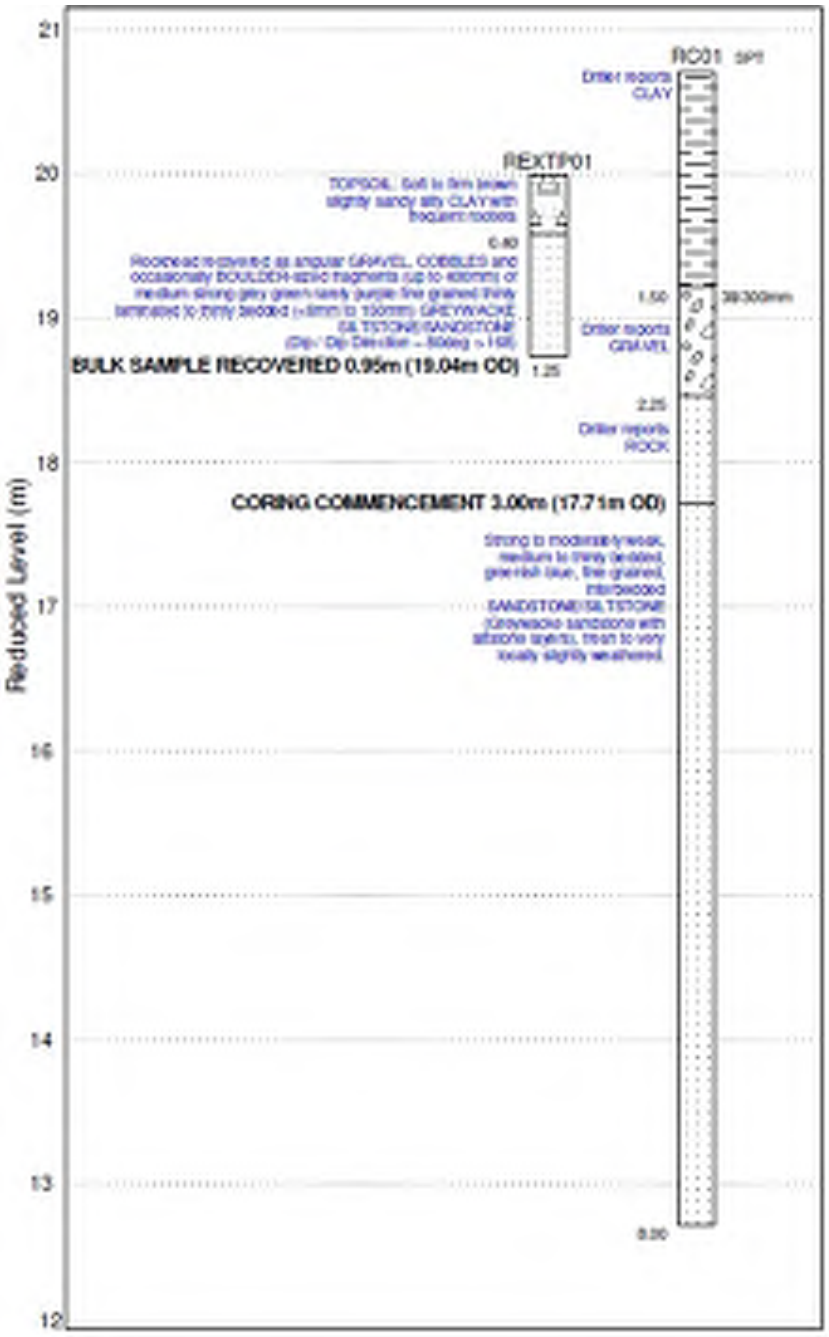



**Figure 13 – Comparison between REXTP01 and nearby RC01 showing intercepted rockhead levels and sampling depths.**

When compared to coreholes nearby, coring at RC01 commenced at 3.0m bgl (17.71m OD), with rockhead being noted by the driller at 2.25m (18.46m OD) underlying a layer of "GRAVEL" (See Figure 13). This is more than 1m deeper than the reported rockhead in REXTP01. It may suggest the overlying layer of "GRAVEL" is a residual soil or completely weathered rockhead. In any case, the cores recovered in RC01 from 3.0m are a further one metre below the level pit REXTP01 was terminated. The weathering grade observed in the rock in REXTP01 might well reduce with depth to reveal more competent rock at depth, as evidenced in the rotary core drillhole findings (See Figure 11).



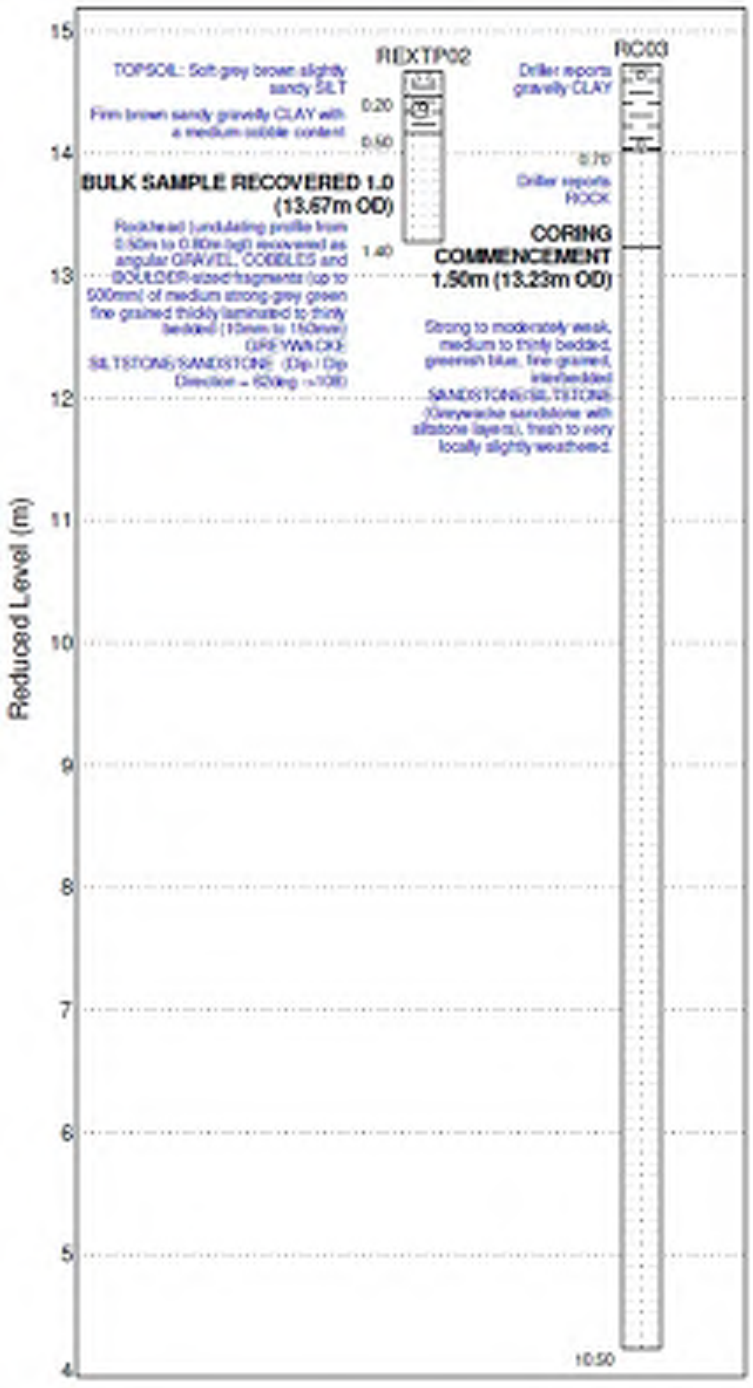



**Figure 14 – Comparison between REXTP02 and nearby corehole RC03 showing intercepted rockhead levels and sampling depths.**

Similarly, in REXTP02, the rock bagged for reusability testing was somewhat destructured but in a less weathered and relatively more intact state than that recovered from REXTP01. When comparing levels of rockhead in REXTP02 and nearby RC03, there is only negligible variation in levels - rock having been encountered at 500mm bgl in REXTP02 (14.17m OD) and at 700mm bgl (14.03m OD) in RC03 (See Figure 14).

Rock was cored at 1.50m (13.23m OD) in RC03 with pit REXTP02 terminated at 1.40m bgl (13.27m OD). Therefore, the rock sourced in REXTP02 is likely to be more representative of the solid competent rock than when compared to the material recovered from REXTP01 in Area 1.

Coring at the four locations proved that the findings of the Minerex Geophysics report, as illustrated in their depth to rock plot, does stand up well to scrutiny. Rockhead levels were as anticipated following consultation with the aforementioned rockhead map (Figures 6 & 8).

### 5.3 Groundwater

Groundwater seepages were not intercepted in open pit excavation. Each of the twelve deep soak pits were remarked as 'dry' to depths varying from 1.60m (9.17m OD at BRE07) to 2.50m bgl (6.50m OD at BRE01). No actual strikes were noted during the construction of the rotary coreholes. However, upon completion, standing water was dipped in all. Table 1 lists the depths at which water was measured following completion.

At the end of coring, water was recorded lying within the bedrock.

Water monitoring standpipes (50mm diameter) were installed in three of the four coreholes upon completion of drilling (RC01, RC02 and RC03). These will facilitate long term groundwater monitoring.

**Table 1 – Water measurements in on-site exploratory holes**

| | Exploratory Hole No. | Water Struck **m bgl** (m OD) | Rate of Flow | Remarks / Stratum of water ingress |
|---|---|---|---|---|
| **Area 1 (Upper Field)** | RC01 | - | - | No Groundwater strike recorded<br>Water level at 3.45m (17.26m OD) upon completion of drillhole |
| | RC02 | - | - | No Groundwater strike recorded<br>Water level at 4.20m (18.25m OD) upon completion of drillhole |
| **Area 2 (Lower Field)** | RC03 | - | - | No Groundwater strike recorded<br>Water level at 8.80m (5.93m OD) upon completion of drillhole |
| | RC04 | - | - | No Groundwater strike recorded<br>Water level at 3.10m (8.48m OD) upon completion of drillhole |

# 6. GROUND ASSESSMENT & ENGINEERING RECOMMENDATIONS

## 6.1 General

In light of the ground investigation findings, the following geotechnical issues are developed and discussed for engineering design:

- Rock Reusability
- Rock Excavatability
- Groundwater / Infiltration
- Slopes / Batters

## 6.2 Rock Reusability

The results from rock testing on samples of variably weathered material acquired from the two rock excavation trial pits (REXTP01 and REXTP02) are outlined in Table 2. Their compliance with the parameters set out in SR21:2014+A1;2016, TII (2022) and Table 6/1 of the Series 600 Earthworks (6F) NRA / TII Specification for Roadworks is assessed in Section 6.2.1.

**Table 2 - Crushed Rock physical, durability and soundness test values**

| Sample Location | Sample Type | Sample Depth | Water Absorption (%) | Los Angeles Coefficient | Mean Magnesium Sulfate Soundness | Flakiness Index | Slake Durability |
|---|---|---|---|---|---|---|---|
| REXTP01 | Weathered Rockhead | 0.95m | 3.0 | 27 | 57 | 35 | Cycle 1: 99.1 Cycle 2: 98.4 |
| REXTP02 | Weathered Rockhead | 1.0m | 4.90 | 28 | 46 | 34 | Cycle 1: 99.3 Cycle 2: 98.7 |

### 6.2.1 Physical, Durability & Soundness

Water absorption values determined on bulk rock samples were found to range between 3.0% and 4.90%. They fail to satisfy the $WA_2$ limit (<2) for T0 and T1 unbound granular fill stipulated in SR21:2014+A1;2016. An aggregate formed from this material would therefore not be satisfy freeze-thaw requirements. The overall results are presented in Table 3A (REXTP01 Sample) and 3B (REXTP02 Sample). Failure to meet the criteria stipulated for each aggregate type is highlighted in red in each table.

Los Angeles abrasion tests produced LA coefficients of 27 and 28. These meet the $LA_{30}$ requirement for T0 / T1 unbound granular fill (<30). Accordingly, both samples meet the $LA_{50}$ requirement for 6F capping (<50). The Magnesium sulphate soundness (MS) values obtained vary from 46 to 57 and therefore do not fulfill the $MS_{25}$ requirement in Annex E of SR21.

Unbound granular fill (UGM) material should satisfy a Flakiness Index of $FI_{35}$ for UGM A and $FI_{50}$ for UGM B according to Table 2.1 of the TII document *Road Pavements – Unbound and Hydraulically Bound Mixtures.* (TII, 2022). The values obtained from testing were 34 and 35 which meet the requirements, only just, for UGM A material. In terms of re-use, the excavated rock (as found in REXTP01 and REXTP02) could be processed and re-used as 6F capping provided the material is crushed to satisfy the grading limits in Table 6/1 of Series 600 NRA / TII SRW. It could also be

considered for re-use as general granular fill (Class 1 to Series 600 TII SWR) for site compounds, laydown areas and landscape berms.



**Table 3A – Rock Physical, Durability & Soundness testing compared to SR21, UGM A/B (formerly Series 800) and Series 600 criteria for REXTP01 sample at 0.95m**

| Sample | Aggregate Type | Particle Density / Water Absorption (%) | Resistance to Fragmentation – Los Angeles Coefficient | Mean Magnesium Sulfate Test Result | Flakiness Index | Slake Durability |
|---|---|---|---|---|---|---|
| REXTP01 at 0.95m (Weathered Rockhead) | **SR21 Annex E** (T0 T1 T2) | **3.0 does not satisfy $WA_2$ limit (<2)** | 27 satisfies $LA_{30}$ limit (<30) | **57 does not satisfy $MS_{25}$ limit (<25)** | n/a | n/a |
| | **UGM A** Formerly Series 800 0/31,5 | **3.0 does not satisfy $WA_{24}2$ limit (<2)** | 27 satisfies $LA_{30}$ limit (<30) | **57 does not satisfy $MS_{25}$ limit (<25)** | 35 satisfies $FI_{35}$ limit (<35) for UGM A | n/a |
| | **UGM B** Formerly Series 800 0/31,5 | **3.0 does not satisfy $WA_{24}2$ limit (<2)** | 27 satisfies $LA_{50}$ limit (<50) | **57 does not satisfy $MS_{25}$ limit (<25)** | 35 satisfies $FI_{50}$ limit (<50) for UGM B | n/a |
| | **Series 600** (6F) | n/a | 27 satisfies upper limit of $LA_{50}$ limit (<50) | n/a | n/a | Cycle 1: 99.1 Cycle 2: 98.4 satisfies lower limit of $SD_{95}$ limit (>95) |

**Table 3B – Rock Physical, Durability & Soundness testing compared to SR21, UGM A/B (formerly Series 800) and Series 600 criteria for REXTP02 sample at 1.0m**



| Sample | Aggregate Type | Particle Density / Water Absorption (%) | Resistance to Fragmentation – Los Angeles Coefficient | Mean Magnesium Sulfate Test Result | Flakiness Index | Slake Durability |
|---|---|---|---|---|---|---|
| REXTP02 at 1.0m (Weathered Rockhead) | **SR21 Annex E** (T0 T1 T2) | **4.90 does not satisfy $WA_2$ limit (<2)** | 28 satisfies $LA_{30}$ limit (<30) | **46 does not satisfy $MS_{25}$ limit (<25)** | n/a | n/a |
| | **UGM A** Formerly Series 800 0/31,5 | **4.90 does not satisfy $WA_{24}2$ limit (<2)** | 28 satisfies $LA_{30}$ limit (<30) | **46 does not satisfy $MS_{25}$ limit (<25)** | 34 satisfies $FI_{35}$ limit (<50) for UGM A | n/a |
| | **UGM B** Formerly Series 800 0/31,5 | **4.90 does not satisfy $WA_{24}2$ limit (<2)** | 28 satisfies $LA_{50}$ limit (<50) | **46 does not satisfy $MS_{25}$ limit (<25)** | 34 satisfies $FI_{50}$ limit (<50) for UGM B | n/a |
| | **Series 600** (6F) | n/a | 28 satisfies upper limit of $LA_{50}$ limit (<50) | n/a | n/a | Cycle 1: 99.3 Cycle 2: 98.7 satisfies lower limit of $SD_{95}$ limit (>95) |

The upper bedrock should **not be used** as structural fill beneath ground bearing floor slabs or foundations as it does not meet the requirements in Annex E of SR21 for physical and durability characteristics. There is the option of selectively stockpiling the more competent rock (larger block sized material) and crushing for re-use as Class 6F2 capping in roads or pavements. It may be the case that rock material found at greater depths satisfies the requirements for 6F material compared to that which is sourced from higher in the stratigraphic column.

Any imported granular fills (particularly T0, T1, T2 Perm to Annex E in SR21:2004+A1:2016) should be thoroughly examined, tested and approved in advance of being used in this project. Independent sampling and testing is advised at least 3 weeks before materials (T0, T1 or T2 Perm) are to be used on site.

### 6.2.2 Chemical

Chemical analysis tests (i.e. total sulphur, acid soluble suphate and water soluble sulphate) were undertaken on selected samples to EN1744. Total sulphur (TS) contents for the samples from REXTP01 and REXTP02 were found to be negligible with measured quantities of 0.02%. Total sulphate or acid soluble sulphate (AS) contents measured 0.02%. Water soluble sulphate (WSS) contents (2:1 extract) of <60mg/l were determined on both samples. The findings show that the samples tested satisfy the limits in Annex E (Table E.1) of SR21, *Guidance on the use of IS EN*

*13242:2002+A1:2007 – Aggregates for unbound and hydraulically bound materials for use in civil engineering work and road construction*.



In the case of UGM A**c** and A**m** as well as UGM B**c** and B**m** (where UGM is placed within 500mm of **c**ementitious or **m**etallic structures), each of the chemical requirements are stipulated in Table 4, reproduced from Table 2.1 (TII, 2022). The water soluble sulphate contents obtained in testing fall within the 1500 mg/l $SO_4$ as do the oxidisable sulphides meet the 0.06% $SO_4$ value. However, since the Water Absorption and Magnesium Sulfate Soundness results fall short of the required cut-off levels, the material could not be used as an unbound granular mixture for road pavements.

In the case of 6F material, the Total Sulphur upper limit value of 1% prescribed in Table 6/1 of Series 600 is met.

**Table 4 – Chemical requirements for aggregates used in UGM's**

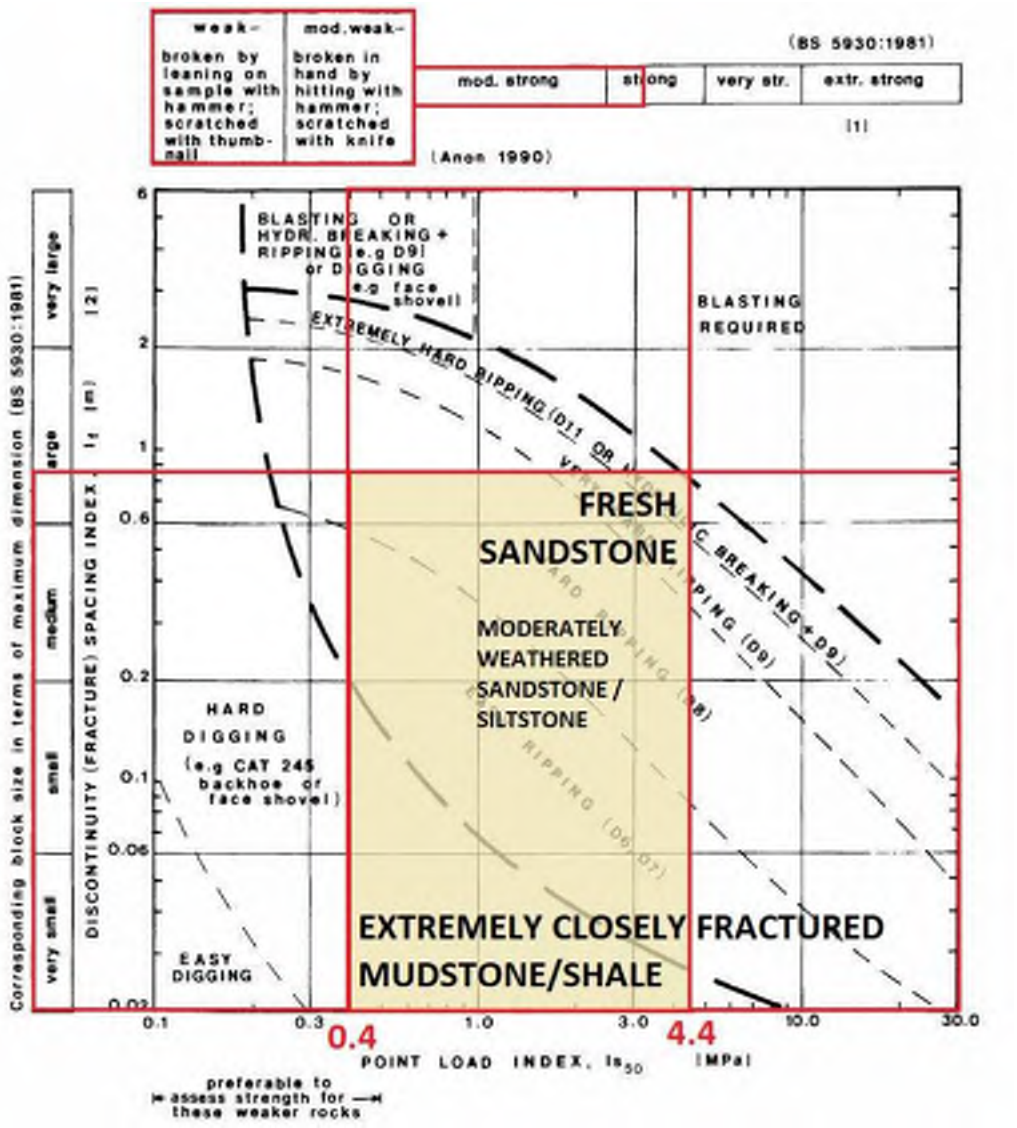
| Property | | Mixture | | | | | | Sample Number | |
|---|---|---|---|---|---|---|---|---|---|
| | | 2.1.1 | 2.1.2 | 2.1.3 | 2.1.4 | 2.1.5 | 2.1.6 | REX TP01 | REX TP02 |
| | | UGM A | UGM Ac | UGM Am | UGM B | UGM Bc | UGM Bm | 0.95 | 1.0m |
| Chemical | Water-soluble sulfate content in mg $SO_4$ per litre | NR[i] | ≤1500 | ≤300 | NR[i] | ≤1500 | ≤300 | <60mg/l | <60mg/l |
| | Oxidisable sulfides content as $SO_4$ | NR[i] | ≤0.30% | ≤0.06% | NR[i] | ≤0.30% | ≤0.06% | 0.04% | 0.04% |

Note: Oxidisable Sulphides are calculated as OS = TPS – AS
Where;
TPS = Total Potential Sulfate = 3 x TS
TS = Total Sulphur content
AS = Acid-soluble sulfates

### 6.3 Rock Excavatability

Fracture spacings recorded in the core drillholes revealed close to medium, occasionally widely spaced discontinuities, which were locally clay smeared. Upper rockhead in REXCR pits was remarked as stained brown, likely due to iron-oxide staining. There were also instances of very closely spaced and extremely closely spaced discontinuities localised in the upper bedrock / weathered horizon (See Figure 7E).

**Figure 15 – Excavatabilty Graph (Pettifer & Fookes, 1994)**




The point load strength index (PLSI) test results and fracture spacing data (from the core logs) can be used to evaluate likely rock excavation methods (termed 'excavatability'). The Pettifer & Fookes (1994) Excavability Chart (reproduced in Figure 15) is a nomogram that allows prediction of excavation methods. Using the strength and fracture spacing data, an evaluation can be made of the likely excavation methods. It is noted that this does not provide an understanding of production rates and solely relates to likely suitable excavation methods. The area outlined in red and and shaded beige suggests the most likely methods for rock excavation.

Note that the shaded area is based on a set of widely ranging point load strengths ($I_s(50)$) which were shown to range from 0.40 to 4.4 MPa. The broad set of PLSI tests is mainly attributable to the variable weathering grades in the bedrock stratigraphy. The average PLSI $I_s(50)$ result was 2.28MPa which would suggest that very hard ripping / hydraulic breaking will be required in the main. In bedrock profiles where rock is notably more weathered (highly weathered), hard digging may be possible using large tracked excavators. However, this is likely to be only applicable to the uppermost rockhead given weathering was largely absent in deeper buried cores.



The geopyhsics report findings are summarised in Table 5 and 6 (taken from Minerex report 6680) and suggest three layers of variably excavatable materials on site. The first is the uppermost soil. An indicaiton of the thickness is presented in Table 6 but it is generally 1.0m to 1.20m. The second layer is identified as a stiff or dense or "very poor rock" layer. It is likely that this relates to either overburden or highly weathered rock. Generally, this layer was found to be 2.0m to 2.50m thick. The final, deepest layer was remarked as "Good Rock" which likely represents the strongest and freshest Greywacke SANDSTONE / SILTSTONE.

These strengths are based on the increased seismic velocites and resistances measured at depth in the geophyiscal survey.

Pitting proved that hydraulic breaking was required in the upper rockhead, albeit with a smaller sixed excavator and breaker than would be deployed on such a site during a main phase of construction. The use of larger machinery with larger digging arms and more powerful hydraulic actuators may facilitate greater diggability locally where the 7tonne excacvator failed to achieve depth. Once the clay cover is removed exposing the rock horizon at depth, the use of a single or mulitshank ripper fixed to a bulldozer will also allow for enhanced breaking of the rock over a broad area.

Simulating the future site dig through the use of a trial dig using similar sized plant proposed for the main dig may be beneficial. This should quickly resolve the diggability of the second and third layers identified in the Minerex report where the 7 tonne tracked excavator encountered immovable rock obstructions.

**Table 5 – Geophysical Survey Layer interpretation.** Taken from Minerex Geophysical Report 6680.

| Layer | General Seismic Velocity Range (m/sec) | Stiffness or Compaction or Rock Quality | Interpretation | Estimated Excavation Method |
|---|---|---|---|---|
| 1 | 150 - 200 | Soft or Loose | Soil | Diggable |
| 2 | 1600 - 1800 | Stiff or Dense or very poor rock | Overburden or highly weathered Greywacke | Diggable or rippable |
| 3 | 4000 | Good rock | Strong Greywacke | Breaking & Blasting |

Therefore, it is possible large track excavators (40T) equipped with heavy duty hydraulic breakers (8T) are advised to efficiently or economically loosen the rock mass. It is highlighted that the Pettifer & Fookes chart (Figre 15) can significantly underestimate rock excavation methods. This is due to the fact that the data set used to produce the nomogram was developed using less indurated Cretaceous or Tertiary rocks unlike the indurated Silurian deposits in Dundalk.



**Table 6 – Interpreted elevations for Layer 1, 2 and 3.** Taken from Minerex Geophysical Report 6680.

| East (ITM) | North (ITM) | Ground Elevation and Top Layer 1 Soft or Loose Soil (mOD) | Distance (m) | Top Layer 2 Stiff or Dense OB or highly weathered Greywacke (mOD) | Top Layer 3 Strong Graywacke (mOD) | Depth m to Layer 2 (bgl) | Depth m to Layer 3 (bgl) |
|---|---|---|---|---|---|---|---|
| 706483.6 | 804365.9 | 14.8 | 0 | 13.8 | 11.3 | 1.04 | 3.53 |
| 706485.5 | 804366.8 | 14.6 | 2 | 13.8 | 11.5 | 0.78 | 3.07 |
| 706487.3 | 804367.2 | 14.7 | 4 | 13.8 | 11.6 | 0.91 | 3.08 |
| 706489.3 | 804367.8 | 14.8 | 6 | 13.8 | 11.6 | 0.92 | 3.13 |
| 706491.3 | 804368.2 | 14.8 | 8 | 13.9 | 11.5 | 0.95 | 3.28 |
| 706493.1 | 804368.9 | 14.8 | 10 | 13.9 | 11.5 | 0.93 | 3.31 |
| 706495.0 | 804369.4 | 14.9 | 12 | 13.9 | 11.6 | 1.01 | 3.30 |
| 706497.0 | 804369.9 | 14.9 | 14 | 13.9 | 11.8 | 1.01 | 3.11 |
| 706499.0 | 804370.3 | 15.0 | 16 | 14.0 | 12.1 | 1.01 | 2.89 |
| 706501.0 | 804370.8 | 15.0 | 18 | 14.0 | 12.3 | 1.08 | 2.76 |
| 706503.0 | 804371.2 | 15.2 | 20 | 14.0 | 12.4 | 1.19 | 2.74 |
| 706504.9 | 804371.6 | 15.2 | 22 | 14.0 | 12.4 | 1.16 | 2.72 |
| 706506.9 | 804372.1 | 15.2 | 24 | 14.0 | 12.5 | 1.21 | 2.71 |
| 706508.8 | 804372.6 | 15.3 | 26 | 14.1 | 12.4 | 1.23 | 2.97 |
| 706510.7 | 804373.0 | 15.3 | 28 | 14.2 | 12.4 | 1.16 | 2.97 |
| 706512.7 | 804373.7 | 15.4 | 30 | 14.2 | 12.2 | 1.14 | 3.15 |
| 706514.6 | 804374.1 | 15.4 | 32 | 14.3 | 12.5 | 1.12 | 2.90 |

### 6.4 Groundwater / Infiltration

As noted in Section 5.3, no water strikes were intercepted in any of the trial pits. However, water was encountered in rotary drillholes following coring. Groundwater levels re-equilibrated after drilling to depths ranging 3.45m (17.26m OD) and 4.20m (18.25m OD) in the Upper Field (Area 1) and to levels from 8.80m bgl (5.93m OD) to 3.10m (8.48m OD) in the Lower field (Area 2). Sporadic measurement of the installed groundwater monitoring wells or installation of data loggers will allow for greater understanding of the groundwater table and the influence both tidal and meteoric on the level. The potential also exists for seasonal changes in groundwater levels.

Twelve soakaway tests were conducted on the site (See Table 7). The soak pits were found to be devoid of groundwater during excavation. A test failure (no or negligible infiltration) was recorded in the test conducted in soak pit BRE10. The result at BRE10 is thought typical of largely impermeable fine glacial till material. Such soils would not be suitable for conventional soakaways offering only low or very limited natural infiltration.

Similarly, the infiltration rates where water did permeate through sidewalls were generally measured at -05E and -06E m/sec typical of sandy silts, very silty fine sands and laminated or mixed strata of silts/sand/clay. Permeability classification would be low to very low in these cases.

**Table 7 – Measured infiltration rates (f) expressed as exposed area (metre) per unit time (minute)**



| Soakaway Test No. | Depth of Test (m bgl) | Infiltration Rate *f* (m/min) | Infiltration Rate *f* (m/sec) |
|---|---|---|---|
| **BRE01** | 2.50 | 0.00092 m/min | 1.52664E-05 m/sec |
| **BRE02** | 2.45 | 0.0013 m/min | 2.16775E-05 m/sec |
| **BRE03** | 2.30 | 0.00143 m/min | 2.38302E-05 m/sec |
| **BRE04** | 2.50 | 5.4E-04 m/min | 9.01374E-06 m/sec |
| **BRE05** | 2.50 | 0.00021 m/min | 3.47952E-06 m/sec |
| **BRE06** | 2.50 | 0.00092 m/min | 1.53236E-05 m/sec |
| **BRE07** | 1.60 | 0.00197 m/min | 3.2906E-05 m/sec |
| **BRE08** | 2.40 | 0.00019 m/min | 3.13329E-06 m/sec |
| **BRE09** | 2.50 | 0.00066 m/min | 1.096E-05 m/sec |
| **BRE10** | 2.10 | 0 m/min | 0 m/sec |
| **BRE11** | 2.0 | 0.00099 m/min | 1.64696E-05 m/sec |
| **BRE12** | 2.30 | 0.00051 m/min | 8.45572E-06 m/sec |

### 6.5 Slopes / Batters

A maximum slope angle of 1V to 1.5H (33°) is recommended for temporary batters constructed within the upper medium strength fine grained soils. A long-term slope angle of 1V to 2H (26°) should be appropriate for batters in the same soils. Where deep excavation works are required in the superficial deposits, the use of trench box support is advised (instability noted in BRE11). In addition, the uppermost fine subsoils will be susceptible to softening and degradation and surface water or groundwater ingress can lead to a significant reduction in shear strength. Perched water can exist locally and this should be considered in risk assessments for excavations.

Site operatives or personnel should not enter unsupported excavations and should be informed of potential risks. Where site operatives or engineering staff work in close proximity to temporary slopes or batters, these should be inspected and approved by a suitably experienced civil engineer, preferably with geotechnical experience. Where there is a risk of spalling of battered slopes, the use of a geogrid is recommended. The geogrid should be anchored at the top and bottom of the ridge face to contain particles such as gravel, cobbles and / or boulders that may become dislodged.

## REFERENCES



**1.0** BS 5930 (2015+A1:2020) Code of Practice for Site Investigation, British Standards Institution (BSI).

**2.0** BS 1377 (1990) Methods of Testing of Soils for Civil Engineering Purposes, BSI.

**3.0** Eurocode 7, Part 2: Ground Investigation & Testing (EN 1997-2:2007)

**4.0** Site Investigation Practice: Assessing BS 5930 (1986), Geological Society Special Publication, No. 2.

**5.0** SR21:2014+A1:2016 Guidance on the use of IS EN 13242+A1:2007

**6.0** Terzaghi, K., Peck, R.B., & Mesri, G. (1996). Soil Mechanics in Engineering, 3rd Edition. New York, Wiley.

**7.0** Transport Infrastructure Ireland (TII) (2022, August). Road Pavements – Unbound and Hydraulically Bound Mixtures. CC-SPW-00800. TII, Dublin

**8.0** Site Investigation Practice: Assessing BS 5930 (1986), Geological Society Special Publication, No. 2.

## Appendix 1

## Soakaway Test Records, Pit Logs & Photographs

# Soakaway Design f -value from field tests

(F2C) IGSL

| | | | |
|---|---|---|---|
| Contract: | Haggardstown | Contract No | 24490 |
| Test No. | BRE01 | Easting | 307052.96 |
| Client | DOBA | Northing | 304338.14 |
| Date: | 15/03/2023 | Elevation | 9.00 |



Summary of ground conditions

| from | to | Description | Ground water |
|---|---|---|---|
| 0.00 | 0.40 | TOPSOIL: Soft to firm brown sandy silty CLAY with frequent rootlets | |
| 0.40 | 1.50 | Firm brownish yellow sandy clayey SILT | Dry |
| 1.50 | 2.50 | Firm brown very sandy silty gravelly CLAY with a medium cobble content | |

Notes: Samples: AA194346 = 0.70m
AA194347 = 1.70m

Field Data

| Depth to Water (m) | Elapsed Time (min) |
|---|---|
| 1.28 | 0.00 |
| 1.29 | 1.00 |
| 1.30 | 2.00 |
| 1.31 | 3.00 |
| 1.32 | 4.00 |
| 1.33 | 5.00 |
| 1.34 | 6.00 |
| 1.35 | 7.00 |
| 1.36 | 8.00 |
| 1.37 | 9.00 |
| 1.38 | 10.00 |
| 1.39 | 12.00 |
| 1.41 | 14.00 |
| 1.43 | 16.00 |
| 1.46 | 18.00 |
| 1.47 | 20.00 |
| 1.50 | 25.00 |
| 1.53 | 30.00 |
| 1.54 | 35.00 |
| 1.56 | 40.00 |
| 1.61 | 50.00 |
| 1.65 | 60.00 |

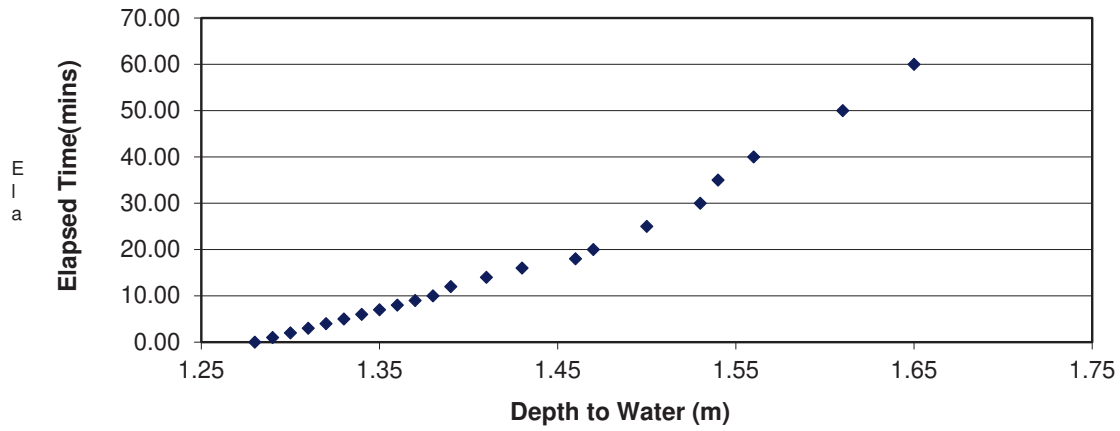
Field Test

| | | |
|---|---|---|
| Depth of Pit (D) | 2.50 | m |
| Width of Pit (B) | 0.50 | m |
| Length of Pit (L) | 1.30 | m |
| Initial depth to Water = | 1.28 | m |
| Final depth to water = | 1.65 | m |
| Elapsed time (mins)= | 60.00 | |
| Top of permeable soil | | m |
| Base of permeable soil | | m |
| Base area= | 0.65 | m2 |
| *Av. side area of permeable stratum over test period= | 3.726 | m2 |
| Total Exposed area = | 4.376 | m2 |

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

**f= 0.00092 m/min or 1.52664E-05 m/sec**

**Depth of water vs Elapsed Time (mins)**



# Soakaway Design f -value from field tests

(F2C) IGSL

| | | | |
|---|---|---|---|
| Contract: | Haggardstown | Contract No | 24490 |
| Test No. | BRE02 | Easting | 307005.90 |
| Client | DOBA | Northing | 304399.11 |
| Date: | 15/03/2023 | Elevation | 8.36 |



Summary of ground conditions

| from | to | Description | Ground water |
|---|---|---|---|
| 0.00 | 0.30 | TOPSOIL: Soft to firm brown sandy silty CLAY with frequent rootlets | |
| 0.30 | 1.10 | Firm brown slightly gravelly sandy silty CLAY with a medium cobble content | Dry |
| 1.10 | 2.45 | Firm very gravelly sandy silty CLAY with a medium to high cobble content | |

Notes: Samples: AA194344 = 0.70m
AA194345 = 1.70m

Field Data

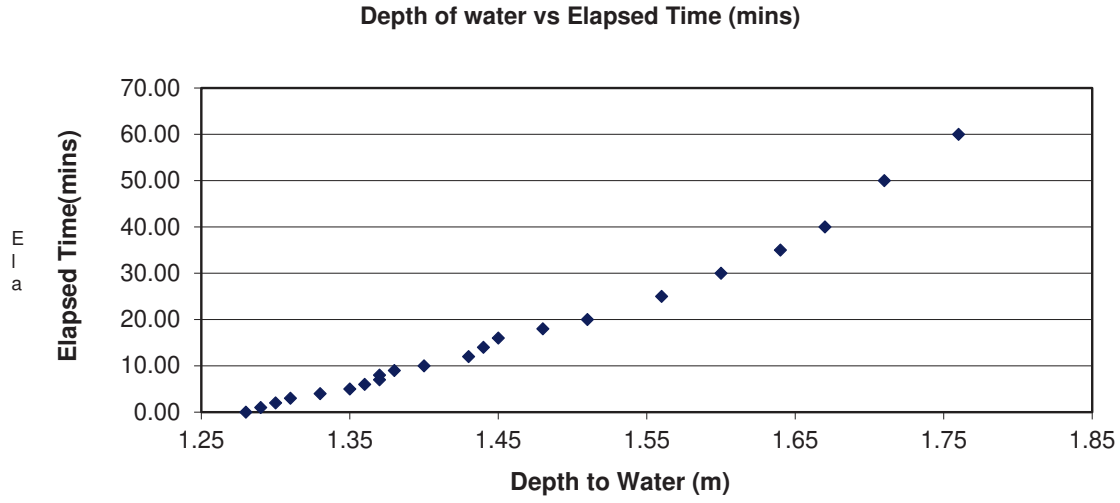
| Depth to Water (m) | Elapsed Time (min) |
|---|---|
| 1.28 | 0.00 |
| 1.29 | 1.00 |
| 1.30 | 2.00 |
| 1.31 | 3.00 |
| 1.33 | 4.00 |
| 1.35 | 5.00 |
| 1.36 | 6.00 |
| 1.37 | 7.00 |
| 1.37 | 8.00 |
| 1.38 | 9.00 |
| 1.40 | 10.00 |
| 1.43 | 12.00 |
| 1.44 | 14.00 |
| 1.45 | 16.00 |
| 1.48 | 18.00 |
| 1.51 | 20.00 |
| 1.56 | 25.00 |
| 1.60 | 30.00 |
| 1.64 | 35.00 |
| 1.67 | 40.00 |
| 1.71 | 50.00 |
| 1.76 | 60.00 |

Field Test

| | | |
|---|---|---|
| Depth of Pit (D) | 2.45 | m |
| Width of Pit (B) | 0.50 | m |
| Length of Pit (L) | 1.30 | m |
| Initial depth to Water = | 1.28 | m |
| Final depth to water = | 1.76 | m |
| Elapsed time (mins)= | 60.00 | |
| Top of permeable soil | | m |
| Base of permeable soil | | m |
| Base area= | 0.65 | m2 |
| *Av. side area of permeable stratum over test period= | 3.348 | m2 |
| Total Exposed area = | 3.998 | m2 |

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

**f= 0.0013 m/min or 2.16775E-05 m/sec**



# Soakaway Design f -value from field tests

(F2C) IGSL

| | | | |
|---|---|---|---|
| Contract: | Haggardstown | Contract No | 24490 |
| Test No. | BRE03 | Easting | 306997.08 |
| Client | DOBA | Northing | 304544.94 |
| Date: | 14/03/2023 | Elevation | 6.84 |



Summary of ground conditions

| from | to | Description | Ground water |
|---|---|---|---|
| 0.00 | 0.40 | TOPSOIL: Soft to firm brown sandy gravelly CLAY with rootlets | |
| 0.40 | 1.40 | Firm brown very sandy gravelly CLAY | Dry |
| 1.40 | 2.10 | Firm very gravelly very sandy silty CLAY with a medium to high cobble content | |
| 2.10 | 2.30 | Weathered rock recovered as a light brown silty clayey GRAVEL | |

Notes: Samples: AA194342 = 0.70m
AA194343 = 1.70m

Field Data

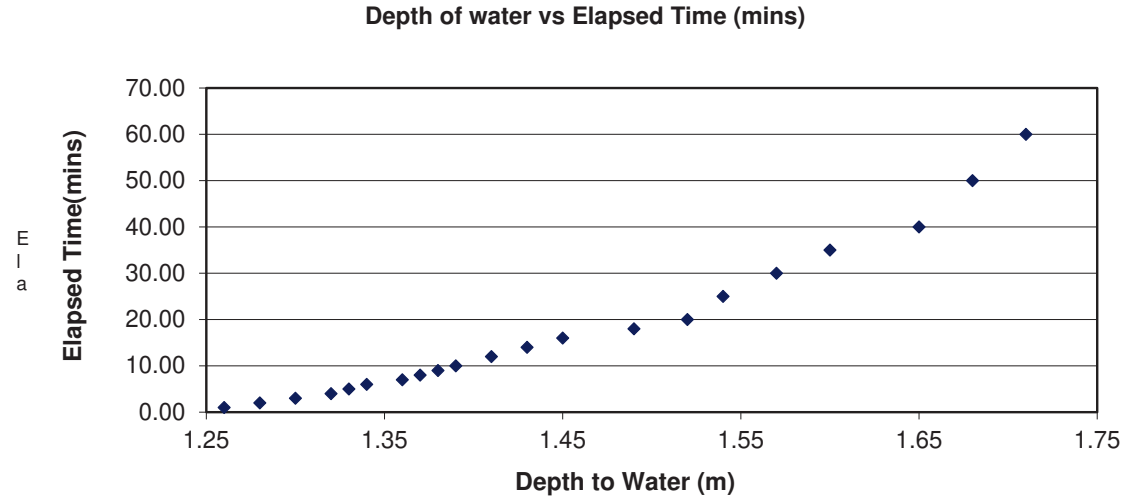
| Depth to Water (m) | Elapsed Time (min) |
|---|---|
| 1.24 | 0.00 |
| 1.26 | 1.00 |
| 1.28 | 2.00 |
| 1.30 | 3.00 |
| 1.32 | 4.00 |
| 1.33 | 5.00 |
| 1.34 | 6.00 |
| 1.36 | 7.00 |
| 1.37 | 8.00 |
| 1.38 | 9.00 |
| 1.39 | 10.00 |
| 1.41 | 12.00 |
| 1.43 | 14.00 |
| 1.45 | 16.00 |
| 1.49 | 18.00 |
| 1.52 | 20.00 |
| 1.54 | 25.00 |
| 1.57 | 30.00 |
| 1.60 | 35.00 |
| 1.65 | 40.00 |
| 1.68 | 50.00 |
| 1.71 | 60.00 |

Field Test

| | | |
|---|---|---|
| Depth of Pit (D) | 2.30 | m |
| Width of Pit (B) | 0.50 | m |
| Length of Pit (L) | 1.40 | m |
| Initial depth to Water = | 1.24 | m |
| Final depth to water = | 1.71 | m |
| Elapsed time (mins)= | 60.00 | |
| Top of permeable soil | | m |
| Base of permeable soil | | m |
| Base area= | 0.7 | m2 |
| *Av. side area of permeable stratum over test period= | 3.135 | m2 |
| Total Exposed area = | 3.835 | m2 |

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

**f= 0.00143 m/min or 2.38302E-05 m/sec**



# Soakaway Design f -value from field tests

(F2C) IGSL

| | | | |
|---|---|---|---|
| Contract: | Haggardstown | Contract No | 24490 |
| Test No. | BRE04 | Easting | 306943.98 |
| Client | DOBA | Northing | 304220.17 |
| Date: | 15/03/2023 | Elevation | 13.22 |



Summary of ground conditions

| from | to | Description | Ground water |
|---|---|---|---|
| 0.00 | 0.40 | TOPSOIL: Soft to firm brown sandy gravelly CLAY with frequent rootlets | |
| 0.40 | 1.20 | Firm brown sandy gravelly CLAY with a medium cobble content | Dry |
| 1.20 | 2.50 | Firm very gravelly sandy silty CLAY with a medium to high cobble content | |

Notes: Samples: AA194350 = 0.70m
AA199300 = 1.70m

Field Data

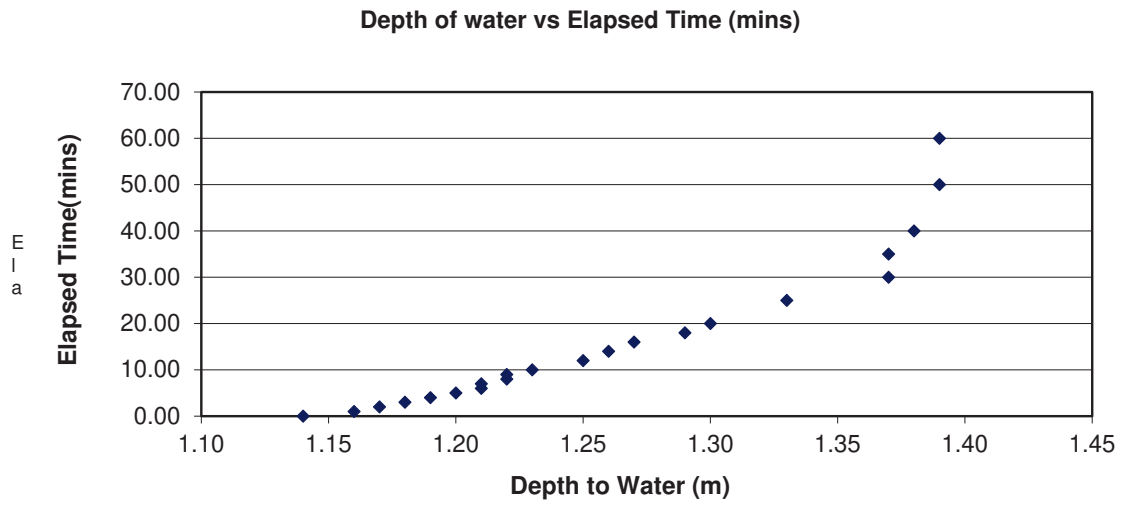
| Depth to Water (m) | Elapsed Time (min) |
|---|---|
| 1.14 | 0.00 |
| 1.16 | 1.00 |
| 1.17 | 2.00 |
| 1.18 | 3.00 |
| 1.19 | 4.00 |
| 1.20 | 5.00 |
| 1.21 | 6.00 |
| 1.21 | 7.00 |
| 1.22 | 8.00 |
| 1.22 | 9.00 |
| 1.23 | 10.00 |
| 1.25 | 12.00 |
| 1.26 | 14.00 |
| 1.27 | 16.00 |
| 1.29 | 18.00 |
| 1.30 | 20.00 |
| 1.33 | 25.00 |
| 1.37 | 30.00 |
| 1.37 | 35.00 |
| 1.38 | 40.00 |
| 1.39 | 50.00 |
| 1.39 | 60.00 |

Field Test

| | | |
|---|---|---|
| Depth of Pit (D) | 2.50 | m |
| Width of Pit (B) | 0.50 | m |
| Length of Pit (L) | 1.40 | m |
| Initial depth to Water = | 1.14 | m |
| Final depth to water = | 1.39 | m |
| Elapsed time (mins)= | 60.00 | |
| Top of permeable soil | | m |
| Base of permeable soil | | m |
| Base area= | 0.7 | m2 |
| *Av. side area of permeable stratum over test period= | 4.693 | m2 |
| Total Exposed area = | 5.393 | m2 |

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

**f= 0.00054 m/min or 9.01374E-06 m/sec**



# Soakaway Design f -value from field tests

(F2C) IGSL

| | | | |
|---|---|---|---|
| Contract: | Haggardstown | Contract No | 24490 |
| Test No. | BRE05 | Easting | 306928.11 |
| Client | DOBA | Northing | 304273.01 |
| Date: | 15/03/2023 | Elevation | 14.12 |



Summary of ground conditions

| from | to | Description | Ground water |
|---|---|---|---|
| 0.00 | 0.30 | TOPSOIL: Soft to firm brown sandy gravelly CLAY with frequent rootlets | |
| 0.30 | 1.10 | Firm brown sandy gravelly CLAY with a medium cobble content | Dry |
| 1.10 | 2.50 | Firm very gravelly sandy silty CLAY with a medium to high cobble content | |

Notes: Samples: AA194348 = 0.70m
AA194349 = 1.70m

Field Data

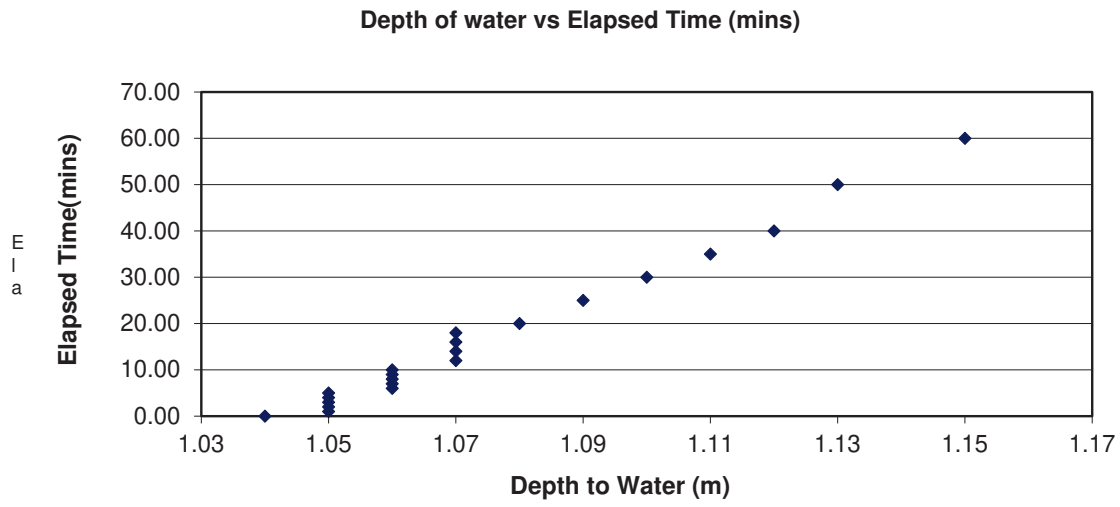
| Depth to Water (m) | Elapsed Time (min) |
|---|---|
| 1.04 | 0.00 |
| 1.05 | 1.00 |
| 1.05 | 2.00 |
| 1.05 | 3.00 |
| 1.05 | 4.00 |
| 1.05 | 5.00 |
| 1.06 | 6.00 |
| 1.06 | 7.00 |
| 1.06 | 8.00 |
| 1.06 | 9.00 |
| 1.06 | 10.00 |
| 1.07 | 12.00 |
| 1.07 | 14.00 |
| 1.07 | 16.00 |
| 1.07 | 18.00 |
| 1.08 | 20.00 |
| 1.09 | 25.00 |
| 1.10 | 30.00 |
| 1.11 | 35.00 |
| 1.12 | 40.00 |
| 1.13 | 50.00 |
| 1.15 | 60.00 |

Field Test

| | | |
|---|---|---|
| Depth of Pit (D) | 2.50 | m |
| Width of Pit (B) | 0.50 | m |
| Length of Pit (L) | 1.30 | m |
| Initial depth to Water = | 1.04 | m |
| Final depth to water = | 1.15 | m |
| Elapsed time (mins)= | 60.00 | |
| Top of permeable soil | | m |
| Base of permeable soil | | m |
| Base area= | 0.65 | m2 |
| *Av. side area of permeable stratum over test period= | 5.058 | m2 |
| Total Exposed area = | 5.708 | m2 |

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

**f= 0.00021 m/min or 3.47952E-06 m/sec**



# Soakaway Design f -value from field tests

(F2C) IGSL

| | | | |
|---|---|---|---|
| Contract: | Haggardstown | Contract No | 24490 |
| Test No. | BRE06 | Easting | 306914.89 |
| Client | DOBA | Northing | 304354.99 |
| Date: | 14/03/2023 | Elevation | 10.10 |



Summary of ground conditions

| from | to | Description | Ground water |
|---|---|---|---|
| 0.00 | 0.30 | TOPSOIL: Soft to firm brown sandy gravelly CLAY with rootlets | |
| 0.30 | 1.10 | Firm brown sandy gravelly CLAY with a medium cobble content | Dry |
| 1.10 | 2.50 | Firm very gravelly sandy silty CLAY with a medium to high cobble content | |

Notes: Samples: AA194338 = 0.70m
AA194339 = 1.70m

Field Data

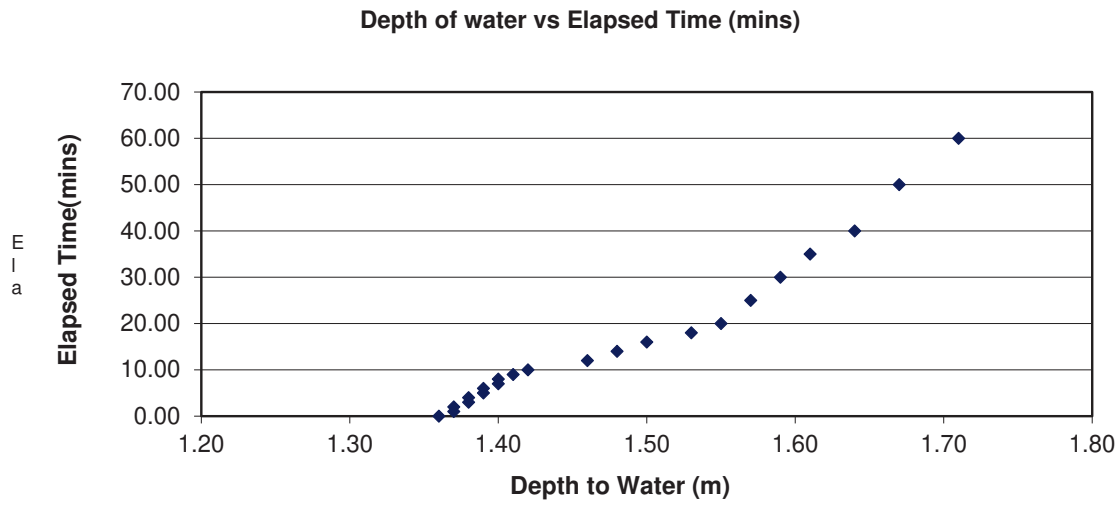
| Depth to Water (m) | Elapsed Time (min) |
|---|---|
| 1.36 | 0.00 |
| 1.37 | 1.00 |
| 1.37 | 2.00 |
| 1.38 | 3.00 |
| 1.38 | 4.00 |
| 1.39 | 5.00 |
| 1.39 | 6.00 |
| 1.40 | 7.00 |
| 1.40 | 8.00 |
| 1.41 | 9.00 |
| 1.42 | 10.00 |
| 1.46 | 12.00 |
| 1.48 | 14.00 |
| 1.50 | 16.00 |
| 1.53 | 18.00 |
| 1.55 | 20.00 |
| 1.57 | 25.00 |
| 1.59 | 30.00 |
| 1.61 | 35.00 |
| 1.64 | 40.00 |
| 1.67 | 50.00 |
| 1.71 | 60.00 |

Field Test

| | | |
|---|---|---|
| Depth of Pit (D) | 2.50 | m |
| Width of Pit (B) | 0.50 | m |
| Length of Pit (L) | 1.30 | m |
| Initial depth to Water = | 1.36 | m |
| Final depth to water = | 1.71 | m |
| Elapsed time (mins)= | 60.00 | |
| Top of permeable soil | | m |
| Base of permeable soil | | m |
| Base area= | 0.65 | m2 |
| *Av. side area of permeable stratum over test period= | 3.474 | m2 |
| Total Exposed area = | 4.124 | m2 |

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

**f= 0.00092 m/min or 1.53236E-05 m/sec**



# Soakaway Design f -value from field tests

(F2C) IGSL

| | | | |
|---|---|---|---|
| Contract: | Haggardstown | Contract No | 24490 |
| Test No. | BRE07 | Easting | 306849.05 |
| Client | DOBA | Northing | 304397.87 |
| Date: | 14/03/2023 | Elevation | 10.77 |



Summary of ground conditions

| from | to | Description | Ground water |
|---|---|---|---|
| 0.00 | 0.20 | TOPSOIL: Soft to firm brown sandy gravelly CLAY with rootlets | |
| 0.20 | 1.10 | Firm brown sandy gravelly CLAY with a medium cobble content | Dry |
| 1.10 | 1.40 | Firm very gravelly sandy silty CLAY with a medium to high cobble content | |
| 1.40 | 1.60 | Weathered rock recovered as a light brown silty clayey GRAVEL | |

Notes: Samples: AA194340 = 0.70m
AA194341 = 1.50m

Field Data

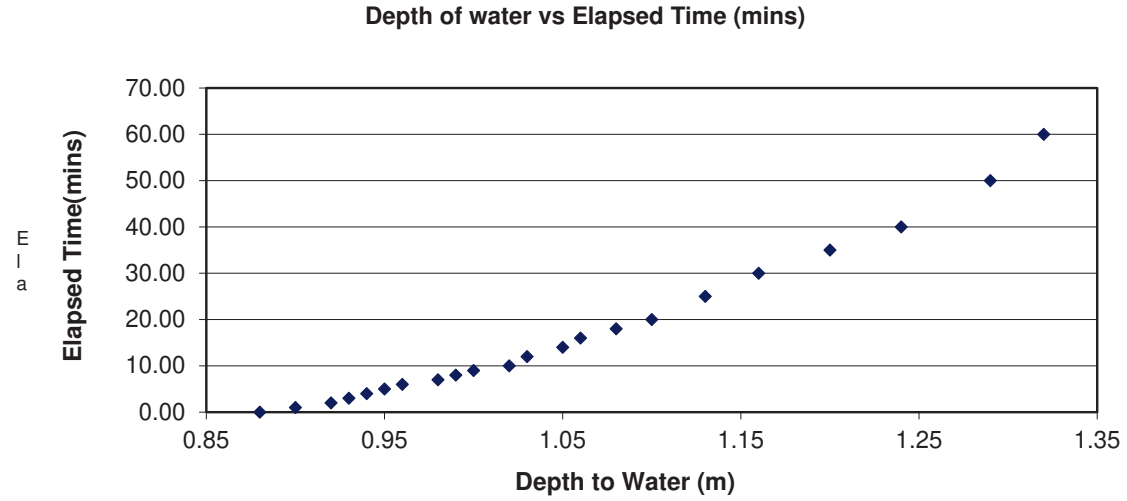
| Depth to Water (m) | Elapsed Time (min) |
|---|---|
| 0.88 | 0.00 |
| 0.90 | 1.00 |
| 0.92 | 2.00 |
| 0.93 | 3.00 |
| 0.94 | 4.00 |
| 0.95 | 5.00 |
| 0.96 | 6.00 |
| 0.98 | 7.00 |
| 0.99 | 8.00 |
| 1.00 | 9.00 |
| 1.02 | 10.00 |
| 1.03 | 12.00 |
| 1.05 | 14.00 |
| 1.06 | 16.00 |
| 1.08 | 18.00 |
| 1.10 | 20.00 |
| 1.13 | 25.00 |
| 1.16 | 30.00 |
| 1.20 | 35.00 |
| 1.24 | 40.00 |
| 1.29 | 50.00 |
| 1.32 | 60.00 |

Field Test

| | | |
|---|---|---|
| Depth of Pit (D) | 1.60 | m |
| Width of Pit (B) | 0.50 | m |
| Length of Pit (L) | 1.40 | m |
| Initial depth to Water = | 0.88 | m |
| Final depth to water = | 1.32 | m |
| Elapsed time (mins)= | 60.00 | |
| Top of permeable soil | | m |
| Base of permeable soil | | m |
| Base area= | 0.7 | m2 |
| *Av. side area of permeable stratum over test period= | 1.9 | m2 |
| Total Exposed area = | 2.6 | m2 |

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

**f= 0.00197 m/min or 3.2906E-05 m/sec**



# Soakaway Design f -value from field tests

(F2C) IGSL

| | | | |
|---|---|---|---|
| Contract: | Haggardstown | Contract No | 24490 |
| Test No. | BRE08 | Easting | 306824.02 |
| Client | DOBA | Northing | 304271.04 |
| Date: | 14/03/2023 | Elevation | 15.37 |



Summary of ground conditions

| from | to | Description | Ground water |
|---|---|---|---|
| 0.00 | 0.30 | TOPSOIL: Soft to firm brown sandy gravelly CLAY with rootlets | |
| 0.30 | 1.00 | Firm brown sandy gravelly CLAY with a medium cobble content | Dry |
| 1.00 | 2.40 | Firm very gravelly sandy silty CLAY with a medium to high cobble content | |

Notes: Samples: AA194336 = 0.70m
AA194337 = 1.70m

Field Data

| Depth to Water (m) | Elapsed Time (min) |
|---|---|
| 1.26 | 0.00 |
| 1.26 | 1.00 |
| 1.27 | 2.00 |
| 1.27 | 3.00 |
| 1.27 | 4.00 |
| 1.27 | 5.00 |
| 1.27 | 6.00 |
| 1.27 | 7.00 |
| 1.27 | 8.00 |
| 1.28 | 9.00 |
| 1.28 | 10.00 |
| 1.28 | 12.00 |
| 1.28 | 14.00 |
| 1.29 | 16.00 |
| 1.29 | 18.00 |
| 1.29 | 20.00 |
| 1.30 | 25.00 |
| 1.31 | 30.00 |
| 1.31 | 35.00 |
| 1.32 | 40.00 |
| 1.33 | 50.00 |
| 1.34 | 60.00 |

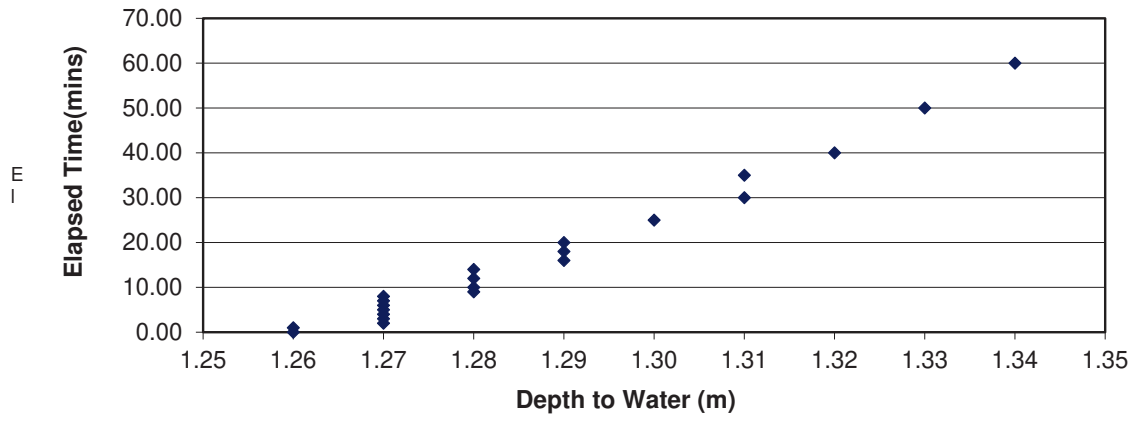
Field Test

| | | |
|---|---|---|
| Depth of Pit (D) | 2.40 | m |
| Width of Pit (B) | 0.50 | m |
| Length of Pit (L) | 1.30 | m |
| Initial depth to Water = | 1.26 | m |
| Final depth to water = | 1.34 | m |
| Elapsed time (mins)= | 60.00 | |
| Top of permeable soil | | m |
| Base of permeable soil | | m |
| Base area= | 0.65 | m2 |
| *Av. side area of permeable stratum over test period= | 3.96 | m2 |
| Total Exposed area = | 4.61 | m2 |

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

**f= 0.00019 m/min or 3.13329E-06 m/sec**

**Depth of water vs Elapsed Time (mins)**



# Soakaway Design f -value from field tests

(F2C) IGSL

| | | | |
|---|---|---|---|
| Contract: | Haggardstown | Contract No | 24490 |
| Test No. | BRE09 | Easting | 306812.97 |
| Client | DOBA | Northing | 304333.02 |
| Date: | 14/03/2023 | Elevation | 14.24 |



Summary of ground conditions

| from | to | Description | Ground water |
|---|---|---|---|
| 0.00 | 0.30 | TOPSOIL: Soft to firm brown sandy gravelly CLAY with rootlets | |
| 0.30 | 1.00 | Firm brown sandy gravelly CLAY with a medium cobble content | Dry |
| 1.00 | 2.50 | Firm very gravelly sandy silty CLAY with a medium to high cobble content | |

Notes: Samples: AA194334 = 0.70m
AA194335 = 1.70m

Field Data

| Depth to Water (m) | Elapsed Time (min) |
|---|---|
| 1.31 | 0.00 |
| 1.31 | 1.00 |
| 1.32 | 2.00 |
| 1.33 | 3.00 |
| 1.34 | 4.00 |
| 1.35 | 5.00 |
| 1.36 | 6.00 |
| 1.37 | 7.00 |
| 1.38 | 8.00 |
| 1.39 | 9.00 |
| 1.40 | 10.00 |
| 1.41 | 12.00 |
| 1.43 | 14.00 |
| 1.44 | 16.00 |
| 1.45 | 18.00 |
| 1.46 | 20.00 |
| 1.48 | 25.00 |
| 1.50 | 30.00 |
| 1.51 | 35.00 |
| 1.53 | 40.00 |
| 1.55 | 50.00 |
| 1.57 | 60.00 |

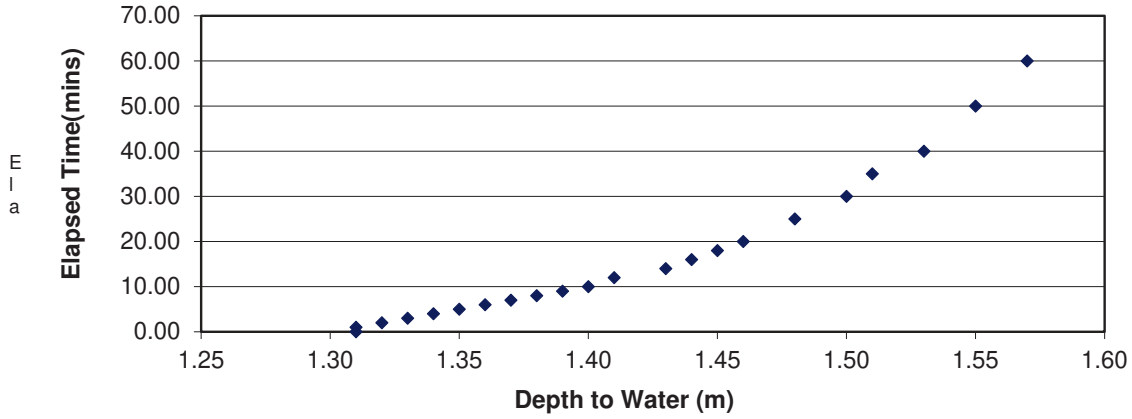
Field Test

| | | |
|---|---|---|
| Depth of Pit (D) | 2.50 | m |
| Width of Pit (B) | 0.50 | m |
| Length of Pit (L) | 1.30 | m |
| Initial depth to Water = | 1.31 | m |
| Final depth to water = | 1.58 | m |
| Elapsed time (mins)= | 60.00 | |
| Top of permeable soil | | m |
| Base of permeable soil | | m |
| Base area= | 0.65 | m2 |
| *Av. side area of permeable stratum over test period= | 3.798 | m2 |
| Total Exposed area = | 4.448 | m2 |

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

**f= 0.00066 m/min or 1.096E-05 m/sec**

**Depth of water vs Elapsed Time (mins)**



# Soakaway Design f -value from field tests

(F2C) IGSL

| | | | |
|---|---|---|---|
| Contract: | Haggardstown | Contract No. | 24490 |
| Test No. | BRE10 | Easting | 306741.02 |
| Client | DOBA | Northing | 304331.93 |
| Date: | 13/03/2023 | Elevation | 16.95 |



Summary of ground conditions

| from | to | Description | Ground water |
|---|---|---|---|
| 0.00 | 0.30 | TOPSOIL: Soft to firm brown sandy gravelly CLAY with rootlets | |
| 0.30 | 0.80 | Firm brown sandy gravelly CLAY with a medium cobble content | Dry |
| 0.80 | 1.60 | Firm very gravelly sandy silty CLAY with a medium to high cobble content | |
| 1.60 | 2.10 | Weathered rock recovered as a light brown silty clayey GRAVEL with a high cobble content | |

Notes: Test ended after 30 minutes due to no soakage

Samples: AA194332 = 0.70m
AA194333 = 1.70m

Field Data

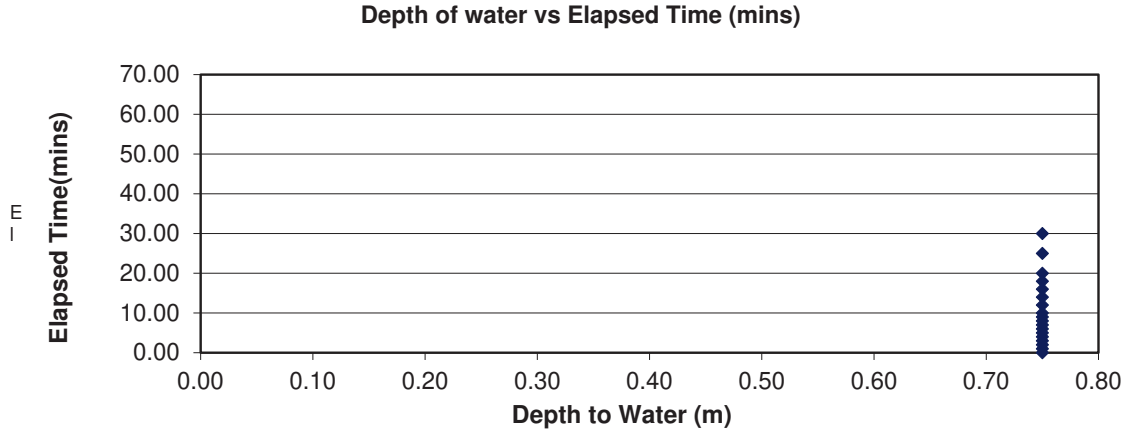
| Depth to Water (m) | Elapsed Time (min) |
|---|---|
| 0.75 | 0.00 |
| 0.75 | 1.00 |
| 0.75 | 2.00 |
| 0.75 | 3.00 |
| 0.75 | 4.00 |
| 0.75 | 5.00 |
| 0.75 | 6.00 |
| 0.75 | 7.00 |
| 0.75 | 8.00 |
| 0.75 | 9.00 |
| 0.75 | 10.00 |
| 0.75 | 12.00 |
| 0.75 | 14.00 |
| 0.75 | 16.00 |
| 0.75 | 18.00 |
| 0.75 | 20.00 |
| 0.75 | 25.00 |
| 0.75 | 30.00 |
| | 35.00 |
| | 40.00 |
| | 50.00 |
| | 60.00 |

Field Test

| | | |
|---|---|---|
| Depth of Pit (D) | 2.10 | m |
| Width of Pit (B) | 0.50 | m |
| Length of Pit (L) | 1.30 | m |
| Initial depth to Water = | 0.75 | m |
| Final depth to water = | 0.75 | m |
| Elapsed time (mins)= | 30.00 | |
| Top of permeable soil | | m |
| Base of permeable soil | | m |
| Base area= | 0.65 | m2 |
| *Av. side area of permeable stratum over test period= | 4.86 | m2 |
| Total Exposed area = | 5.51 | m2 |

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

**f= 0 m/min or 0 m/sec**



# Soakaway Design f -value from field tests

(F2C) IGSL

| | | | |
|---|---|---|---|
| Contract: | Haggardstown | Contract No. | 24490 |
| Test No. | BRE11 | Easting | 306794.08 |
| Client | DOBA | Northing | 304131.09 |
| Date: | 15/03/2023 | Elevation | 20.81 |



Summary of ground conditions

| from | to | Description | Ground water |
|---|---|---|---|
| 0.00 | 0.30 | TOPSOIL: Soft to firm dark brown sandy gravelly CLAY with frequent rootlets | |
| 0.30 | 0.90 | Firm brown very sandy gravelly CLAY | Dry |
| 0.90 | 1.70 | Firm very gravelly very sandy CLAY with a medium to high cobble content | |
| 1.70 | 2.00 | Weathered rock recovered as a light brown silty clayey GRAVEL | |

Notes: Samples: AA199301 = 0.70m
AA199302 = 1.70m

Field Data

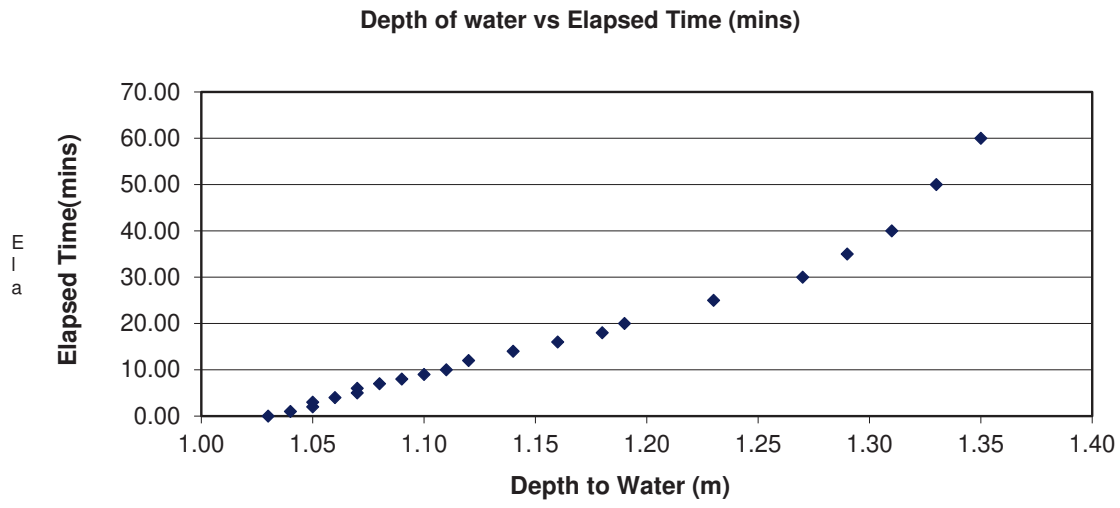
| Depth to Water (m) | Elapsed Time (min) |
|---|---|
| 1.03 | 0.00 |
| 1.04 | 1.00 |
| 1.05 | 2.00 |
| 1.05 | 3.00 |
| 1.06 | 4.00 |
| 1.07 | 5.00 |
| 1.07 | 6.00 |
| 1.08 | 7.00 |
| 1.09 | 8.00 |
| 1.10 | 9.00 |
| 1.11 | 10.00 |
| 1.12 | 12.00 |
| 1.14 | 14.00 |
| 1.16 | 16.00 |
| 1.18 | 18.00 |
| 1.19 | 20.00 |
| 1.23 | 25.00 |
| 1.27 | 30.00 |
| 1.29 | 35.00 |
| 1.31 | 40.00 |
| 1.33 | 50.00 |
| 1.35 | 60.00 |

Field Test

| | | |
|---|---|---|
| Depth of Pit (D) | 2.00 | m |
| Width of Pit (B) | 0.50 | m |
| Length of Pit (L) | 1.40 | m |
| Initial depth to Water = | 1.03 | m |
| Final depth to water = | 1.35 | m |
| Elapsed time (mins)= | 60.00 | |
| Top of permeable soil | | m |
| Base of permeable soil | | m |
| Base area= | 0.7 | m2 |
| *Av. side area of permeable stratum over test period= | 3.078 | m2 |
| Total Exposed area = | 3.778 | m2 |

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

**f= 0.00099 m/min or 1.64696E-05 m/sec**



# Soakaway Design f -value from field tests

(F2C) IGSL

| | | | |
|---|---|---|---|
| Contract: | Haggardstown | Contract No | 24490 |
| Test No. | BRE12 | Easting | 306661.15 |
| Client | DOBA | Northing | 304376.93 |
| Date: | 13/03/2023 | Elevation | 15.92 |



Summary of ground conditions

| from | to | Description | Ground water |
|---|---|---|---|
| 0.00 | 0.30 | TOPSOIL: Soft to firm brown slightly sandy silty CLAY with rootlets | |
| 0.30 | 0.90 | Firm orangish brown sandy gravelly CLAY with a medium cobble content | Dry |
| 0.90 | 1.80 | Firm gravelly sandy silty CLAY with a medium cobble content | |
| 1.80 | 2.30 | Firm very gravelly sandy silty CLAY with a medium to high cobble content | |
| 2.20 | 2.30 | Weathered rock recovered as a light brown silty clayey GRAVEL | |

Notes:

Samples: AA194329 = 0.50m AA194330 = 1.50m AA194331 = 2.0m

Field Data

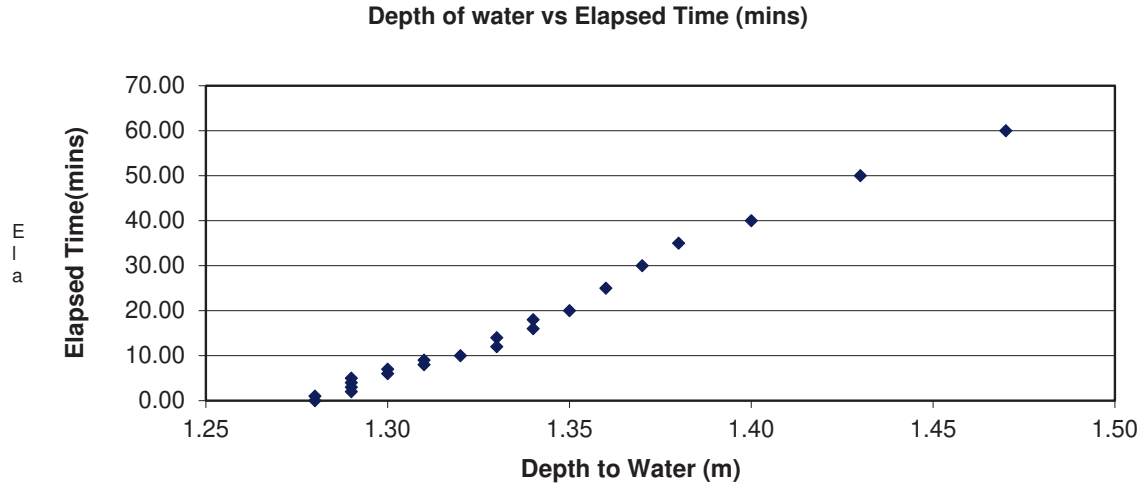
| Depth to Water (m) | Elapsed Time (min) |
|---|---|
| 1.28 | 0.00 |
| 1.28 | 1.00 |
| 1.29 | 2.00 |
| 1.29 | 3.00 |
| 1.29 | 4.00 |
| 1.29 | 5.00 |
| 1.30 | 6.00 |
| 1.30 | 7.00 |
| 1.31 | 8.00 |
| 1.31 | 9.00 |
| 1.32 | 10.00 |
| 1.33 | 12.00 |
| 1.33 | 14.00 |
| 1.34 | 16.00 |
| 1.34 | 18.00 |
| 1.35 | 20.00 |
| 1.36 | 25.00 |
| 1.37 | 30.00 |
| 1.38 | 35.00 |
| 1.40 | 40.00 |
| 1.43 | 50.00 |
| 1.47 | 60.00 |

Field Test

| | | |
|---|---|---|
| Depth of Pit (D) | 2.30 | m |
| Width of Pit (B) | 0.50 | m |
| Length of Pit (L) | 1.20 | m |
| Initial depth to Water = | 1.28 | m |
| Final depth to water = | 1.47 | m |
| Elapsed time (mins)= | 60.00 | |
| Top of permeable soil | | m |
| Base of permeable soil | | m |
| Base area= | 0.6 | m2 |
| *Av. side area of permeable stratum over test period= | 3.145 | m2 |
| Total Exposed area = | 3.745 | m2 |

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

**f= 0.00051 m/min or 8.45572E-06 m/sec**



# TRIAL PIT RECORD

**REPORT NUMBER** 24490

| | | | |
|---|---|---|---|
| **CONTRACT** | Haggardstown | **TRIAL PIT NO.** | **BRE01** |
| | | **SHEET** | Sheet 1 of 1 |
| **LOGGED BY** | MB | **CO-ORDINATES** | 307,052.96 E<br>304,338.14 N |
| | | **DATE STARTED** | 15/03/2023 |
| | | **DATE COMPLETED** | 15/03/2023 |
| **CLIENT** | Glenveagh Homes | **GROUND LEVEL (m)** | 9.00 |
| **ENGINEER** | DOBA | **EXCAVATION METHOD** | Hyundai 7T |



| Geotechnical Description | Legend | Depth (m) | Elevation | Water Strike | Samples: Sample Ref | Samples: Type | Samples: Depth | Vane Test (KPa) | Hand Penetrometer (KPa) |
|---|---|---|---|---|---|---|---|---|---|
| 0.0 TOPSOIL: Soft to firm brown sandy silty CLAY with frequent rootlets. Sand is fine to medium. | | | | | | | | | |
| Firm brownish yellow sandy clayey SILT. Sand is fine to medium. | | 0.40 | 8.60 | | AA194346 | B | 0.70 | | |
| 1.0 | | | | | | | | | |
| Firm brown very sandy silty gravelly CLAY with a medium cobble content. Sand is fine to medium. Gravel and cobbles are angular to subangular tabular and platy fine to coarse of greywacke sandstone. | | 1.50 | 7.50 | | AA194347 | B | 1.70 | | |
| 2.0 | | | | | | | | | |
| End of Trial Pit at 2.50m | | 2.50 | 6.50 | | | | | | |

**Groundwater Conditions**
Dry

**Stability**
Good

**General Remarks**
CAT scan used ahead of breaking ground. Soakaway test carried out to BRE365. Pit backfilled with arisings.

# TRIAL PIT RECORD

**REPORT NUMBER** 24490

| | | | |
|---|---|---|---|
| **CONTRACT** | Haggardstown | **TRIAL PIT NO.** | **BRE02** |
| | | **SHEET** | Sheet 1 of 1 |
| **LOGGED BY** | MB | **CO-ORDINATES** | 307,005.90 E<br>304,399.11 N |
| | | **DATE STARTED** | 15/03/2023 |
| | | **DATE COMPLETED** | 15/03/2023 |
| **CLIENT** | Glenveagh Homes | **GROUND LEVEL (m)** | 8.36 |
| **ENGINEER** | DOBA | **EXCAVATION METHOD** | Hyundai 7T |



| Geotechnical Description | Legend | Depth (m) | Elevation | Water Strike | Samples: Sample Ref | Samples: Type | Samples: Depth | Vane Test (KPa) | Hand Penetrometer (KPa) |
|---|---|---|---|---|---|---|---|---|---|
| 0.0 TOPSOIL: Soft to firm brown sandy silty CLAY with frequent rootlets. Sand is fine to medium. | | | | | | | | | |
| Firm brown slightly gravelly sandy silty CLAY with a medium cobble content. Sand is fine to medium. Gravel and cobbles are angular to subangular tabular and platy fine to coarse of greywacke sandstone. | | 0.30 | 8.06 | | AA194344 | B | 0.70 | | |
| 1.0 Firm very gravelly sandy silty CLAY with a medium to high cobble content. Sand is fine to coarse. Gravel is fine to coarse subangular to angular. Cobbles are subangluar to subrounded. Gravel and cobbles are tabular and platy fine to coarse of greywacke sandstone. | | 1.10 | 7.26 | | AA194345 | B | 1.70 | | |
| 2.0 End of Trial Pit at 2.45m | | 2.45 | 5.91 | | | | | | |

**Groundwater Conditions**
Dry

**Stability**
Good

**General Remarks**
CAT scan used ahead of breaking ground. Soakaway test carried out to BRE365. Pit backfilled with arisings.

# TRIAL PIT RECORD

**REPORT NUMBER** 24490

| | | | |
|---|---|---|---|
| **CONTRACT** | Haggardstown | **TRIAL PIT NO.** | **BRE03** |
| | | **SHEET** | Sheet 1 of 1 |
| **LOGGED BY** | MB | **CO-ORDINATES** | 306,997.08 E<br>304,544.94 N |
| | | **DATE STARTED** | 14/03/2023 |
| | | **DATE COMPLETED** | 14/03/2023 |
| **CLIENT** | Glenveagh Homes | **GROUND LEVEL (m)** | 6.84 |
| | | **EXCAVATION METHOD** | Hyundai 7T |
| **ENGINEER** | DOBA | | |



| Geotechnical Description | Legend | Depth (m) | Elevation | Water Strike | Samples: Sample Ref | Samples: Type | Samples: Depth | Vane Test (KPa) | Hand Penetrometer (KPa) |
|---|---|---|---|---|---|---|---|---|---|
| 0.0 TOPSOIL: Soft to firm dark brown sandy gravelly CLAY with frequent rootlets. Sand is fine to medium. | | | | | | | | | |
| | | 0.40 | 6.44 | | | | | | |
| Firm brown very sandy gravelly CLAY. Sand is fine to medium. Gravel is angular to subangular tabular and platy fine to coarse of greywacke sandstone. | | | | | AA194342 | B | 0.70 | | |
| 1.0 Firm very gravelly very sandy CLAY with a medium to high cobble content. Sand is fine to coarse. Gravel is fine to coarse subangular to angular. Cobbles are subangluar to subrounded. Gravel and cobbles are tabular and platy fine to coarse of greywacke sandstone. | | 1.00 | 5.84 | | | | | | |
| | | | | | AA194343 | B | 1.70 | | |
| 2.0 | | | | | | | | | |
| | | 2.10 | 4.74 | | | | | | |
| Possible Weathered Rock recovered as light brown silty clayey GRAVEL with a high cobble content. Gravel and cobbles are angular to subangular tabular and platy fine to coarse of greywacke sandstone. | | | | | | | | | |
| | | 2.30 | 4.54 | | | | | | |
| Obstruction<br>End of Trial Pit at 2.30m | | | | | | | | | |

**Groundwater Conditions**
Dry

**Stability**
Good

**General Remarks**
CAT scan used ahead of breaking ground. Soakaway test carried out to BRE365. Pit backfilled with arisings.

# TRIAL PIT RECORD

**REPORT NUMBER** 24490

| | | | |
|---|---|---|---|
| **CONTRACT** | Haggardstown | **TRIAL PIT NO.** | **BRE04** |
| | | **SHEET** | Sheet 1 of 1 |
| **LOGGED BY** | MB | **CO-ORDINATES** | 306,943.98 E<br>304,220.17 N |
| | | **DATE STARTED** | 15/03/2023 |
| | | **DATE COMPLETED** | 15/03/2023 |
| **CLIENT** | Glenveagh Homes | **GROUND LEVEL (m)** | 13.22 |
| | | **EXCAVATION METHOD** | Hyundai 7T |
| **ENGINEER** | DOBA | | |



| Geotechnical Description | Legend | Depth (m) | Elevation | Water Strike | Samples: Sample Ref | Samples: Type | Samples: Depth | Vane Test (KPa) | Hand Penetrometer (KPa) |
|---|---|---|---|---|---|---|---|---|---|
| 0.0 TOPSOIL: Soft to firm brown sandy gravelly CLAY with frequent rootlets. Sand is fine to medium. | | 0.40 | 12.82 | | | | | | |
| Firm brown sandy gravelly CLAY with a medium cobble content. Sand is fine to medium. Gravel and cobbles are angular to subangular tabular and platy fine to coarse of greywacke sandstone. | | | | | AA194350 | B | 0.70 | | |
| 1.0 Firm very gravelly sandy silty CLAY with a medium to high cobble content. Sand is fine to coarse. Gravel is fine to coarse subangular to angular. Cobbles are subangluar to subrounded. Gravel and cobbles are tabular and platy fine to coarse of greywacke sandstone. | | 1.20 | 12.02 | | | | | | |
| | | | | | AA199300 | B | 1.70 | | |
| 2.0 End of Trial Pit at 2.50m | | 2.50 | 10.72 | | | | | | |

**Groundwater Conditions**
Dry

**Stability**
Good

**General Remarks**
CAT scan used ahead of breaking ground. Soakaway test carried out to BRE365. Pit backfilled with arisings.

# TRIAL PIT RECORD

**REPORT NUMBER** 24490

| | | | |
|---|---|---|---|
| **CONTRACT** | Haggardstown | **TRIAL PIT NO.** | **BRE05** |
| | | **SHEET** | Sheet 1 of 1 |
| **LOGGED BY** | MB | **CO-ORDINATES** | 306,928.11 E<br>304,273.01 N |
| | | **DATE STARTED** | 15/03/2023 |
| | | **DATE COMPLETED** | 15/03/2023 |
| **CLIENT** | Glenveagh Homes | **GROUND LEVEL (m)** | 14.12 |
| **ENGINEER** | DOBA | **EXCAVATION METHOD** | Hyundai 7T |



| Geotechnical Description | Legend | Depth (m) | Elevation | Water Strike | Samples: Sample Ref | Samples: Type | Samples: Depth | Vane Test (KPa) | Hand Penetrometer (KPa) |
|---|---|---|---|---|---|---|---|---|---|
| 0.0 TOPSOIL: Soft to firm brown sandy gravelly CLAY with frequent rootlets. Sand is fine to medium. | | | | | | | | | |
| Firm brown sandy gravelly CLAY with a medium cobble content. Sand is fine to medium. Gravel and cobbles are angular to subangular tabular and platy fine to coarse of greywacke sandstone. | | 0.30 | 13.82 | | AA194348 | B | 0.70 | | |
| 1.0 Firm very gravelly sandy silty CLAY with a medium to high cobble content. Sand is fine to coarse. Gravel is fine to coarse subangular to angular. Cobbles are subangluar to subrounded. Gravel and cobbles are tabular and platy fine to coarse of greywacke sandstone. | | 1.10 | 13.02 | | AA194349 | B | 1.70 | | |
| 2.0 End of Trial Pit at 2.50m | | 2.50 | 11.62 | | | | | | |

**Groundwater Conditions**
Dry

**Stability**
Good

**General Remarks**
CAT scan used ahead of breaking ground. Soakaway test carried out to BRE365. Pit backfilled with arisings.

# TRIAL PIT RECORD

**REPORT NUMBER** 24490

| | | | |
|---|---|---|---|
| **CONTRACT** | Haggardstown | **TRIAL PIT NO.** | **BRE06** |
| | | **SHEET** | Sheet 1 of 1 |
| **LOGGED BY** | MB | **CO-ORDINATES** | 306,914.89 E<br>304,354.99 N |
| | | **DATE STARTED** | 14/03/2023 |
| | | **DATE COMPLETED** | 14/03/2023 |
| **CLIENT** | Glenveagh Homes | **GROUND LEVEL (m)** | 10.10 |
| | | **EXCAVATION METHOD** | Hyundai 7T |
| **ENGINEER** | DOBA | | |



| Geotechnical Description | Legend | Depth (m) | Elevation | Water Strike | Samples: Sample Ref | Samples: Type | Samples: Depth | Vane Test (KPa) | Hand Penetrometer (KPa) |
|---|---|---|---|---|---|---|---|---|---|
| 0.0 TOPSOIL: Soft to firm brown sandy gravelly CLAY with frequent rootlets. Sand is fine to medium. | | 0.30 | 9.80 | | | | | | |
| Firm brown sandy gravelly CLAY with a medium cobble content. Sand is fine to medium. Gravel and cobbles are angular to subangular tabular and platy fine to coarse of greywacke sandstone. | | | | | AA194338 | B | 0.70 | | |
| 1.0 Firm very gravelly sandy silty CLAY with a medium to high cobble content. Sand is fine to coarse. Gravel is fine to coarse subangular to angular. Cobbles are subangluar to subrounded. Gravel and cobbles are tabular and platy fine to coarse of greywacke sandstone. | | 1.10 | 9.00 | | | | | | |
| | | | | | AA194339 | B | 1.70 | | |
| 2.0 End of Trial Pit at 2.50m | | 2.50 | 7.60 | | | | | | |

**Groundwater Conditions**
Dry

**Stability**
Good

**General Remarks**
CAT scan used ahead of breaking ground. Soakaway test carried out to BRE365. Pit backfilled with arisings.

# TRIAL PIT RECORD

**REPORT NUMBER** 24490

| | | | |
|---|---|---|---|
| **CONTRACT** | Haggardstown | **TRIAL PIT NO.** | **BRE07** |
| | | **SHEET** | Sheet 1 of 1 |
| **LOGGED BY** | MB | **CO-ORDINATES** | 306,849.05 E<br>304,397.87 N |
| | | **DATE STARTED** | 14/03/2023 |
| | | **DATE COMPLETED** | 14/03/2023 |
| **CLIENT** | Glenveagh Homes | **GROUND LEVEL (m)** | 10.77 |
| **ENGINEER** | DOBA | **EXCAVATION METHOD** | Hyundai 7T |



| Geotechnical Description | Legend | Depth (m) | Elevation | Water Strike | Samples: Sample Ref | Samples: Type | Samples: Depth | Vane Test (KPa) | Hand Penetrometer (KPa) |
|---|---|---|---|---|---|---|---|---|---|
| 0.0 TOPSOIL: Soft to firm brown sandy gravelly CLAY with frequent rootlets. Sand is fine to medium. | | | | | | | | | |
| Firm brown sandy gravelly CLAY with a medium cobble content. Sand is fine to medium. Gravel and cobbles are angular to subangular tabular and platy fine to coarse of greywacke sandstone. | | 0.20 | 10.57 | | AA194340 | B | 0.70 | | |
| 1.0 Firm very gravelly sandy silty CLAY with a medium to high cobble content. Sand is fine to coarse. Gravel is fine to coarse subangular to angular. Cobbles are subangluar to subrounded. Gravel and cobbles are tabular and platy fine to coarse of greywacke sandstone. | | 1.10 | 9.67 | | | | | | |
| Possible Weathered Rock recovered as light brown silty clayey GRAVEL with a high cobble content. Gravel and cobbles are angular to subangular tabular and platy fine to coarse of greywacke sandstone. | | 1.40 | 9.37 | | AA194341 | B | 1.50 | | |
| Obstruction<br>End of Trial Pit at 1.60m | | 1.60 | 9.17 | | | | | | |
| 2.0 | | | | | | | | | |

**Groundwater Conditions**
Dry

**Stability**
Good

**General Remarks**
CAT scan used ahead of breaking ground. Soakaway test carried out to BRE365. Pit backfilled with arisings.

# TRIAL PIT RECORD

**REPORT NUMBER** 24490

| | | | |
|---|---|---|---|
| **CONTRACT** | Haggardstown | **TRIAL PIT NO.** | **BRE08** |
| | | **SHEET** | Sheet 1 of 1 |
| **LOGGED BY** | MB | **CO-ORDINATES** | 306,824.02 E<br>304,271.04 N |
| | | **DATE STARTED** | 14/03/2023 |
| | | **DATE COMPLETED** | 14/03/2023 |
| **CLIENT** | Glenveagh Homes | **GROUND LEVEL (m)** | 15.37 |
| **ENGINEER** | DOBA | **EXCAVATION METHOD** | Hyundai 7T |



| Geotechnical Description | Legend | Depth (m) | Elevation | Water Strike | Samples: Sample Ref | Samples: Type | Samples: Depth | Vane Test (KPa) | Hand Penetrometer (KPa) |
|---|---|---|---|---|---|---|---|---|---|
| 0.0 TOPSOIL: Soft to firm brown sandy gravelly CLAY with frequent rootlets. Sand is fine to medium. | | | | | | | | | |
| Firm brown sandy gravelly CLAY with a medium cobble content. Sand is fine to medium. Gravel and cobbles are angular to subangular tabular and platy fine to coarse of greywacke sandstone. | | 0.30 | 15.07 | | AA194336 | B | 0.70 | | |
| 1.0 Firm very gravelly sandy silty CLAY with a medium to high cobble content. Sand is fine to coarse. Gravel is fine to coarse subangular to angular. Cobbles are subangluar to subrounded. Gravel and cobbles are tabular and platy fine to coarse of greywacke sandstone. | | 1.00 | 14.37 | | AA194337 | B | 1.70 | | |
| 2.0 End of Trial Pit at 2.40m | | 2.40 | 12.97 | | | | | | |

**Groundwater Conditions**
Dry

**Stability**
Good

**General Remarks**
CAT scan used ahead of breaking ground. Soakaway test carried out to BRE365. Pit backfilled with arisings.

# TRIAL PIT RECORD

**REPORT NUMBER** 24490

| | | | |
|---|---|---|---|
| **CONTRACT** | Haggardstown | **TRIAL PIT NO.** | **BRE09** |
| | | **SHEET** | Sheet 1 of 1 |
| **LOGGED BY** | MB | **CO-ORDINATES** | 306,812.97 E<br>304,333.02 N |
| | | **DATE STARTED** | 14/03/2023 |
| | | **DATE COMPLETED** | 14/03/2023 |
| **CLIENT** | Glenveagh Homes | **GROUND LEVEL (m)** | 14.24 |
| **ENGINEER** | DOBA | **EXCAVATION METHOD** | Hyundai 7T |



| Geotechnical Description | Legend | Depth (m) | Elevation | Water Strike | Samples: Sample Ref | Samples: Type | Samples: Depth | Vane Test (KPa) | Hand Penetrometer (KPa) |
|---|---|---|---|---|---|---|---|---|---|
| 0.0 TOPSOIL: Soft to firm brown sandy gravelly CLAY with frequent rootlets. Sand is fine to medium. | | | | | | | | | |
| Firm brown sandy gravelly CLAY with a medium cobble content. Sand is fine to medium. Gravel and cobbles are angular to subangular tabular and platy fine to coarse of greywacke sandstone. | | 0.30 | 13.94 | | AA194334 | B | 0.70 | | |
| 1.0 Firm very gravelly sandy silty CLAY with a medium to high cobble content. Sand is fine to coarse. Gravel is fine to coarse subangular to angular. Cobbles are subangluar to subrounded. Gravel and cobbles are tabular and platy fine to coarse of greywacke sandstone. | | 1.00 | 13.24 | | AA194335 | B | 1.70 | | |
| 2.0 End of Trial Pit at 2.50m | | 2.50 | 11.74 | | | | | | |

**Groundwater Conditions**
Dry

**Stability**
Good

**General Remarks**
CAT scan used ahead of breaking ground. Soakaway test carried out to BRE365. Pit backfilled with arisings.

# TRIAL PIT RECORD

**REPORT NUMBER** 24490

| | | | |
|---|---|---|---|
| **CONTRACT** | Haggardstown | **TRIAL PIT NO.** | **BRE10** |
| | | **SHEET** | Sheet 1 of 1 |
| **LOGGED BY** | MB | **CO-ORDINATES** | 306,741.02 E<br>304,331.93 N |
| | | **DATE STARTED** | 13/03/2023 |
| | | **DATE COMPLETED** | 13/03/2023 |
| **CLIENT** | Glenveagh Homes | **GROUND LEVEL (m)** | 16.95 |
| **ENGINEER** | DOBA | **EXCAVATION METHOD** | Hyundai 7T |



| Geotechnical Description | Legend | Depth (m) | Elevation | Water Strike | Samples: Sample Ref | Samples: Type | Samples: Depth | Vane Test (KPa) | Hand Penetrometer (KPa) |
|---|---|---|---|---|---|---|---|---|---|
| 0.0 TOPSOIL: Soft to firm brown sandy gravelly CLAY with frequent rootlets. Sand is fine to medium. | | | | | | | | | |
| Firm brown sandy gravelly CLAY with a medium cobble content. Sand is fine to medium. Gravel and cobbles are angular to subangular tabular and platy fine to coarse of greywacke sandstone. | | 0.30 | 16.65 | | AA194332 | B | 0.50 | | |
| Firm very gravelly sandy silty CLAY with a medium to high cobble content. Sand is fine to coarse. Gravel is fine to coarse subangular to angular. Cobbles are subangluar to subrounded. Gravel and cobbles are tabular and platy fine to coarse of greywacke sandstone. | | 0.80 | 16.15 | | | | | | |
| 1.0 | | | | | AA194333 | B | 1.50 | | |
| Possible Rockhead recovered as angular GRAVEL-, COBBLE- and occasionally BOULDER-sized fragments (up to 400mm) of medium strong grey green rarely purple fine grained thinly laminated to thinly bedded (<6mm to 150mm) GREYWACKE SILTSTONE/SANDSTONE. | | 1.60 | 15.35 | | | | | | |
| 2.0 | | | | | | | | | |
| End of Trial Pit at 2.10m | | 2.10 | 14.85 | | | | | | |

**Groundwater Conditions**
Dry

**Stability**
Good

**General Remarks**
CAT scan used ahead of breaking ground. Bucket excavation used to 1.60m (undulating rockhead profile). 1T hydraulic breaker deployed to extend pit to 2.10m. Soakaway test carried out to BRE365. Pit backfilled with arisings.

# TRIAL PIT RECORD

**REPORT NUMBER** 24490

| | | | |
|---|---|---|---|
| **CONTRACT** | Haggardstown | **TRIAL PIT NO.** | **BRE11** |
| | | **SHEET** | Sheet 1 of 1 |
| **LOGGED BY** | MB | **CO-ORDINATES** | 306,794.08 E<br>304,131.09 N |
| | | **DATE STARTED** | 15/03/2023 |
| | | **DATE COMPLETED** | 15/03/2023 |
| **CLIENT** | Glenveagh Homes | **GROUND LEVEL (m)** | 20.81 |
| | | **EXCAVATION METHOD** | Hyundai 7T |
| **ENGINEER** | DOBA | | |



| Geotechnical Description | Legend | Depth (m) | Elevation | Water Strike | Samples: Sample Ref | Samples: Type | Samples: Depth | Vane Test (KPa) | Hand Penetrometer (KPa) |
|---|---|---|---|---|---|---|---|---|---|
| 0.0 TOPSOIL: Soft to firm dark brown sandy gravelly CLAY with frequent rootlets. Sand is fine to medium. | | | | | | | | | |
| Firm brown very sandy gravelly CLAY. Sand is fine to medium. Gravel is angular to subangular tabular and platy fine to coarse of greywacke sandstone. | | 0.30 | 20.51 | | AA199301 | B | 0.70 | | |
| 1.0 Firm very gravelly very sandy CLAY with a medium to high cobble content. Sand is fine to coarse. Gravel is fine to coarse subangular to angular. Cobbles are subangluar to subrounded. Gravel and cobbles are tabular and platy fine to coarse of greywacke sandstone. | | 0.90 | 19.91 | | | | | | |
| Possible Weathered Rock recovered as a light brown silty clayey GRAVEL with a high cobble content. Gravel and cobbles are angular to subangular tabular and platy fine to coarse of greywacke sandstone. | | 1.70 | 19.11 | | AA199302 | B | 1.70 | | |
| 2.0 End of Trial Pit at 2.00m | | 2.00 | 18.81 | | | | | | |

**Groundwater Conditions**
Dry

**Stability**
Slightly unstable

**General Remarks**
CAT scan used ahead of breaking ground. Soakaway test carried out to BRE365. Pit backfilled with arisings.

# TRIAL PIT RECORD

**REPORT NUMBER** 24490

| | | | |
|---|---|---|---|
| **CONTRACT** | Haggardstown | **TRIAL PIT NO.** | **BRE12** |
| | | **SHEET** | Sheet 1 of 1 |
| **LOGGED BY** | MB | **CO-ORDINATES** | 306,661.15 E<br>304,376.93 N |
| | | **DATE STARTED** | 13/03/2023 |
| | | **DATE COMPLETED** | 13/03/2023 |
| **CLIENT** | Glenveagh Homes | **GROUND LEVEL (m)** | 15.92 |
| **ENGINEER** | DOBA | **EXCAVATION METHOD** | Hyundai 7T |



| Geotechnical Description | Legend | Depth (m) | Elevation | Water Strike | Samples: Sample Ref | Samples: Type | Samples: Depth | Vane Test (KPa) | Hand Penetrometer (KPa) |
|---|---|---|---|---|---|---|---|---|---|
| 0.0 TOPSOIL: Soft to firm brown slightly sandy silty CLAY with frequent rootlets. Sand is fine to medium. | | | | | | | | | |
| | | 0.30 | 15.62 | | | | | | |
| Firm orangish brown sandy gravelly CLAY with a medium cobble content. Sand is fine to medium. Gravel and cobbles are angular to subangular tabular and platy fine to coarse of greywacke sandstone. | | | | | AA194329 | B | 0.50 | | |
| | | 0.90 | 15.02 | | | | | | |
| 1.0 Firm gravelly sandy silty CLAY with a medium cobble content. Sand is fine to coarse. Gravel is fine to coarse subangular to angular. Cobbles are subangluar to subrounded. Gravel and cobbles are tabular and platy fine to coarse of greywacke sandstone. | | | | | AA194330 | B | 1.50 | | |
| | | 1.80 | 14.12 | | | | | | |
| Firm very gravelly sandy silty CLAY with a medium to high cobble content. Sand is fine to coarse. Gravel is fine to coarse subangular to angular. Cobbles are subangluar to subrounded. | | | | | AA194331 | B | 2.00 | | |
| 2.0 | | | | | | | | | |
| | | 2.20 | 13.72 | | | | | | |
| Possible Weathered Rock recovered as a light brown silty clayey GRAVEL with a high cobble content. Gravel and cobbles are angular to subangular tabular and platy fine to coarse of greywacke sandstone. | | 2.30 | 13.62 | | | | | | |
| Obstruction<br>End of Trial Pit at 2.30m | | | | | | | | | |

**Groundwater Conditions**
Dry

**Stability**
Good

**General Remarks**
CAT scan used ahead of breaking ground. Soakaway test carried out to BRE365. Pit backfilled with arisings.

**BRE01 - 1 of 3**



**BRE01 - 2 of 3**

**BRE01 - 3 of 3**



**BRE02 - 1 of 3**

**BRE02 - 2 of 3**

**BRE02 - 3 of 3**



**BRE03 - 1 of 3**



**BRE03 - 2 of 3**

**BRE03 - 3 of 3**



**BRE04 - 1 of 3**



**BRE04 - 2 of 3**

**BRE04 - 3 of 3**



**BRE05 - 1 of 3**



**BRE05 - 2 of 3**

**BRE05 - 3 of 3**



**BRE06 - 1 of 3**



**BRE06 - 2 of 3**

**BRE06 - 3 of 3**



**BRE07 - 1 of 3**



**BRE07 - 2 of 3** Water from infiltration test

**BRE07 - 3 of 3** Water from infiltration test



**BRE08 - 1 of 3**



**BRE08 - 2 of 3**

**BRE08 - 3 of 3**



**BRE09 - 1 of 3**



**BRE09 - 2 of 3** Water from infiltration test

**BRE09 - 3 of 3**



**BRE10 - 1 of 3**



**BRE10 - 2 of 3**

**BRE10 - 3 of 3**



**BRE11 - 1 of 3**



**BRE11 - 2 of 3**

**BRE11 - 3 of 3**



**BRE12 - 1 of 3**



**BRE12 - 2 of 3**

**BRE12 - 3 of 3**



## Appendix 2

## Rock Excavation Pit Logs, Photographs & Rock Excavation Trial Report Sheets

# TRIAL PIT RECORD

**REPORT NUMBER** 24490

| | | | |
|---|---|---|---|
| **CONTRACT** | Haggardstown | **TRIAL PIT NO.** | **REXTP01** |
| | | **SHEET** | Sheet 1 of 1 |
| **LOGGED BY** | JL/MB | **CO-ORDINATES** | 306,656.79 E<br>304,266.21 N |
| | | **DATE STARTED** | 13/03/2023 |
| | | **DATE COMPLETED** | 13/03/2023 |
| **CLIENT** | Glenveagh Homes | **GROUND LEVEL (m)** | 19.99 |
| **ENGINEER** | DOBA | **EXCAVATION METHOD** | Hyundai 7T |



| Geotechnical Description | Legend | Depth (m) | Elevation | Water Strike | Samples: Sample Ref | Samples: Type | Samples: Depth | Vane Test (KPa) | Hand Penetrometer (KPa) |
|---|---|---|---|---|---|---|---|---|---|
| 0.0 TOPSOIL: Soft to firm brown slightly sandy silty CLAY with frequent rootlets. Sand is fine to medium. | | | | | | | | | |
| Rockhead recovered as angular GRAVEL, COBBLES and occasionally BOULDER-sized fragments (up to 400mm) of medium strong grey green rarely purple fine grained thinly laminated to thinly bedded (<6mm to 150mm) GREYWACKE SILTSTONE/SANDSTONE (Dip / Dip Direction = 80deg ->168)<br><br>Weathering: Occasional brown penetrative discolouration on surfaces. Where rock fragments are platy / where thin laminations exist, reduced to extremely weak to very weak.<br><br>Discontinuities: Very closely to closely, occasionally extremely closely spaced, smooth planar, tight to partly open, clean. Often stained brown. | | 0.40 | 19.59 | | | | | | |
| 1.0 | | | | | | LB | 0.95 | | |
| End of Trial Pit at 1.25m | | 1.25 | 18.74 | | | | | | |

**Groundwater Conditions**
Dry

**Stability**
Good

**General Remarks**
CAT scan used ahead of breaking ground. Bucket excavation used to 0.40m. 1T hydraulic breaker deployed to extend pit to 1.25m. 1T bulk sample taken of rock from 0.95m depth. Pit backfilled with arisings.

# TRIAL PIT RECORD

**REPORT NUMBER** 24490

| | | | |
|---|---|---|---|
| **CONTRACT** | Haggardstown | **TRIAL PIT NO.** | **REXTP02** |
| | | **SHEET** | Sheet 1 of 1 |
| **LOGGED BY** | JL/MB | **CO-ORDINATES** | 306,959.34 E<br>304,289.66 N |
| | | **DATE STARTED** | 13/03/2023 |
| | | **DATE COMPLETED** | 13/03/2023 |
| **CLIENT** | Glenveagh Homes | **GROUND LEVEL (m)** | 14.67 |
| **ENGINEER** | DOBA | **EXCAVATION METHOD** | Hyundai 7T |



| | Geotechnical Description | Legend | Depth (m) | Elevation | Water Strike | Samples: Sample Ref | Samples: Type | Samples: Depth | Vane Test (KPa) | Hand Penetrometer (KPa) |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | TOPSOIL: Soft grey brown slightly sandy SILT. Sand is fine. | | | | | | | | | |
| | Firm brown sandy gravelly CLAY with a medium cobble content. Sand is fine to medium. Gravel and cobbles are angular to subangular tabular and platy fine to coarse of greywacke sandstone. | | 0.20 | 14.47 | | | | | | |
| | Rockhead (undulating profile from 0.50m to 0.80m bgl) recovered as angular GRAVEL, COBBLES and BOULDER-sized fragments (up to 500mm) of medium strong grey green fine grained thickly laminated to thinly bedded (10mm to 150mm) GREYWACKE SILTSTONE/SANDSTONE (Dip / Dip Direction = 62deg ->108)<br>Weathering: Common brown penetrative discolouration on surfaces. Where rock fragments are platy / where thick laminations exist, reduced to very weak. | | 0.50 | 14.17 | | | | | | |
| 1.0 | Discontinuities: Very closely to closely, rarely extremely closely spaced, smooth planar, tight, clean. Often stained brown. Frequent blocky boulders in pit arising from breaking. | | | | | | LB | 1.00 | | |
| | End of Trial Pit at 1.40m | | 1.40 | 13.27 | | | | | | |

**Groundwater Conditions**
Dry

**Stability**
Good

**General Remarks**
CAT scan used ahead of breaking ground. Bucket excavation used to 0.50-0.80m (undulating rockhead profile). 1T hydraulic breaker deployed to extend pit to 1.40m. 1T bulk sample taken of rock from 1.0m depth. Pit backfilled with arisings.

**REXTP01 – 1 of 16** Rockhead at 0.40m



**REXTP01 – 2 of 16** First break

**REXTP01 – 3 of 16**

**REXTP01 – 4 of 16**

**REXTP01 – 5 of 16**



**REXTP01 – 6 of 16** Arisings from first break

**REXTP01 – 7 of 16**



**REXTP01 – 8 of 16** Second break before lift of arisings

**REXTP01 – 9 of 16**



**REXTP01 – 10 of 16** Arisings from second break

**REXTP01 – 11 of 16** Third break




**REXTP01 – 12 of 16**

**REXTP01 – 13 of 16** Arisings from third break



**REXTP01 – 14 of 16**

**REXTP01 – 15 of 16**



**REXTP01 – 16 of 16**

**REXTP02 – 1 of 6** Undulating rockhead from 0.50m to 0.80m



**REXTP02 – 2 of 6** Bucket excavation to 0.80m

**REXTP02 – 3 of 6** Results from initial break



**REXTP02 – 4 of 6**

**REXTP02 – 5 of 6**



**REXTP02 – 6 of 6**

| Project No: 24490 | Rock Excavation Trial Report Sheet | |
|---|---|---|

**Project:** Haggardstown
**Client:** Glenveagh Homes
**Engineer:** DOBA
**Location:** Haggardstown, Dundalk

**Trial No.:** Rock Excavation **REXTP01**
**Date commenced:** 13/03/2023
**Date completed:** 13/03/2023
**Logged by:** JL

| ING Coordinates | Easting | Northing | Elevation |
|---|---|---|---|
| | 306656.791 | 304266.205 | 19.989 |

**Equipment Details**

Breaker: 1T hydraulic breaker
Plant Used: Hyundai 7T
Bucket: 3' toothed bucket

**General Site Conditions**

Crest of hill in undulating grassed field (UPPER FIELD)

**Rock Excavation Log**

| Lift No. | From Depth (m) | To. Depth (m) | Bedrock Description | Duration Breaking/Digging (min) | Duration Lifting (min) | Length (m) | Width (m) |
|---|---|---|---|---|---|---|---|
| 1 | 0.40 | 0.65 | See below | 7 | 5 | 1.60 | 1.00 |
| 2 | 0.65 | 0.95 | See below | 10 | 2 | 1.60 | 1.00 |
| 3 | 0.95 | 1.25 | See below | 10 | 3 | 1.60 | 1.00 |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

**Hydraulic Breaking Production Details**

| Lift No. | Production (m^3) | Duration Digging (min) | Digging Production Rate (m^3/hr) | Comments |
|---|---|---|---|---|
| 1 | 0.4 | 7.00 | 3 | Greywacke - distinctly weathered to destructured (Hydraulic breaking) |
| 2 | 0.5 | 10.00 | 3 | Greywacke - distinctly weathered to destructured (Hydraulic breaking) |
| 3 | 0.5 | 10.00 | 3 | Greywacke - distinctly weathered to destructured (Hydraulic breaking) |

**Rock Mass Geology**

| Depth(m) | | |
|---|---|---|
| | | **Rock Mass Description (See also REXTP01 Log)** |
| 0.00 | 0.40 | TOPSOIL: Soft to firm brown slightly sandy silty CLAY with frequent rootlets. Sand is fine to medium. |
| 0.40 | 1.25 | **Rockhead** recovered as angular GRAVEL, COBBLES and occasionally BOULDER-sized fragments (up to 400mm) of medium strong grey green rarely purple fine grained thinly laminated to thinly bedded (<6mm to 150mm) GREYWACKE SILTSTONE/SANDSTONE |
| | | |
| | | |
| | | |

**Sample details:** Large bulk sample taken at a depth of 0.95m and placed in a 1T sack

**Groundwater:** Dry

**Stability:** No primary stability issues in shallow pit - vertical bedding faces exposed in opposing sidewalls

| Project No: 24490 | Rock Excavation Trial Report Sheet | |
|---|---|---|

**Project:** Haggardstown
**Client:** Glenveagh Homes
**Engineer:** DOBA
**Location:** Haggardstown, Dundalk

**Trial No.:** Rock Excavation **REXTP02**
**Date commenced:** 13/03/2023
**Date completed:** 13/03/2023
**Logged by:** JL

| | Easting | Northing | Elevation |
|---|---|---|---|
| **ING Coordinates** | 306959.344 | 304289.659 | 14.67 |

**Equipment Details**

Breaker: 1T hydraulic breaker
Plant Used: Hyundai 7T
Bucket: 3' toothed bucket

**General Site Conditions**

Crest of hill in undulating grassed field (LOWER Field)

**Rock Excavation Log**

| Lift No. | From Depth (m) | To. Depth (m) | Bedrock Description | Duration Breaking/Digging (min) | Duration Lifting (min) | Length (m) | Width (m) |
|---|---|---|---|---|---|---|---|
| 1 | 0.50 | 1.40 | See below | 7 | 5 | 3.00 | 1.50 |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

**Hydraulic Breaking Production Details**

| Lift No. | Production (m^3) | Duration Digging (min) | Digging Production Rate (m^3/hr) | Comments |
|---|---|---|---|---|
| 1 | 4.1 | 7.00 | 35 | Greywacke - distinctly weathered to destructured (combined Hydraulic breaking & Bucket Excavation - undulating rock profile) |
| | | | | |

**Rock Mass Geology**

| Depth(m) | | |
|---|---|---|
| | | **Rock Mass Description (See also REXTP02 Log)** |
| 0.00 | 0.20 | TOPSOIL: Soft grey brown slightly sandy SILT. Sand is fine. |
| 0.20 | 0.50 | Firm brown sandy gravelly CLAY with a medium cobble content. Sand is fine to medium. Gravel and cobbles are angular to subangular tabular and platy fine to coarse of greywacke sandstone. |
| 0.40 | 1.40 | **Rockhead** recovered as angular GRAVEL, COBBLES and BOULDER-sized fragments (up to 500mm) of medium strong grey green fine grained thickly laminated to thinly bedded (10mm to 150mm) GREYWACKE SILTSTONE/SANDSTONE |
| | | |
| | | |
| | | |

**Sample details:** Large bulk sample taken at a depth of 0.95m and placed in a 1T sack

**Groundwater:** Dry

**Stability:** No primary stability issues in shallow pit

## Appendix 3

## Rotary Core Drillhole Logs & Core Photographs

# GEOTECHNICAL CORE LOG RECORD

**REPORT NUMBER** 24490



| | | | |
|---|---|---|---|
| **CONTRACT** | Haggardstown | **DRILLHOLE NO** | **RC01** |
| | | **SHEET** | Sheet 1 of 1 |
| **CO-ORDINATES** | 306,673.50 E<br>304,260.56 N | **DATE DRILLED** | 21/03/2023 |
| **GROUND LEVEL (mOD)** | 20.71 | **DATE LOGGED** | 22/03/2023 |
| **CLIENT** | Glenveagh Homes | **DRILLED BY** | IGSL - JK |
| **ENGINEER** | DOBA | **LOGGED BY** | D.O'Shea |
| **RIG TYPE** | BT-44 | | |
| **FLUSH** | Air/Mist | | |
| **INCLINATION (deg)** | -90 | | |
| **CORE DIAMETER (mm)** | 78 | | |

| Downhole Depth (m) | Core Run Depth (m) | T.C.R.% | S.C.R.% | R.Q.D.% | Description | Depth (m) | Elevation |
|---|---|---|---|---|---|---|---|
| 0 | | | | | SYMMETRIX DRILLING: No recovery, observed by driller as returns of CLAY | 1.50 | 19.21 |
| | | | | | SYMMETRIX DRILLING: No recovery, observed by driller as returns of GRAVEL | 2.25 | 18.46 |
| | | | | | SYMMETRIX DRILLING: No recovery, observed by driller as returns of ROCK | 3.00 | 17.71 |
| 3 | 3.00 | 100 | 43 | 23 | Strong to moderately weak, medium to thinly bedded, greenish blue, fine-grained, interbedded SANDSTONE/SILTSTONE (Greywacke sandstone with siltstone layers), fresh to very locally slightly weathered.<br><br>Discontinuities are medium to closely spaced, smooth to locally rough, planar to locally curviplanar. Apertures are tight to locally moderately open, locally clay smeared, locally quartz-veined (1-10mm thick). Dips are 20-30° & locally 70-80°. | | |
| 4 | 4.50 | 100 | 41 | 33 | | | |
| 6 | 6.00 | 100 | 33 | 25 | | | |
| 7 | 7.00 | 100 | 18 | 11 | | | |
| 8 | 8.00 | | | | End of Borehole at 8.00 m | 8.00 | 12.71 |

Fracture Spacing Log (mm): 0 – 250 – 500

Non-intact Zone

Legend

Standpipe Details

SPT (N Value): N = 38 (7, 7, 10, 10, 9, 9)

**REMARKS**

Hole cased 0.00-3.00m.

**WATER STRIKE DETAILS**

| Water Strike | Casing Depth | Sealed At | Rise To | Time (min) | Comments |
|---|---|---|---|---|---|
| | | | | | No water strike recorded |

**INSTALLATION DETAILS**

| Date | Tip Depth | RZ Top | RZ Base | Type |
|---|---|---|---|---|
| 22-03-23 | 8.00 | 2.50 | 8.00 | 50mm SP |

**GROUNDWATER DETAILS**

| Date | Hole Depth | Casing Depth | Depth to Water | Comments |
|---|---|---|---|---|
| 22-03-23 | 8.00 | 3.00 | 3.45 | Water level recorded 5 mins after end of drilling. |

IGSL RC FI 10M 24490.GPJ IGSL.GDT 12/4/23

# GEOTECHNICAL CORE LOG RECORD

**REPORT NUMBER** 24490



| | | | |
|---|---|---|---|
| **CONTRACT** | Haggardstown | **DRILLHOLE NO** | **RC02** |
| | | **SHEET** | Sheet 1 of 1 |
| **CO-ORDINATES** | 306,773.82 E<br>304,132.76 N | **DATE DRILLED** | 20/03/2023 |
| **GROUND LEVEL (mOD)** | 22.45 | **DATE LOGGED** | 21/03/2023 |
| **CLIENT** | Glenveagh Homes | **DRILLED BY** | IGSL - JK |
| **ENGINEER** | DOBA | **LOGGED BY** | D.O'Shea |
| **RIG TYPE** | BT-44 | | |
| **FLUSH** | Air/Mist | | |
| **INCLINATION (deg)** | -90 | | |
| **CORE DIAMETER (mm)** | 78 | | |

| Downhole Depth (m) | Core Run Depth (m) | T.C.R.% | S.C.R.% | R.Q.D.% | Description | Depth (m) | Elevation | SPT (N Value) |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | SYMMETRIX DRILLING: No recovery, observed by driller as returns of CLAY | 1.50 | 20.95 | |
| 1 | | | | | SYMMETRIX DRILLING: No recovery, observed by driller as returns of gravelly CLAY | 2.20 | 20.25 | N = 29 (3, 7, 5, 8, 7, 9) |
| 2 | | | | | SYMMETRIX DRILLING: No recovery, observed by driller as returns of GRAVEL | 2.55 | 19.90 | |
| | 3.00 | | | | SYMMETRIX DRILLING: No recovery, observed by driller as returns of ROCK | 3.00 | 19.45 | |
| 3 | | 100 | 64 | 55 | Strong to moderately weak, thickly to thinly bedded, greenish blue, fine-grained, interbedded SANDSTONE/SILTSTONE (Greywacke sandstone with siltstone layers), fresh to very locally slightly weathered. | | | |
| 4 | 4.50 | 100 | 74 | 61 | Discontinuities are widely to closely spaced, smooth to locally rough, planar to locally curviplanar. Apertures are tight to locally moderately open, commonly clay smeared, locally quartz-veined (1-25mm thick). Dips are 10°, 40° & 70-80°. | | | |
| 5 | 5.60 | | | | | | | |
| 6 | | 100 | 67 | 44 | | | | |
| | 7.00 | | | | | | | |
| 7 | | 100 | 92 | 92 | | | | |
| | 8.00 | | | | | 8.00 | 14.45 | |
| 8 | | | | | End of Borehole at 8.00 m | | | |
| 9 | | | | | | | | |

Fracture Spacing Log (mm): 0 – 250 – 500

Non-intact Zone: 730

**REMARKS**

Hole cased 0.00-3.00m.

**WATER STRIKE DETAILS**

| Water Strike | Casing Depth | Sealed At | Rise To | Time (min) | Comments |
|---|---|---|---|---|---|
| | | | | | No water strike recorded |

**GROUNDWATER DETAILS**

| Date | Hole Depth | Casing Depth | Depth to Water | Comments |
|---|---|---|---|---|
| 21-03-23 | 8.00 | 3.00 | 4.20 | Water level recorded 5 mins after end of drilling. |

**INSTALLATION DETAILS**

| Date | Tip Depth | RZ Top | RZ Base | Type |
|---|---|---|---|---|
| 21-03-23 | 8.00 | 3.00 | 8.00 | 50mm SP |

# GEOTECHNICAL CORE LOG RECORD

**REPORT NUMBER** 24490



| | | | |
|---|---|---|---|
| **CONTRACT** | Haggardstown | **DRILLHOLE NO** | **RC03** |
| | | **SHEET** | Sheet 1 of 2 |
| **CO-ORDINATES** | 306,966.13 E<br>304,289.43 N | **DATE DRILLED** | 15/03/2023 |
| **GROUND LEVEL (mOD)** | 14.73 | **DATE LOGGED** | 16/03/2023 |
| **CLIENT** | Glenveagh Homes | **DRILLED BY** | IGSL - JK |
| **ENGINEER** | DOBA | **LOGGED BY** | D.O'Shea |
| **RIG TYPE** | BT-44 | | |
| **FLUSH** | Air/Mist | | |
| **INCLINATION (deg)** | -90 | | |
| **CORE DIAMETER (mm)** | 78 | | |

| Downhole Depth (m) | Core Run Depth (m) | T.C.R.% | S.C.R.% | R.Q.D.% | Description | Depth (m) | Elevation |
|---|---|---|---|---|---|---|---|
| 0 | | | | | SYMMETRIX DRILLING: No recovery, observed by driller as returns of gravelly CLAY | 0.70 | 14.03 |
| 1 | 1.50 | | | | SYMMETRIX DRILLING: No recovery, observed by driller as returns of ROCK | 1.50 | 13.23 |
| 2 | 2.35 | 100 | 42 | 0 | Strong to moderately weak, medium to thinly bedded, greenish blue, fine-grained, interbedded SANDSTONE/SILTSTONE (Greywacke sandstone with siltstone layers), fresh to very locally slightly weathered.<br><br>Discontinuities are medium to closely spaced, smooth to locally rough, planar to locally curviplanar. Apertures are tight to locally moderately open, locally clay smeared, locally quartz-veined (1-15mm thick). Dips are 70-80° & locally 20-30°. | | |
| 3 | 3.23 | 100 | 47 | 31 | | | |
| 4 | 4.30 | 100 | 33 | 0 | | | |
| 5 | 5.50 | 100 | 77 | 52 | | | |
| 6 | 6.50 | 100 | 68 | 26 | | | |
| 7 | 7.50 | 100 | 92 | 63 | | | |
| 8 | 8.50 | 100 | 42 | 23 | | | |
| 9 | 9.50 | 100 | 51 | 35 | | | |

Fracture Spacing Log (mm): 0 / 250 / 500

Non-intact Zone

Legend

Standpipe Details

SPT (N Value)

**REMARKS**

Hole cased 0.00-1.50m.

**WATER STRIKE DETAILS**

| Water Strike | Casing Depth | Sealed At | Rise To | Time (min) | Comments |
|---|---|---|---|---|---|
| | | | | | No water strike recorded |

**INSTALLATION DETAILS**

| Date | Tip Depth | RZ Top | RZ Base | Type |
|---|---|---|---|---|
| 16-03-23 | 10.50 | 1.00 | 10.50 | 50mm SP |

**GROUNDWATER DETAILS**

| Date | Hole Depth | Casing Depth | Depth to Water | Comments |
|---|---|---|---|---|
| 16-03-23 | 10.50 | 1.50 | 8.80 | Water level recorded 5 mins after end of drilling. |

IGSL RC FI 10M 24490.GPJ IGSL.GDT 12/4/23

# GEOTECHNICAL CORE LOG RECORD

**REPORT NUMBER** 24490

**CONTRACT** Haggardstown

**DRILLHOLE NO** RC03
**SHEET** Sheet 2 of 2

**CO-ORDINATES** 306,966.13 E
304,289.43 N
**GROUND LEVEL (mOD)** 14.73

**RIG TYPE** BT-44
**FLUSH** Air/Mist
**INCLINATION (deg)** -90
**CORE DIAMETER (mm)** 78

**DATE DRILLED** 15/03/2023
**DATE LOGGED** 16/03/2023

**CLIENT** Glenveagh Homes
**ENGINEER** DOBA

**DRILLED BY** IGSL - JK
**LOGGED BY** D.O'Shea



| Downhole Depth (m) | Core Run Depth (m) | T.C.R.% | S.C.R.% | R.Q.D.% | Fracture Spacing Log (mm) 0 250 500 | Non-intact Zone | Legend | Description | Depth (m) | Elevation | Standpipe Details | SPT (N Value) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 10.50 | 100 | 52 | 36 | | | | End of Borehole at 10.50 m | 10.50 | 4.23 | | |
| 11 | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | |
| 16 | | | | | | | | | | | | |
| 17 | | | | | | | | | | | | |
| 18 | | | | | | | | | | | | |
| 19 | | | | | | | | | | | | |

**REMARKS**

Hole cased 0.00-1.50m.

**WATER STRIKE DETAILS**

| Water Strike | Casing Depth | Sealed At | Rise To | Time (min) | Comments |
|---|---|---|---|---|---|
| | | | | | No water strike recorded |

**GROUNDWATER DETAILS**

| Date | Hole Depth | Casing Depth | Depth to Water | Comments |
|---|---|---|---|---|
| 16-03-23 | 10.50 | 1.50 | 8.80 | Water level recorded 5 mins after end of drilling. |

**INSTALLATION DETAILS**

| Date | Tip Depth | RZ Top | RZ Base | Type |
|---|---|---|---|---|
| 16-03-23 | 10.50 | 1.00 | 10.50 | 50mm SP |

# GEOTECHNICAL CORE LOG RECORD

**REPORT NUMBER** 24490

**CONTRACT** Haggardstown

**DRILLHOLE NO** RC04
**SHEET** Sheet 1 of 1

**CO-ORDINATES** 306,922.10 E
304,445.05 N
**GROUND LEVEL (mOD)** 11.58

**RIG TYPE** BT-44
**FLUSH** Air/Mist
**INCLINATION (deg)** -90
**CORE DIAMETER (mm)** 78

**DATE DRILLED** 14/03/2023
**DATE LOGGED** 15/03/2023

**CLIENT** Glenveagh Homes
**ENGINEER** DOBA

**DRILLED BY** IGSL - JK
**LOGGED BY** D.O'Shea



| Downhole Depth (m) | Core Run Depth (m) | T.C.R.% | S.C.R.% | R.Q.D.% | Description | Depth (m) | Elevation |
|---|---|---|---|---|---|---|---|
| 0 | | | | | SYMMETRIX DRILLING: No recovery, observed by driller as returns of gravelly CLAY | 0.80 | 10.78 |
| 1 | | | | | SYMMETRIX DRILLING: No recovery, observed by driller as returns of weathered ROCK | 1.20 | 10.38 |
| | 1.50 | | | | SYMMETRIX DRILLING: No recovery, observed by driller as returns of ROCK | 1.50 | 10.08 |
| 2 | | 100 | 74 | 55 | Strong to moderately weak, medium to thinly bedded, greenish blue, fine-grained, interbedded SANDSTONE/SILTSTONE (Greywacke sandstone with siltstone layers), fresh to very locally slightly weathered. | | |
| | 2.50 | | | | | | |
| 3 | | 100 | 38 | 20 | Discontinuities are medium to closely spaced, smooth to locally rough, planar to locally curviplanar. Apertures are tight to locally moderately open, locally clay smeared, commonly quartz-veined (1-15mm thick). Dips are 70-80° & locally 20-30°. | | |
| | 3.67 | | | | | | |
| 4 | | 100 | 76 | 50 | | | |
| | 4.90 | | | | | | |
| 5 | | 100 | 90 | 85 | | | |
| | 5.50 | | | | | | |
| 6 | | 100 | 82 | 71 | | | |
| | 6.50 | | | | | | |
| 7 | | 100 | 66 | 57 | | | |
| | 7.50 | | | | | 7.50 | 4.08 |
| 8 | | | | | End of Borehole at 7.50 m | | |
| 9 | | | | | | | |

Fracture Spacing Log (mm): 0 – 250 – 500

Non-intact Zone: 350.000000000001

Standpipe Details

SPT (N Value)

**REMARKS**

Hole cased 0.00-1.50m.

**WATER STRIKE DETAILS**

| Water Strike | Casing Depth | Sealed At | Rise To | Time (min) | Comments |
|---|---|---|---|---|---|
| | | | | | No water strike recorded |

**GROUNDWATER DETAILS**

| Date | Hole Depth | Casing Depth | Depth to Water | Comments |
|---|---|---|---|---|
| 15-03-23 | 7.50 | 1.50 | 3.10 | Water level recorded 5 mins after end of drilling. |

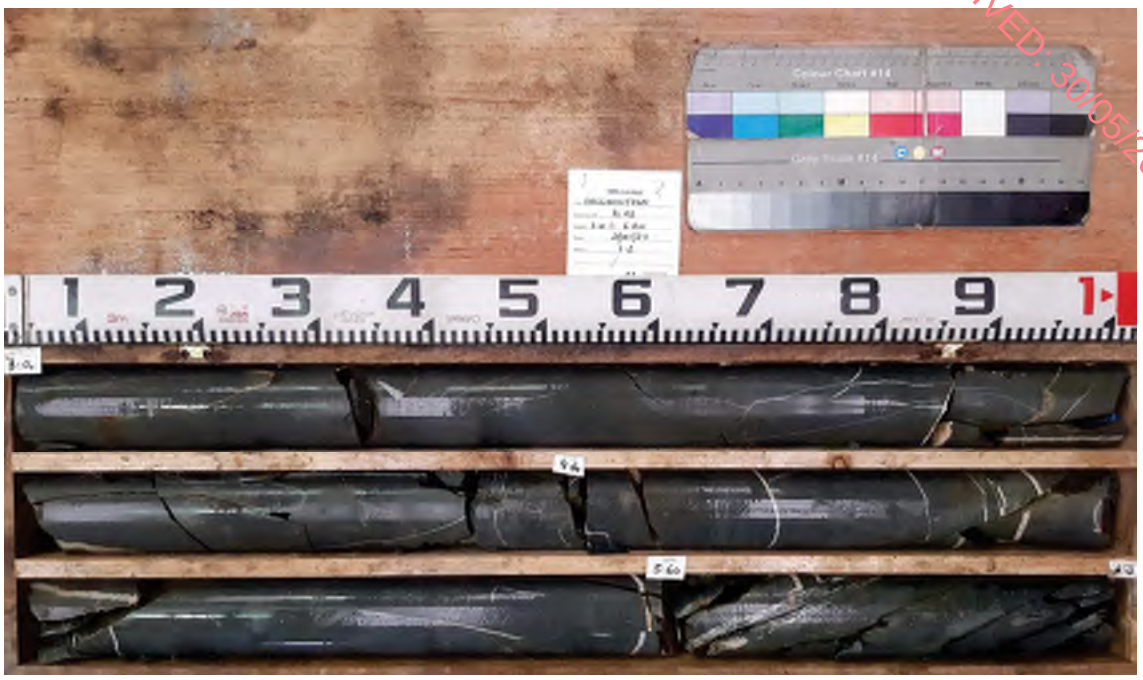
**INSTALLATION DETAILS**

| Date | Tip Depth | RZ Top | RZ Base | Type |
|---|---|---|---|---|
| | | | | |

**RC01 Box 1 of 2 – 3.00-6.00m**


**RC01 Box 2 of 2 – 6.00-8.00m**

**RC02 Box 1 of 2 – 3.00-6.00m**



**RC02 Box 2 of 2 – 6.00-8.00m**

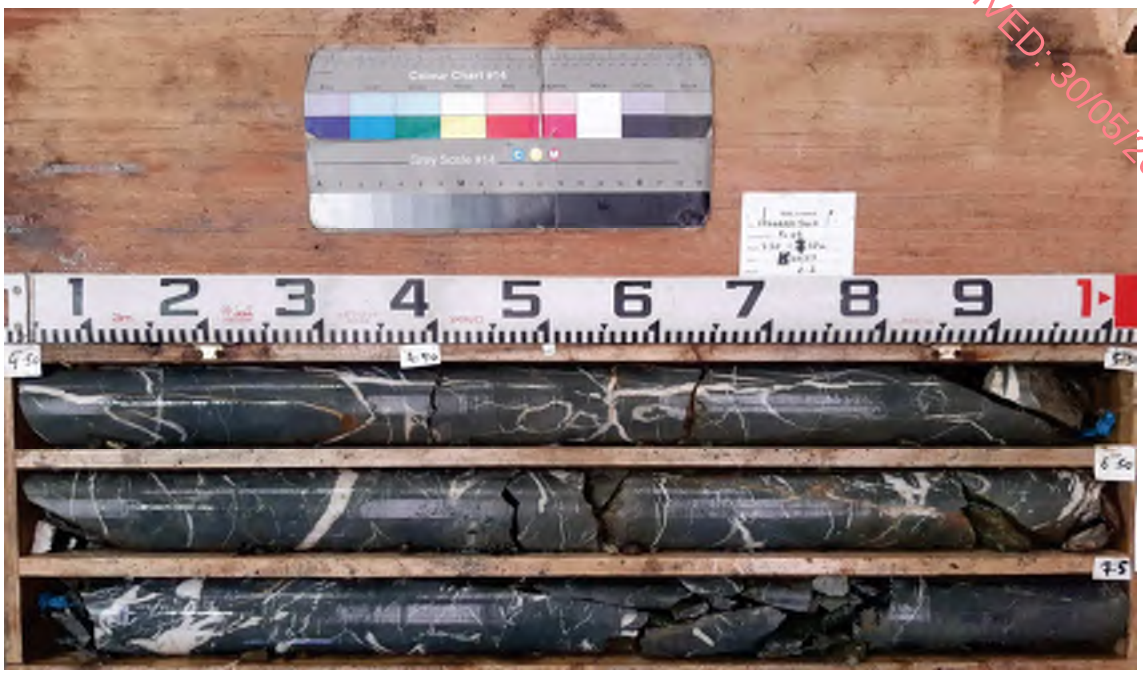
**RC03 Box 1 of 3 – 1.50-4.50m**

**RC03 Box 2 of 3 – 4.50-7.50m**

**RC03 Box 3 of 3 – 7.50-10.50m**

**RC04 Box 1 of 2 – 1.50-4.50m**

**RC04 Box 2 of 2 – 4.50-7.50m**



## Appendix 4

## Geophysical Survey Report

Haggardstown
Dundalk, Co, Louth

# Geophysical Survey

Report Status: Draft

*MGX Project Number: 6680*

*MGX File Ref: 6680d-005.doc*

13th February 2023

**Confidential Report To:**

**IGSL**
Unit F
M7 Business Park
Naas
Co. Kildare

**Report submitted by:**
**Minerex Geophysics Limited**

Unit F4, Maynooth Business Campus
Maynooth, Co. Kildare, W23X7Y5
Ireland
Tel.: 01-6510030
Email: info@mgx.ie

**Issued by:**

Author: John Connaughton (Geophysicist)

Reviewer: Hartmut Krahn (Senior Geophysicist)

Minerex Geophysics Limited

Subsurface Geophysical Investigations

# EXECUTIVE SUMMARY



1. Minerex Geophysics Ltd. (MGX) carried out a geophysical survey consisting of seismic refraction (p-wave) surveying for the ground investigation for the proposed development at Haggardstown, County Louth.
2. The main objective of the survey was to determine the depth to rock and the overburden thickness across the site.
3. The seismic refraction data was modelled using a three-layer model.
4. The top layer is described as soft or loose soil and has an average thickness of 1m across the site.
5. The second layer is interpreted as stiff or dense overburden or poor very weathered greywacke. This layer has a thickness of between 1 – 7m. This layer would be diggable to rippable.
6. The final layer is interpreted as good greywacke. The elevations and depth to the top of this layer are shown in Maps 2 and 3 respectively.
7. The contours maps were created from the seismic models though in the areas of rough vegetation with visible boulders and absence of tillage farming a depth of 1m to the top of rock was estimated.
8. The data for the top of rock elevation and depth is attached in an Excel worksheet (Table 3).
9. This report can be updated if any additional geotechnical data becomes available.

# CONTENTS

## List of Tables, Maps and Figures:

# 1. INTRODUCTION

## 1.1 Background

Minerex Geophysics Ltd. (MGX) carried out a geophysical survey for a housing development in Haggardstown, Dundalk. The survey consisted of seismic refraction (p-wave) measurements across the site. The survey was commissioned by IGSL.

The role of geophysics as a non-destructive fast method is to provide a geological interpretation over a wide area to complement direct ground investigations at specific locations. The direct ground investigation results can be used to improve the initial geophysical results and interpretation.

The survey was aimed to investigate the depth to the top of rock across the survey area.

## 1.2 Objectives

The main objectives of the geophysical survey were:

- To determine the ground conditions under the site
- To determine the depth to rock and the overburden thickness
- To estimate the strength or stiffness or compaction of overburden materials and the rock quality
- To detect lateral changes within the geological layers

## 1.3 Site Description

The site is located in the townland of Haggardstown, south of Dundalk. The site was accessed from Bother Maol which borders to the north of the site. The site is bounded by houses to the north and east, agricultural fields to the south and a golf course to the west. The site comprises of two large fields. Elevations range from 23mOD in the SW to 3mOD in the East with a general fall in elevations from the west to the east. There is a proposed access road to the east of the site.

## 1.4 Geology

A previous geotechnical report describes (GES, 2018) the ground investigation work done and the results of direct investigation and laboratory testing.

Ground conditions are summarised as follows:

The overburden is generally described as slightly sandy slightly gravelly silt clay with some localised silty sandy gravel. The rock encountered is described as highly destructed greywacke. Rock is encountered at depths between 0.3 m and 3.6m below ground level (bgl)

Online geological maps of Ireland (GSI, 2022) give the following information:

The overburden geology consists of till derived from lower Palaeozoic sandstones and shales.

In terms of rock the survey area is underlain by the Clontail Formation, described as calcareous red-mica greywacke.

There is shallow rock noted within the site on areas of raised ground where tillage cultivation did not take place, where boulders are visible and where the ground is overgrown.

There are no faults recorded near the site.

### 1.5 Report

This report includes the results and interpretation of the geophysical survey. Maps and tables are included to illustrate the results of the survey. More detailed descriptions of geophysical methods and measurements can be found in GSEG (2002), Milsom (1989) and Reynolds (1997).

The description of soil, rock and the use of geotechnical terms (soft, stiff, dense etc) follows Eurocode (2007) and BSI (2015) standards. The terms are defined in the standards and the physical parameters are related from experience. This geophysical survey has been acquired, processed, interpreted and reported in accordance with these guidelines.

The client provided maps of the site and the digital version was used as the background map in this report. Elevations were surveyed on site and are used in the vertical sections.

The interpretative nature and the non-invasive survey methods must be taken into account when considering the results of this survey and Minerex Geophysics Limited, while using appropriate practice to execute, interpret and present the data, give no guarantees in relation to the existing subsurface.

# 2. GEOPHYSICAL SURVEY

## 2.1 Methodology

The methodology consisted of using Seismic Refraction surveying across the site to allow for the development of quasi-3D images of the top of rock. The geophone spacing was 2m for good resolution.

The survey locations are indicated on Map 1. The lines and parameters are tabulated in Table 1 attached at the end of this report.

## 2.2 Seismic Refraction

Seismic refraction lines were surveyed with geophone spacing of 2m and 24 geophones per set-up resulting in a 46m length per set-up. The recording equipment consisted of a 24 Channel GEOMETRICS ES-3000 engineering seismograph with 4.5Hz vertical geophones. The seismic energy source consisted of a hammer and plate. A zero-delay trigger was used to start the recording. Normally 7 shot points per p-wave set-up were used.

Set-ups were acquired in longer continuous lines using common shot points between set-ups and concatenating into longer lines at the processing stage.

The seismic refraction survey method focuses on propagating p-waves travelling through the subsurface, which are generated by hitting a hammer on a plate. As the wave propagates through the subsurface, its velocity varies as it travels through overburden, rock with different elastic properties, and along geological boundaries. Velocity data is recorded via the surveying equipment, which is then processed, allowing geological layer thicknesses and boundaries to be established.

Seismic Refraction generally determines the depth to horizontal or near horizontal layers where the compaction or strength or rock quality changes with an accuracy of around 20% of the depth to that layer. Where the layers are shallower than the geophone spacing depth deviations of +- 1m to top of layers can occur.

The seismic refraction set-ups with 46m individual length have a reasonable penetration depth of around 10m. An internationally accepted maximum depth estimate for a seismic refraction set-up is 1/6 of the set-up length including offshots. The depth penetration varies according to the velocity structure of the subsurface.

## 2.3 Site Work

The data acquisition was carried out between the 16$^{th}$ and 30$^{th}$ of January 2023. The weather conditions were good throughout the acquisition period. Health and safety standards were adhered to at all times. The locations and elevations were surveyed with a Carlson NR3 RTK-GPS to accuracy < 0.05m.

# 3. RESULTS AND INTERPRETATION

The interpretation of geophysical data was executed utilizing the known response of geophysical measurements, typical physical parameters for subsurface features that may underlay the site, and the experience of the authors.

The interpretation is based on the seismic refraction data as well as information from the previous geotechnical investigation. The rock in the trial pits and boreholes was described as highly weathered destructed greywacke extracted as gravel. The top of the good rock would be at a depth below this.

## 3.1 Seismic Refraction

The seismic refraction data was positioned and processed with the SEISIMAGER software package to give a layered model of the subsurface. The number of layers has been determined by analysing the seismic traces and 3 layers were used in the models. All seismic lines were subject to a standardised processing sequence which consisted of a topographic correction which was based on integrated elevation data, first break picking, tomographic inversion, travel-time computation via ray-tracing and velocity modelling. Residual deviations of typically 0.4 to 1.8 msec RMS have been obtained for each line. Following each processing stage QC procedures were adhered to. The overburden layers are described below while Maps 2 and 3 show the elevation and depth of the good rock layer.

The p-wave seismic velocity is closely linked to the density of subsurface materials and to parameters like compaction, stiffness, strength and rock quality. The higher the density of the subsurface materials the higher the seismic velocity. More compacted, stiffer, denser and stronger material will have a higher seismic velocity. For rock, the seismic velocity is higher when the rock is stronger, less weathered and has a higher quality. If the rock is more weathered, broken, fractured, fissured or karstified then the seismic velocity will be reduced compared to that of intact fresh rock.

Because of the above relationship, the seismic refraction method and seismic velocities are suitable to investigate ground where the layers get denser, more compacted and stronger with depth. A disadvantage is that some materials may have the same seismic velocity: Stiff or dense overburden and a very weathered rock can have the same seismic velocity range (as is the case in the layer 2 below).

The modelled seismic data has created the following layered ground model:

Layer 1 has a thickness of 0.5 - 2m, an average thickness of 1m and seismic velocities of 150 - 200m/s. This overburden would be soil with a soft or loose stiffness or compaction. This layer would be diggable.

Layer 2 was modelled with a velocity range of 1600 - 1800m/s and has a thickness of between 1 and 7m. The velocity indicates overburden material with stiff or dense strength or compaction or a very poor very weathered rock. This layer would be diggable to rippable.

Good rock is indicated by seismic velocities of 4000m/s and the top of this strong rock varied between 1 and 8m bgl. This layer would require breaking or blasting for removal.

### 3.2 Interpretation of Seismic Refraction

Table 2 summarises the interpretation. The stiffness or compaction and the rock strength or quality have been estimated from the seismic velocity. The estimation of the excavatability for the bedrock has been made according to the caterpillar chart published in Reynolds (1997). The geotechnical assessment for rippability will have to take factors like rock type and jointing into account and the estimation in this report is solely based on the seismic velocities.

The interpretation has been made from all available information. For overburden layers and the top of the rock the seismic refraction data has been used as seismic refraction is the best method to delineate layer boundaries. The rock type is taken from the geotechnical report.

Table 2: Summary of Interpretation

| **Layer** | **General Seismic Velocity Range (m/sec)** | **Stiffness or Compaction or Rock Quality** | **Interpretation** | **Estimated Excavation Method** |
|---|---|---|---|---|
| 1 | 150 - 200 | Soft or Loose | Soil | Diggable |
| 2 | 1600 - 1800 | Stiff or Dense or very poor rock | Overburden or highly weathered Greywacke | Diggable or rippable |
| 3 | 4000 | Good rock | Strong Greywacke | Breaking & Blasting |

### 3.3 Elevation of Strong Rock

The strong rock elevation contour map (Map 2) was constructed using data from the seismic refraction survey. It included elevation values read from each of the seismic refraction survey lines shown on Map 1. In areas where likely shallow rock was interpreted from the landscape, visible boulders, lack of tillage farming, overgrown vegetation and the geological map, a rock depth of 1m was given on the contour map. These areas are marked in blue on Map 1.

The results were compared to the geotechnical data but as good rock was never definitively encountered within the boreholes or trial pits, this data is not used in the construction of the contour map. The dataset was

interpolated and contoured using a minimum curvature option in the SURFER software programme. The colour contours show the elevation in metres with the red contours depicting areas where the good rock is higher and the blue where the rock is deeper.

The rock elevations generally follow the ground elevations within the highest rock elevations at the higher ground in the west and lower rock in the east.

Map 3 shows the depth to rock below ground level (bgl). This map shows some variations in the depth to rock relative to the ground elevations. There is an area of deeper rock near the middle of the site and towards the east. The shallowest rock is generally in the west and along the southern boundary of the site.

The data for all the survey lines as well as surveyed likely shallow rock and borehole locations provided by the client were tabulated in an excel spreadsheet (Table 3). The format is shown in the image below. Every point was surveyed with a Carlson NR3 RTK-GPS to accuracy < 0.05m. The point names are given in the first column. They correspond to the name of the lines shown on Map 1. The elevation to the top of Layers 2 and 3 are taken from the seismic refraction models along each of these lines. The depths are computed in the from the data available in the table.

| Name | East (ITM) | North (ITM) | Ground Elevation and Top Layer 1 Soft or Loose Soil (mOD) | Distance (m) | Top Layer 2 Stiff or Dense OB or highly weathered Greywacke (mOD) | Top Layer 3 Strong Graywacke (mOD) | Depth m to Layer 2 (bgl) | Depth m to Layer 3 (bgl) |
|---|---|---|---|---|---|---|---|---|
| **S1.01** | 706483.6 | 804365.9 | 14.8 | 0 | 13.8 | 11.3 | 1.04 | 3.53 |
| **S1.02** | 706485.5 | 804366.8 | 14.6 | 2 | 13.8 | 11.5 | 0.78 | 3.07 |
| **S1.03** | 706487.3 | 804367.2 | 14.7 | 4 | 13.8 | 11.6 | 0.91 | 3.08 |
| **S1.04** | 706489.3 | 804367.8 | 14.8 | 6 | 13.8 | 11.6 | 0.92 | 3.13 |
| **S1.05** | 706491.3 | 804368.2 | 14.8 | 8 | 13.9 | 11.5 | 0.95 | 3.28 |
| **S1.06** | 706493.1 | 804368.9 | 14.8 | 10 | 13.9 | 11.5 | 0.93 | 3.31 |
| **S1.07** | 706495.0 | 804369.4 | 14.9 | 12 | 13.9 | 11.6 | 1.01 | 3.30 |
| **S1.08** | 706497.0 | 804369.9 | 14.9 | 14 | 13.9 | 11.8 | 1.01 | 3.11 |
| **S1.09** | 706499.0 | 804370.3 | 15.0 | 16 | 14.0 | 12.1 | 1.01 | 2.89 |
| **S1.10** | 706501.0 | 804370.8 | 15.0 | 18 | 14.0 | 12.3 | 1.08 | 2.75 |
| **S1.11** | 706503.0 | 804371.2 | 15.2 | 20 | 14.0 | 12.4 | 1.19 | 2.74 |
| **S1.12** | 706504.9 | 804371.6 | 15.2 | 22 | 14.0 | 12.4 | 1.16 | 2.72 |
| **S1.13** | 706506.9 | 804372.1 | 15.2 | 24 | 14.0 | 12.5 | 1.21 | 2.71 |
| **S1.14** | 706508.8 | 804372.6 | 15.3 | 26 | 14.1 | 12.4 | 1.23 | 2.97 |
| **S1.15** | 706510.7 | 804373.0 | 15.3 | 28 | 14.2 | 12.4 | 1.16 | 2.97 |
| **S1.16** | 706512.7 | 804373.7 | 15.4 | 30 | 14.2 | 12.2 | 1.14 | 3.15 |
| **S1.17** | 706514.6 | 804374.1 | 15.4 | 32 | 14.3 | 12.5 | 1.12 | 2.90 |

Image 1: Table 3 formatting

## 4. CONCLUSIONS

The following conclusions are made:

- The geophysical surveys carried out at the site in Haggardstown consisted of a total of 3584m of 2m spaced seismic refraction along parallel lines spaced throughout the site.
- The aim of the survey was to determine the depth of rock throughout the site.
- The seismic refraction models used a three-layer model.
- The top layer is described as soft or loose soil, which has a thickness of 0.5 – 2m.
- The second layer is described as stiff or dense overburden or poor very weathered greywacke. This layer has a thickness of between 1 and 7m. It is not possible to differentiate between the overburden and very weathered greywacke due to the destructed nature if the rock.
- The third layer is the good rock layer.
- The depth to the top of good rock and its elevation is shown as contour maps (Map 2 and Map 3).
- The contours maps were created from the seismic models though in the areas of rough vegetation with visible boulders and absence of tillage farming a depth of 1m to the top of rock was estimated.
- The elevations of the top of good rock generally follow the ground elevations, falling from west to east. Map 3 shows the difference in the depth to rock throughout the survey area and shows some variations throughout the site.
- The data for the top of rock elevation and depth is attached in an Excel worksheet (Table 3).
- The interpretation presented here should be reviewed once any additional geotechnical data becomes available.

## 5. REFERENCES

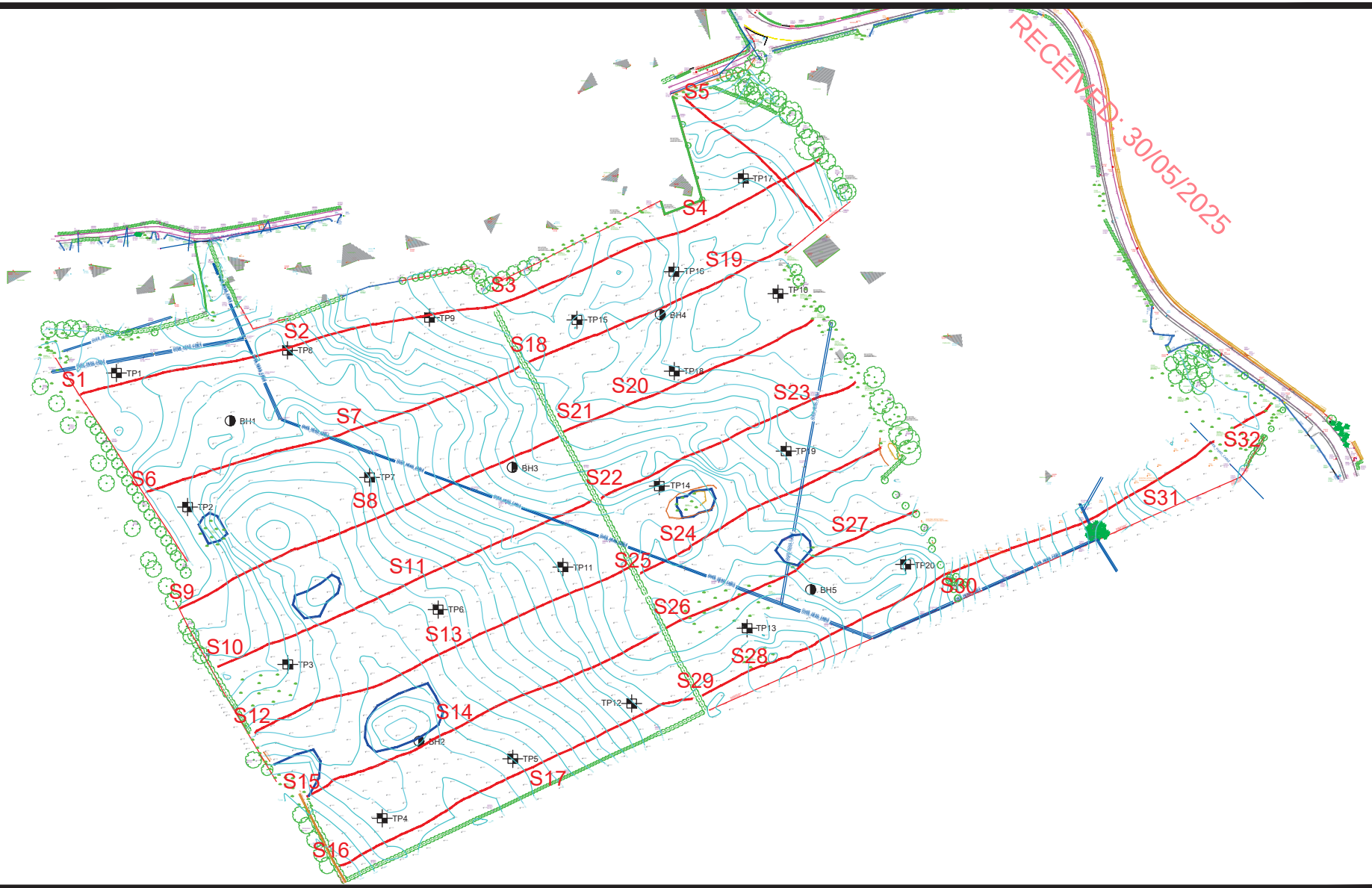


1. **BSI, 2015.** BS5930, Code of Practice for Ground Investigations, British Standards Institute 2015
2. **Eurocode, 2007.** EN 1997-2:2007. Eurocode 7. Part 2 Ground Investigation and Testing 2007
3. **GSEG, 2002.** Geophysics in Engineering Investigations. Geological Society Engineering Geology Special Publication 19, London, 2002
4. **GSI, 2023.** Online Bedrock Geological Map of Ireland. Geological Survey of Ireland 2022
5. **Milsom, 1989.** Field Geophysics. John Wiley and Sons, 1989
6. **Reynolds, 1997.** An Introduction to Applied and Environmental Geophysics. John Wiley and Son, 1997
7. **Weaver, 1975.** Geological Factors significant in the Assessment of Rippability, 1975
8. **GES 2018.** Proposed Residential Development, Blackrock, Dundalk, Ground Investigation

# Table 1: Geophysical Survey Locations and Acquisition Parameters



| Seismic Refraction Survey | | | | |
|---|---|---|---|---|
| **Line** | **Geophone Spacing (m)** | **Length (m)** | **Survey direction** | **Survey Type/Mode** |
| S1 | 2 | 144 | W-E | Concatenated |
| S2 | 2 | 144 | W-E | Concatenated |
| S3 | 2 | 144 | W-E | Concatenated |
| S4 | 2 | 88 | W-E | Concatenated |
| S5 | 2 | 124 | SW-NE | Concatenated |
| S6 | 2 | 144 | W-E | Concatenated |
| S7 | 2 | 122 | W-E | Concatenated |
| S8 | 2 | 144 | E-W | Concatenated |
| S9 | 2 | 134 | E-W | Concatenated |
| S10 | 2 | 144 | W-E | Concatenated |
| S11 | 2 | 128 | W-E | Concatenated |
| S12 | 2 | 144 | E-W | Concatenated |
| S13 | 2 | 128 | E-W | Concatenated |
| S14 | 2 | 144 | W-E | Concatenated |
| S15 | 2 | 114 | W-E | Concatenated |
| S16 | 2 | 144 | E-W | Concatenated |
| S17 | 2 | 116 | E-W | Concatenated |
| S18 | 2 | 144 | W-E | Concatenated |
| S19 | 2 | 46 | W-E | Single Setup |
| S20 | 2 | 144 | E-W | Concatenated |
| S21 | 2 | 38 | E-W | Single Setup |
| S22 | 2 | 144 | W-E | Concatenated |
| S23 | 2 | 42 | W-E | Single Setup |
| S24 | 2 | 144 | E-W | Concatenated |
| S25 | 2 | 36 | E-W | Single Setup |
| S26 | 2 | 144 | W-E | Concatenated |
| S27 | 2 | 40 | W-E | Single Setup |
| S28 | 2 | 144 | E-W | Concatenated |
| S29 | 2 | 36 | E-W | Single Setup |
| S30 | 2 | 144 | W-E | Concatenated |
| S31 | 2 | 58 | W-E | Concatenated |
| S32 | 2 | 30 | W-E | Single Setup |
| | **SUM** | **3584** | | |





Minerex
Geophysics Limited

Unit F4, Maynooth Business Campus
Maynooth, Co. Kildare
Tel. (01) 6510030
Email: info@mgx.ie
Web: www.mgx.ie


| | |
|---|---|
| CLIENT | IGSL |
| PROJECT | Haggardstown, County Louth Geophysical Survey |
| TITLE | Map 1: Geophysical Survey Location Map |

| | |
|---|---|
| SCALE: | 1:2,500 @ A3 |
| PROJECT: | 6680 |
| DRAWN: | JC |
| DATE: | 03/02/2023 |
| MGX FILE: | 6680d_Drawings.dwg |
| STATUS: | Draft |

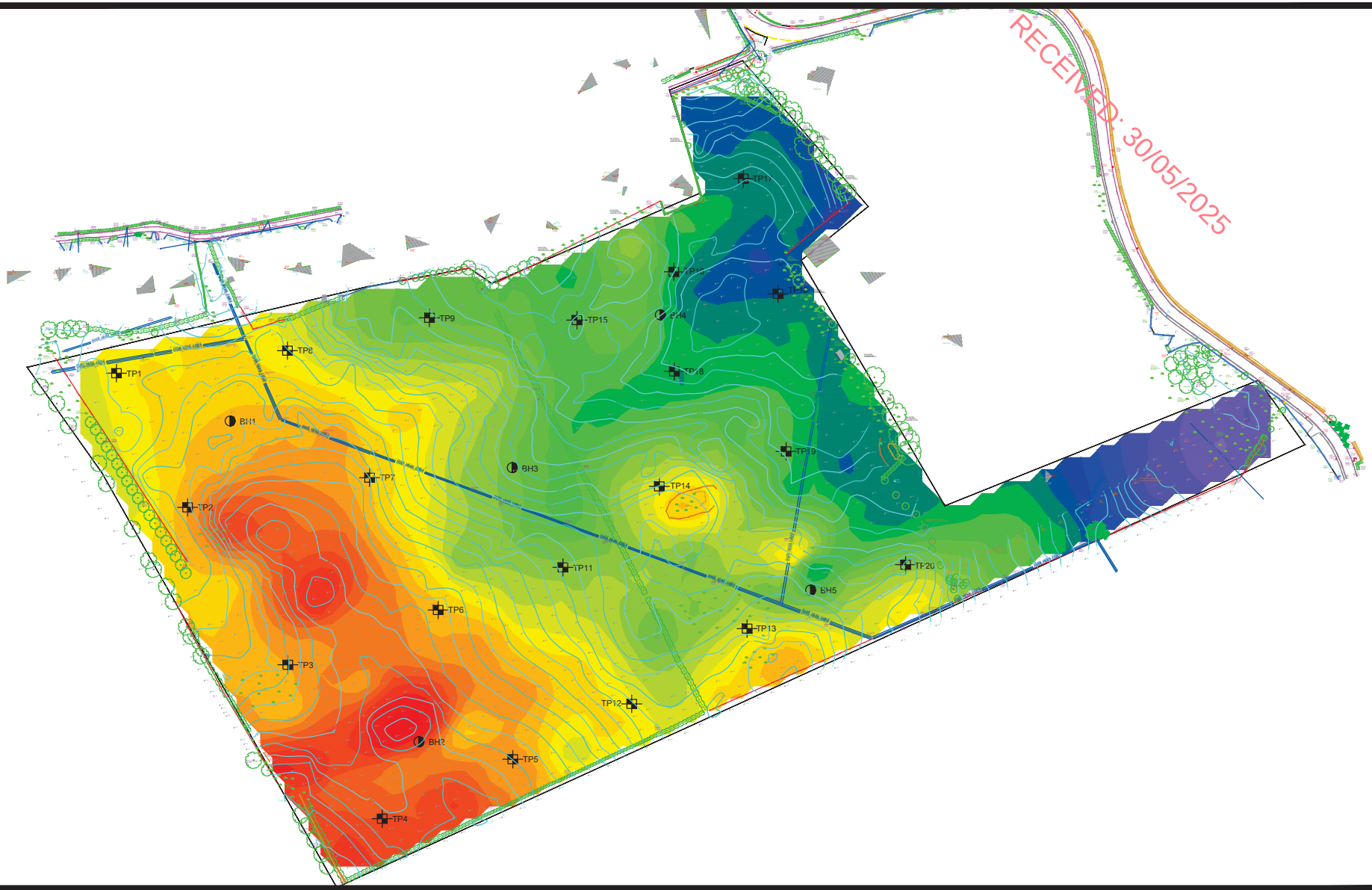
**Geophysical Survey Locations:**

- S1 — Seismic Refraction Line
- Likely Shallow Rock

Locations are in Irish Transverse Mercator (ITM), Elevations are in mOD (Malin Head)

**Direct Ground Investigation Locations:**

- BH1 — Borehole Logs
- TP1 — Trial Pit






Minerex
Geophysics Limited

Unit F4, Maynooth Business Campus
Maynooth, Co. Kildare
Tel. (01) 6510030
Email: info@mgx.ie
Web: www.mgx.ie

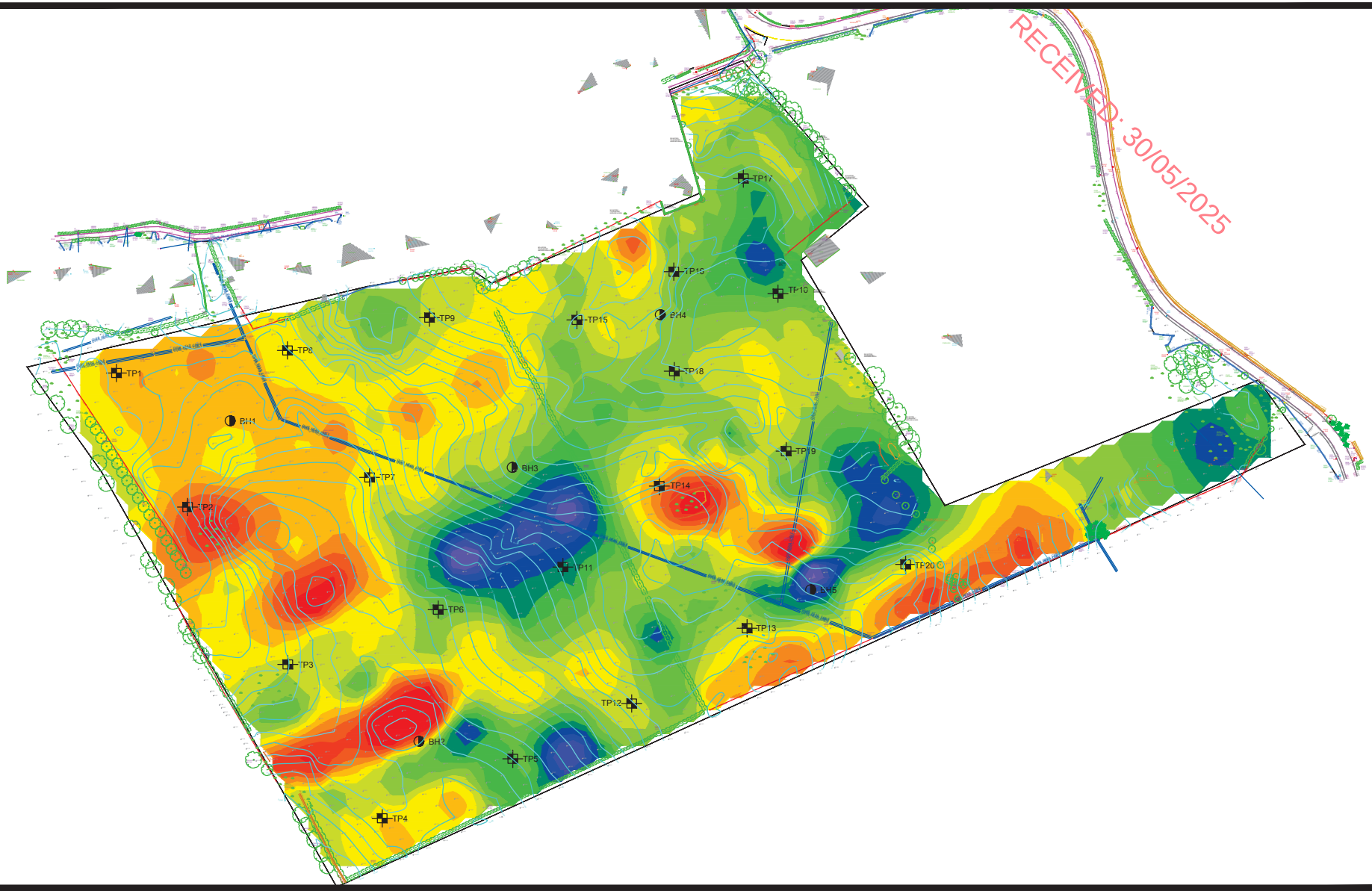
| | |
|---|---|
| CLIENT | IGSL |
| PROJECT | Haggardstown, County Louth Geophysical Survey |
| TITLE | Map 2: Contour Map of Interpreted Good Rock Elevations |

| | |
|---|---|
| SCALE: | 1:2,500 @ A3 |
| PROJECT: | 6680 |
| DRAWN: | JC |
| DATE: | 03/02/2023 |
| MGX FILE: | 6680d_Drawings.dwg |
| STATUS: | Draft |

The Colour Contour Map shows the Elevation of the Top of Good Rock (Layer 3 from Seismic Refraction) in mOD

Elevation of Good Rock (mOD)

-4 -2 0 2 4 6 8 10 12 14 16 18 20 22






Minerex
Geophysics Limited

Unit F4, Maynooth Business Campus
Maynooth, Co. Kildare
Tel. (01) 6510030
Email: info@mgx.ie
Web: www.mgx.ie

| | |
|---|---|
| CLIENT | IGSL |
| PROJECT | Haggardstown, County Louth Geophysical Survey |
| TITLE | Map 3: Contour Map of Interpreted Good Rock Depth |

| | |
|---|---|
| SCALE: | 1:2,500 @ A3 |
| PROJECT: | 6680 |
| DRAWN: | JC |
| DATE: | 03/02/2023 |
| MGX FILE: | 6680d_Drawings.dwg |
| STATUS: | Draft |

The Colour Contour Map shows the Depth to the Top of Good Rock (Layer 3 from Seismic Refraction) in m (bgl)

Depth to the Good Rock (m (bgl))

0 1 2 3 4 5 6 7 8

## Appendix 5

## Geotechnical Laboratory Results (Rock)

## (Diametrial) POINT LOAD STRENGTH INDEX TEST DATA

Contract: Haggardstown

Contract no. 24490

Sample Type: Core

Date of test: 03/04/2023

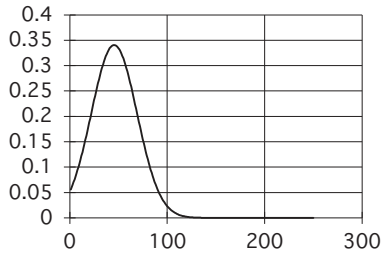
| RC No. | Depth m | D (Diameter) mm | P (failure load) kN | F | Is (index strength) Mpa | Is(50) (index strength) Mpa | *UCS MPa | Type | Orienation |
|---|---|---|---|---|---|---|---|---|---|
| RC01 | 3.2 | 78 | 4.0 | 1.222 | 0.66 | 0.80 | 16 | d | // |
| | 4.6 | 78 | 12.0 | 1.222 | 1.97 | 2.41 | 48 | d | // |
| | 5.7 | 78 | 18.0 | 1.222 | 2.96 | 3.61 | 72 | d | // |
| | 5.8 | 78 | 21.0 | 1.222 | 3.45 | 4.22 | 84 | d | // |
| | 7.2 | 78 | 7.0 | 1.222 | 1.15 | 1.41 | 28 | d | // |
| RC02 | 3.6 | 78 | 19.0 | 1.222 | 3.12 | 3.81 | 76 | d | // |
| | 4.7 | 78 | 2.0 | 1.222 | 0.33 | 0.40 | 8 | d | // |
| | 5.4 | 78 | 10.0 | 1.222 | 1.64 | 2.01 | 40 | d | // |
| | 7.8 | 78 | 9.0 | 1.222 | 1.48 | 1.81 | 36 | d | // |
| | 7.9 | 78 | 11.0 | 1.222 | 1.81 | 2.21 | 44 | d | // |
| RC03 | 2.6 | 78 | 4.0 | 1.222 | 0.66 | 0.80 | 16 | d | // |
| | 4.5 | 78 | 5.0 | 1.222 | 0.82 | 1.00 | 20 | d | // |
| | 6.3 | 78 | 12.0 | 1.222 | 1.97 | 2.41 | 48 | d | // |
| | 7.3 | 78 | 14.0 | 1.222 | 2.30 | 2.81 | 56 | d | // |
| | 10.4 | 78 | 18.0 | 1.222 | 2.96 | 3.61 | 72 | d | // |
| RC04 | 1.6 | 78 | 8.0 | 1.222 | 1.31 | 1.61 | 32 | d | // |
| | 4.0 | 78 | 22.0 | 1.222 | 3.62 | 4.42 | 88 | d | // |
| | 5.1 | 78 | 12.0 | 1.222 | 1.97 | 2.41 | 48 | d | // |
| | 6.3 | 78 | 11.0 | 1.222 | 1.81 | 2.21 | 44 | d | // |
| | 7.4 | 78 | 8.0 | 1.222 | 1.31 | 1.61 | 32 | d | // |

| Statistical Summary Data | Is(50) | UCS* |
|---|---|---|
| Number of Samples Tested | 20 | 20 |
| Minimum | 0.40 | 8 |
| Average | 2.28 | 46 |
| Maximum | 4.42 | 88 |
| Standard Dev. | 1.17 | 23 |
| Upper 95% Confidence Limit | 4.57 | 91.49 |
| Lower 95% Confidence Limit | -0.02 | -0.34 |

Comments:

*UCS taken as k x Point Load Is(50): k= 20

*UCS Normal Distribution Curve




| Abbreviations | |
|---|---|
| i | irregular |
| a | axial |
| b | block |
| d | diametral |

approx. orientation to planes of weakness/bedding

| | |
|---|---|
| U | unknown |
| P | perpendicular |
| // | parallel |

# Appendix 6

## Rock Reusability Test Results

IGSL Ltd
Unit J5, Materials Laboratory
M7 Business Park
Naas
Co. Kildare
045-899324

# Test Report

## Resistance to Fragmentation - Los Angeles Test

Tested in accordance with BS EN1097-2:2020



| | | |
|---|---|---|
| **Report No.** | | **R145666** |
| Client: | | DOBA |
| Contract: | | Haggardstown Dundalk Louth |
| Contract No: | | 24490 |
| Sample No. | | A23/0956 |
| Client Ref*: | | REX TP01 |
| Location*: | | Not Stated |
| Source*: | | Not Stated |
| Material Type*: | | Aggregate |
| Sample Received: | | 27/04/2023 |
| Date tested: | | 27/04/2023 |
| Sample Cert: | | ~~Attached~~ /Not Provided |
| Size of Material: | 1 | <14mm >12.5mm |
| | 2 | <12.5mm >10mm |
| Los Angeles Coefficient: | | 27 |

Results relate only to the specimen tested, in as received condition unless otherwise noted.
Opinions and interpretations are outside the scope of accreditation.
* denotes Customer supplied information.


Persons authorised to approve report

J Barrett (Quality Manager)
H Byrne (Laboratory Manager)

| IGSL Ltd Materials Laboratory | Approved by | Date | Page |
|---|---|---|---|
| | H Byrne | 15/5/23 | 1 of 1 |

IGSL Ltd
Unit J5, Materials Laboratory
M7 Business Park
Naas
Co. Kildare
045-899324

# Test Report

## Resistance to Fragmentation - Los Angeles Test

Tested in accordance with BS EN1097-2:2020



| | | |
|---|---|---|
| **Report No.** | | **R145665** |
| Client: | | DOBA |
| Contract: | | Haggardstown Dundalk Louth |
| Contract No: | | 24490 |
| Sample No. | | A23/0957 |
| Client Ref*: | | REX TP02 |
| Location*: | | Not Stated |
| Source*: | | Not Stated |
| Material Type*: | | Aggregate |
| Sample Received: | | 27/04/2023 |
| Date tested: | | 27/04/2023 |
| Sample Cert: | | ~~Attached~~ /Not Provided |
| Size of Material: | 1 | <14mm >12.5mm |
| | 2 | <12.5mm >10mm |
| Los Angeles Coefficient: | | 28 |

Results relate only to the specimen tested, in as received condition unless otherwise noted.
Opinions and interpretations are outside the scope of accreditation.
* denotes Customer supplied information.


Persons authorised to approve report

J Barrett (Quality Manager)
H Byrne (Laboratory Manager)

| IGSL Ltd Materials Laboratory | Approved by | Date | Page |
|---|---|---|---|
| | H Byrne | 15/5/23 | 1 of 1 |

IGSL Ltd
Materials Laboratory
Unit J5, M7 Business Park
Newhall, Naas
Co. Kildare
045 846176

# Test Report

## Slake Durability

Tested in accordance with ISRM Part 2 (1981)



| | |
|---|---|
| **Report No.** | **R145661** |
| Contract No. | 24490 |
| Contract Name: | Haggardstown Dundalk Louth |
| Client: | DOBA |

| | |
|---|---|
| Sample No. | A23/0956 |
| Client Ref | REX TP01 |
| Location | Not Stated |
| Sample Certificate | ~~Approved~~ /Not Provided |
| Date Received | 27/04/23 |
| Date Tested | 27/04/23 |

Slake Durability

| | |
|---|---|
| Cycle 1 | 99.1 |
| Cycle 2 | 98.4 |

Description of the rock

Pre Test: Grey brown sandstone/siltstone

Post Test: Grey brown sandstone/siltstone

The slaking fluid is tap water at 20°C unless otherwise stated in this report.

The results relate to the specimens tested.
Any remaining material will be retained for one month.
Opinions and interpretations are outside the scope of accreditation.

Persons authorised to approve report

J Barrett (Quality Manager)
H Byrne (Laboratory Manager)

| IGSL Materials Laboratory | Approved by | Date | Page |
|---|---|---|---|
| | H Byrne | 15/5/23 | 1 of 1 |

IGSL Ltd
Materials Laboratory
Unit J5, M7 Business Park
Newhall, Naas
Co. Kildare
045 846176

# Test Report

## Slake Durability

Tested in accordance with ISRM Part 2 (1981)



| | |
|---|---|
| **Report No.** | **R145662** |
| Contract No. | 24490 |
| Contract Name: | Haggardstown Dundalk Louth |
| Client: | DOBA |

| | |
|---|---|
| Sample No. | A23/0957 |
| Client Ref | REX TP02 |
| Location | Not Stated |
| Sample Certificate | ~~Approved~~ /Not Provided |
| Date Received | 27/04/23 |
| Date Tested | 27/04/23 |

Slake Durability

| | |
|---|---|
| Cycle 1 | 99.3 |
| Cycle 2 | 98.7 |

Description of the rock

Pre Test: Grey brown sandstone/siltstone

Post Test: Grey brown sandstone/siltstone

The slaking fluid is tap water at 20°C unless otherwise stated in this report.

The results relate to the specimens tested.
Any remaining material will be retained for one month.
Opinions and interpretations are outside the scope of accreditation.

Persons authorised to approve report

J Barrett (Quality Manager)
H Byrne (Laboratory Manager)

| IGSL Materials Laboratory | Approved by | Date | Page |
|---|---|---|---|
| | H Byrne | 15/5/23 | 1 of 1 |

IGSL Ltd
Materials Laboratory
M7 Business Park.
Newhall, Naas.
Co. Kildare

# Test Report

## Particle Density/Water Absorption

Tested in accordance with EN1097-6:2013

ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.133T



| | |
|---|---|
| **Report No.** | **R145664** |
| Client: | DOBA |
| Contract No. | 24490 |
| Contract Name: | Haggardstown Dundalk Louth |
| Sample No. | A23/0956 |
| Client Ref.* | REX TP01 |
| Material Type*: | Aggregate |
| Date Received: | 27/4/23 |
| Date testing started | 27/4/23 |
| Location*: | N/A |
| Sample Certificate: | Not provided |
| Test Method: | Pyknometer method, |
| Condition of material: | As received |
| Oven dried particle density ($Mg/m^3$) | 2.33 |
| Saturated surface dried particle density ($Mg/m^3$) | 2.40 |
| Apparent particle density ($Mg/m^3$) | 2.51 |
| Water Absorption (%) | 3.0 |

Results relate only to the specimen tested, in as received condition unless otherwise noted.
Opinions and interpretations are outside the scope of accreditation.
* denotes Customer supplied information.
This report shall not be reproduced except in full without written approval from the Laboratory.

Approved signatories
J Barrett (Quality Manager)
H Byrne (Laboratory Manager)

| IGSL Ltd Materials Laboratory | Approved by | Date | Page |
|---|---|---|---|
| | H Byrne | 15/5/23 | 1 of 1 |

IGSL Ltd
Materials Laboratory
M7 Business Park.
Newhall, Naas.
Co. Kildare

# Test Report

## Particle Density/Water Absorption

Tested in accordance with EN1097-6:2013

ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.133T



| | |
|---|---|
| **Report No.** | **R145663** |
| Client: | DOBA |
| Contract No. | 24490 |
| Contract Name: | Haggardstown Dundalk Louth |
| Sample No. | A23/0957 |
| Client Ref.* | REX TP02 |
| Material Type*: | Aggregate |
| Date Received: | 27/4/23 |
| Date testing started | 27/4/23 |
| Location*: | N/A |
| Sample Certificate: | Not provided |
| Test Method: | Pyknometer method, |
| Condition of material: | As received |
| Oven dried particle density ($Mg/m^3$) | 2.38 |
| Saturated surface dried particle density ($Mg/m^3$) | 2.49 |
| Apparent particle density ($Mg/m^3$) | 2.69 |
| Water Absorption (%) | 4.9 |

Results relate only to the specimen tested, in as received condition unless otherwise noted.
Opinions and interpretations are outside the scope of accreditation.
* denotes Customer supplied information.
This report shall not be reproduced except in full without written approval from the Laboratory.

Approved signatories
J Barrett (Quality Manager)
H Byrne (Laboratory Manager)

| IGSL Ltd Materials Laboratory | Approved by | Date | Page |
|---|---|---|---|
| | H Byrne | 15/5/23 | 1 of 1 |

IGSL Ltd
Materials Laboratory
Unit J5,M7 Business Park
Naas
Co. Kildare
045 899324

# Test Report

## Particle Shape - Flakiness

Tested in accordance with BS EN933-3:2012



| | |
|---|---|
| **Report No.** | **R145660** |
| Contract No. | 24490 |
| Contract Name: | Haggardstown Dundalk Louth |
| Customer: | DOBA |
| Sample No. | A23/0956 |
| Customer Ref*: | REX TP01 |
| Location*: | Not Stated |
| Material Type*: | Aggerate |
| Sample Received: | 27/04/2023 |
| Date tested: | 27/04/2023 |
| Sample Cert: | ~~Attached~~ /Not Provided |
| Mass of Test Portion (g): | 6137 |
| Flakiness Index: | 35 |

Results relate only to the specimen tested, in as received condition unless otherwise noted.
Opinions and interpretations are outside the scope of accreditation.
* denotes Customer supplied information.


Persons authorised to approve reports
J Barrett (Quality Manager)
H Byrne (Laboratory Manager)

| IGSL Ltd Materials Laboratory | Approved by | Date | Page |
|---|---|---|---|
| | H Byrne | 15/05/23 | 1 of 1 |

IGSL Ltd
Materials Laboratory
Unit J5,M7 Business Park
Naas
Co. Kildare
045 899324

# Test Report

## Particle Shape - Flakiness

Tested in accordance with BS EN933-3:2012



| | |
|---|---|
| **Report No.** | **R145659** |
| Contract No. | 24490 |
| Contract Name: | Haggardstown Dundalk Louth |
| Customer: | DOBA |
| Sample No. | A23/0957 |
| Customer Ref*: | REX TP02 |
| Location*: | Not Stated |
| Material Type*: | Aggerate |
| Sample Received: | 27/04/2023 |
| Date tested: | 27/04/2023 |
| Sample Cert: | ~~Attached~~ /Not Provided |
| Mass of Test Portion (g): | 6613 |
| Flakiness Index: | 34 |

Results relate only to the specimen tested, in as received condition unless otherwise noted.
Opinions and interpretations are outside the scope of accreditation.
* denotes Customer supplied information.


Persons authorised to approve reports
J Barrett (Quality Manager)
H Byrne (Laboratory Manager)

| IGSL Ltd Materials Laboratory | Approved by | Date | Page |
|---|---|---|---|
| | H Byrne | 15/05/23 | 1 of 1 |

IGSL Ltd
Materials Laboratory
M7 Business Park.
Newhall, Naas.
Co. Kildare

# Test Report

## Magnesium Sulfate Test

Tested in accordance with EN1367-2:2009



| | |
|---|---|
| **Report No.** | **R145968** |
| Client: | DOBA |
| Contract No. | 24490 |
| Contract Name: | Haggardstown Dundalk Louth |
| Sample No. | A23/0956 |
| Client Ref. | Rex TP01 |
| Material Type: | Crushed Rock |
| Date Received: | 27/4/23 |
| Date testing started | 4/5/23 |
| Location: | N/A |
| Sample Certificate: | Not provided |
| Size Range | 10-14mm |
| Magnesium Sulfate Value ($MS_1$) Portion 1 | 61 |
| Magnesium Sulfate Value ($MS_2$) Portion 2 | 53 |
| Mean Magnesium Sulfate Value | 57 |

Results relate only to the specimens tested.
Specimens were tested in as received condition unless otherwise noted.


Approved signatories
J Barrett (Quality Manager)
H Byrne (Laboratory Manager)

| IGSL | Approved by | Date | Page |
|---|---|---|---|
| | H Byrne | 25/5/23 | 1 of 1 |

IGSL Ltd
Materials Laboratory
M7 Business Park.
Newhall, Naas.
Co. Kildare

# Test Report

## Magnesium Sulfate Test

Tested in accordance with EN1367-2:2009



| | |
|---|---|
| **Report No.** | **R145969** |
| Client: | DOBA |
| Contract No. | 24490 |
| Contract Name: | Haggardstown Dundalk Louth |
| Sample No. | A23/0957 |
| Client Ref. | Rex TP02 |
| Material Type: | Crushed Rock |
| Date Received: | 27/4/23 |
| Date testing started | 4/5/23 |
| Location: | N/A |
| Sample Certificate: | Not provided |
| Size Range | 10-14mm |
| Magnesium Sulfate Value ($MS_1$) Portion 1 | 49 |
| Magnesium Sulfate Value ($MS_2$) Portion 2 | 42 |
| Mean Magnesium Sulfate Value | 46 |

Results relate only to the specimens tested.
Specimens were tested in as received condition unless otherwise noted.


Approved signatories
J Barrett (Quality Manager)
H Byrne (Laboratory Manager)

| IGSL | Approved by | Date | Page |
|---|---|---|---|
| | H Byrne | 25/5/23 | 1 of 1 |

## Appendix 7

## Chemical Laboratory Results (Rock)

7 - 11 Harding Street
Leicester
LE1 4DH



**IGSL**
Unit F
M7 Business Park
Naas

**Analytical Test Report: L23/01879/IGS - 23-33464**

| | | | |
|---|---|---|---|
| Your Project Reference: | **24490 Haggardstown Dundalk** | | |
| Your Order Number: | 21365 | Testing Received / Instructed: | 24/04/2023 / 24/04/2023 |
| Report Issue Number: | 1 | Sample Tested: | 24/04 to 03/05/2023 |
| Samples Analysed: | 2 aggregate samples | Report issued: | 03/05/2023 |

Signed

**James Gane**
Analytical Services Manager
CTS Group

Notes:

Samples will be retained for 14 days after issue of this report unless otherwise requested.

The results included within the report are representative of the samples submitted for analysis.

A certificate of sampling was not supplied

Samples were supplied by customer, results apply to the samples as received.

Within the report any information provided by the client is identified with a '#'

**Where specification limits are included these are for guidance only. Where a measured value has been highlighted this is not implying acceptance or failure and certainty of measurement values have not been taken into account.**

**Uncertainty of measurement values are available on request.**

**Accreditation Key**

UKAS = UKAS Accreditation, u = Unaccredited

Date of Issue: 18.08.2022

Issued by: J. Gane

Issue No: 1

Rev No: 0

7 - 11 Harding Street
Leicester
LE1 4DH



**L23/01879/IGS - 23-33464**

**Project Reference - 24490 Haggardstown Dundalk**

**Analytical Test Results**

| Lab Reference | | | 291416 | 291417 |
|---|---|---|---|---|
| Client Sample Reference | | | A223/0956 | A223/0957 |
| Material | | | Aggregate | Aggregate |
| Source / Client Ref | | | Rex TP01 | Rex TP02 |
| Sample Description | | | Mudstone | Mudstone |
| | **Units** | **Accreditation** | | |
| **EN 1744 Determinations** | | | | |
| Total Sulphur content (as S) | (%) | UKAS | 0.02 | 0.02 |
| Acid soluble sulphate content (as $SO_3$) | (%) | UKAS | 0.01 | 0.01 |
| Acid soluble sulphate content (as $SO_4$) | (%) | u | 0.02 | 0.02 |
| Water soluble sulphate content (as $SO_3$) | (%) | UKAS | < 0.01 | < 0.01 |
| Water soluble sulphate content (as $SO_3$) | (mg/l) | u | < 50 | < 50 |
| Water soluble sulphate content (as $SO_4$) | (%) | u | < 0.01 | < 0.01 |
| Water soluble sulphate content (as $SO_4$) | (mg/l) | u | < 60 | < 60 |

7 - 11 Harding Street
Leicester
LE1 4DH



**L23/01879/IGS - 23-33464**

**Project Reference - 24490 Haggardstown Dundalk**

**Analysis Methodologies**

| Test Title | Details and Test method used |
|---|---|
| EN1744 Acid Soluble Sulphate | Testing was in accordance with BS EN 1744-1:2009 + A1:2012 clause 12. |
| EN1744 Total Sulphur (Cl. 11.1) | Testing was in accordance with BS EN 1744-1:2009 + A1:2012 clause 11. |
| EN1744 Water Soluble Sulphate | Testing was in accordance with BS EN 1744-1:2009 + A1:2012 clause 10. |

## Appendix 8

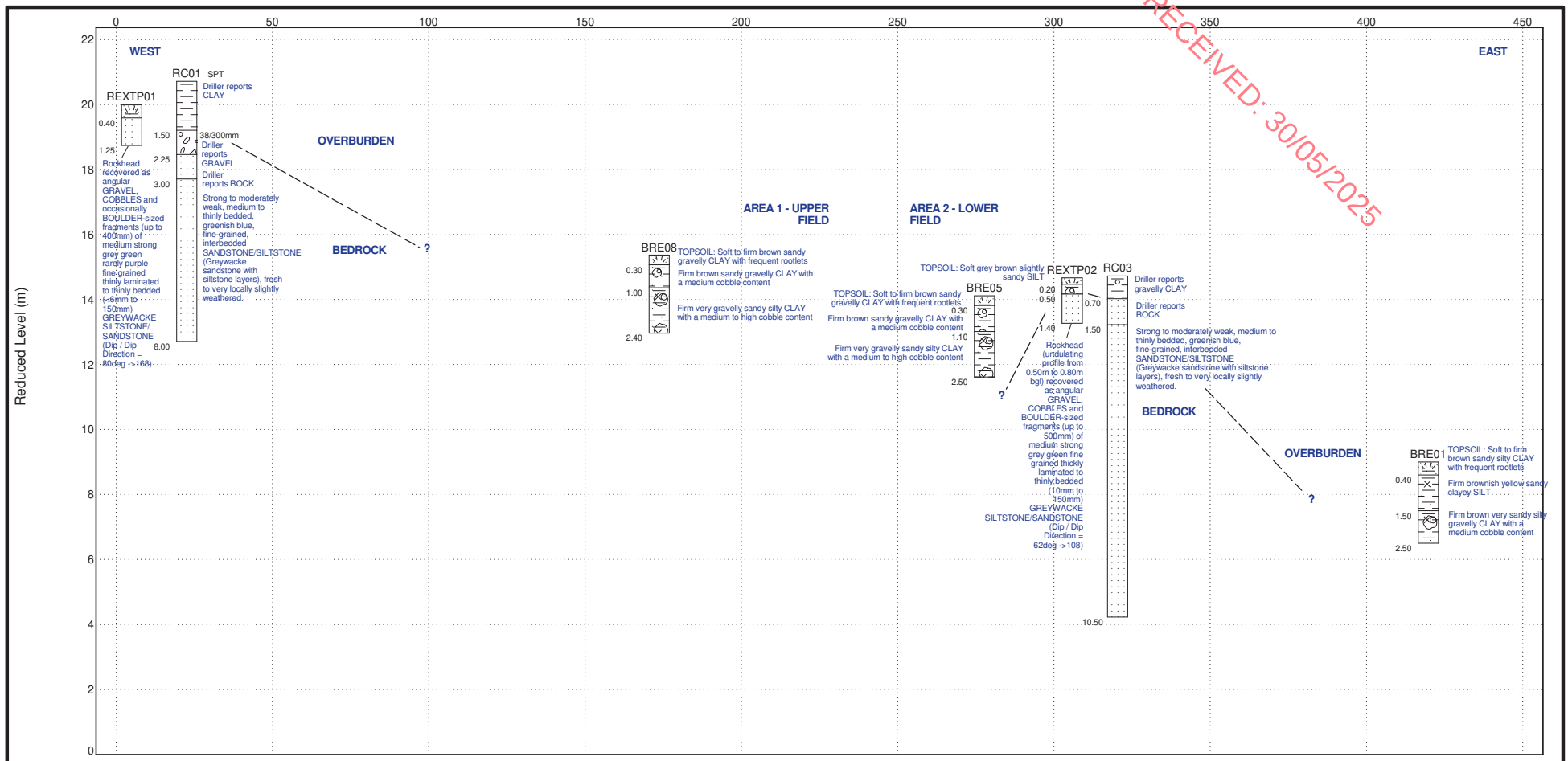
## Exploratory Hole Location Plan

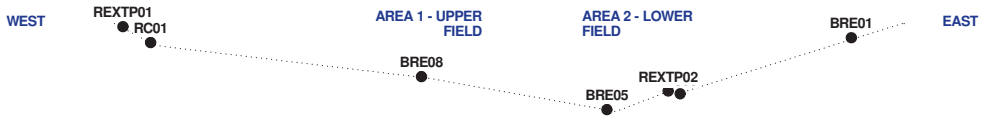
# 24490 - Haggardstown

Exploratory Hole Location Plan

## Appendix 9

## Geological Cross Sections




## LITHOLOGY GRAPHICS

TOPSOIL | Sandy silty CLAY | Sandy gravelly silty CLAY with cobbles | Sandy gravelly cobbly CLAY | CLAY

GRAVEL | SANDSTONE | Gravelly CLAY

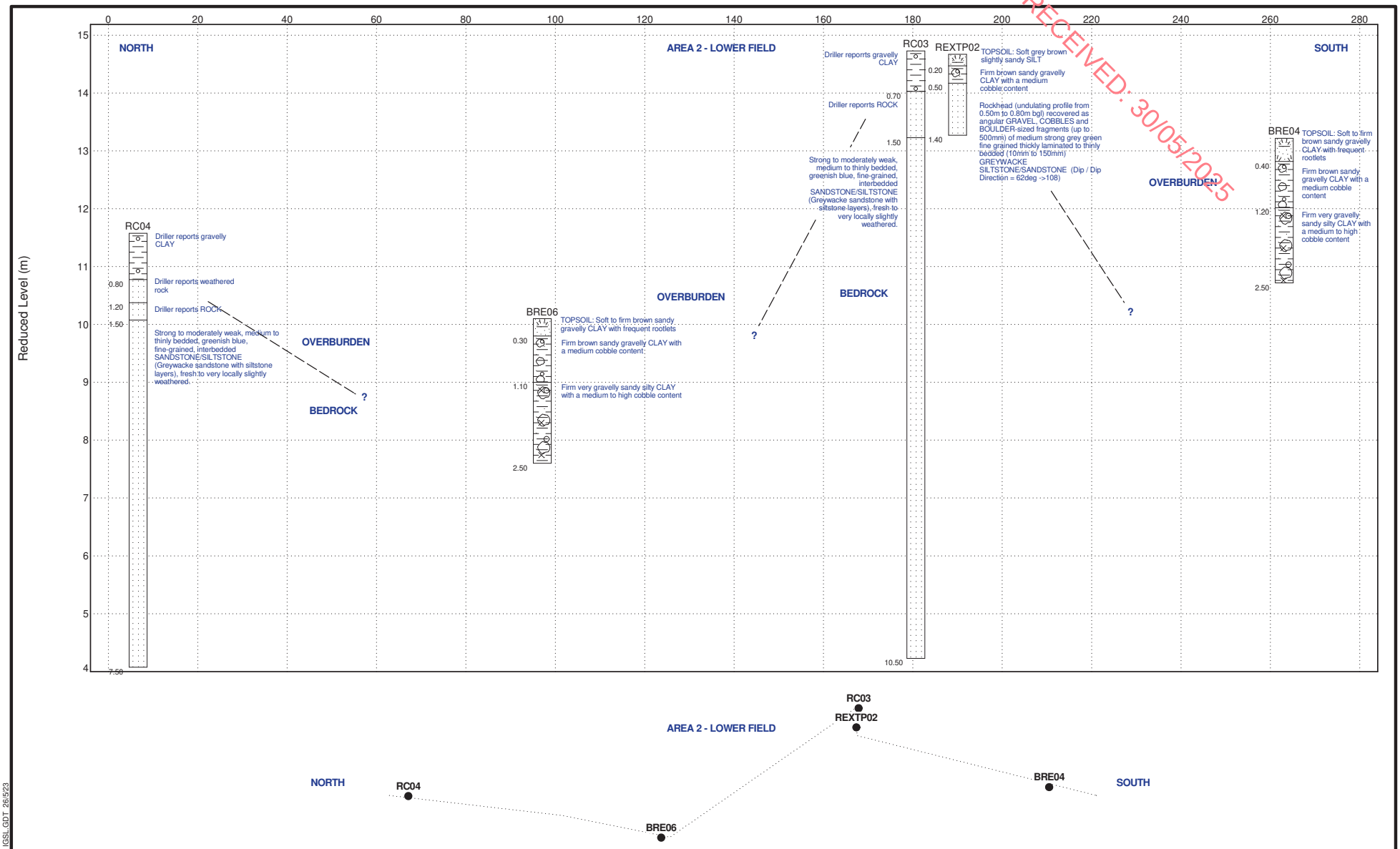
## SUBSURFACE SECTION W-E

Client: Glenveagh Homes

Project: Haggardstown

Number: 24490

FENCE BH AND PROBE 24490.GPJ GSL.GDT 26/6/23







## LITHOLOGY GRAPHICS

TOPSOIL | Sandy gravelly cobbly CLAY | Sandy gravelly silty CLAY with cobbles | Gravelly CLAY | SANDSTONE

## SUBSURFACE SECTION N-S

Client: Glenveagh Homes

Project: Haggardstown

Number: 24490

FENCE BH AND PROBE 24490.GPJ IGSL.GDT 26/6/23

## Appendix 10

## Simplified Petrographic Records

# GEOLOGICAL CLASSIFICATION / SIMPLIFIED PETROLOGY ©



| | | | |
|---|---|---|---|
| **Project No.** 24490 | **Sample Ref No.** | A23/0956 | Sheet 1 of 2 |
| **Project Location:** Haggardstown | **Sample Location:** | REXTP01 | |
| **Client:** Glenveagh Homes | **Examination & Log by:** | D.O'Shea | |
| | **Date Logged:** | 26/05/2023 | |

**Notes on sample preparation & examination:** Sample reduced (riffled & quartered) in accordance with IS EN 932-2:1999. Sample examined and classified by IGSL Professional Geologist in accordance with IS EN 14689-1:2004, IS EN 932-3:1997 and IS 398;2013 Part 1, Testing & Categorization Protocol. Sample examined with hand lens and bionocular microscope.

## Bulk Sample

## Sample Description

Aggregate consists of sandstone/siltstone with fine grained grey/brown coatings. No evidence of mineralogical changes, encrustations (e.g. gypsum) or deleterious constituents (e.g. calcareous mudstone or shale) in the sample provided. Sample in a dry state.

## Riffled & Quartered Sub-Sample

## Washed Fragments Sub-Sample Characteristics

**Particle Sizes Estimation (mm):**

| Max | Mean | Min. |
|---|---|---|
| 110 | 30 | 10 |

**Particle Shape:**

Angular to subangular, tabular

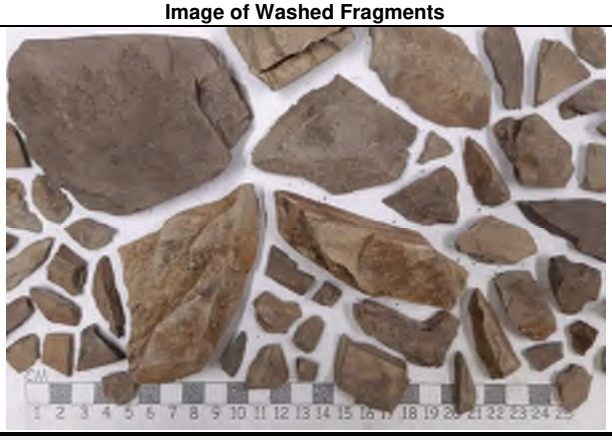
**Nature of Fines:**

Grey/brown, silt or clay size

**Nature of Coatings:**

Grey/brown, fine sand & silt / clay size

## Image of Washed Fragments



## Assessed Rock Types (lithologies) in Bulk Sample

| Rock Types | % Present |
|---|---|
| **Type 1:** Sandstone/Siltstone | 100% |
| | |
| | |
| | |

***Note:*** *Rock types and proportions assesed by examining bulk sample and washing the fragments and examining by naked eye, hand lens and binocular microscope.*

| Project No. | GEOLOGICAL CLASSIFICATION / SIMPLIFIED PETROLOGY © | Sheet 2 of 2 |
|---|---|---|



**ROCK Type 1**

| | | | | | |
|---|---|---|---|---|---|
| Dominant Particle size: | | 10-110mm | | | |
| Colour: | | Blueish grey | | | |
| Strength: | | Strong | | | |
| Apparent Porosity / Water Absorption: | | Low | | | |
| Reaction to dilute HCL (Dry Sample): | | N/A | | | |
| Presence of Laminations in hand specimen | YES | ☐ | NO | ☑ | If YES, Laminar Spacing |
| Surface Coatings | YES | ☑ | NO | ☐ | Clay/silt |
| Staining | YES | ☑ | NO | ☐ | Common Iron-Oxide |
| Secondary Mineral Present | YES | ☐ | NO | ☑ | |
| Carbonate Mineralisation | YES | ☐ | NO | ☑ | |
| Sulphate Mineralisation | YES | ☐ | NO | ☑ | |

**ROCK Type 2**

| | | | | | |
|---|---|---|---|---|---|
| Dominant Particle size: | | | | | |
| Colour: | | | | | |
| Strength: | | | | | |
| Apparent Porosity / Water Absorption: | | | | | |
| Reaction to dilute HCL (Dry Sample): | | | | | |
| Presence of Laminations in hand specimen | YES | ☐ | NO | ☐ | If YES, Laminar Spacing |
| Surface Coatings | YES | ☐ | NO | ☐ | |
| Staining | YES | ☐ | NO | ☐ | |
| Secondary Mineral Present | YES | ☐ | NO | ☐ | |
| Carbonate Mineralisation | YES | ☐ | NO | ☐ | |
| Sulphate Mineralisation | YES | ☐ | NO | ☐ | |

**ROCK Type 3**

| | | | | | |
|---|---|---|---|---|---|
| Dominant Particle size: | | | | | |
| Colour: | | | | | |
| Strength: | | | | | |
| Apparent Porosity / Water Absorption: | | | | | |
| Reaction to dilute HCL (Dry Sample): | | | | | |
| Presence of Laminations in hand specimen | YES | ☐ | NO | ☐ | If YES, Laminar Spacing |
| Surface Coatings | YES | ☐ | NO | ☐ | |
| Staining | YES | ☐ | NO | ☐ | |
| Secondary Mineral Present | YES | ☐ | NO | ☐ | |
| Carbonate Mineralisation | YES | ☐ | NO | ☐ | |
| Sulphate Mineralisation | YES | ☐ | NO | ☐ | |

**Selected Microscopy Images**

# GEOLOGICAL CLASSIFICATION / SIMPLIFIED PETROLOGY ©



| | | | |
|---|---|---|---|
| **Project No.** 24490 | **Sample Ref No.** | A23/0957 | Sheet 1 of 2 |
| **Project Location:** Haggardstown | **Sample Location:** | REXTP02 | |
| **Client:** Glenveagh Homes | **Examination & Log by:** | D.O'Shea | |
| | **Date Logged:** | 26/05/2023 | |

**Notes on sample preparation & examination:** Sample reduced (riffled & quartered) in accordance with IS EN 932-2:1999. Sample examined and classified by IGSL Professional Geologist in accordance with IS EN 14689-1:2004, IS EN 932-3:1997 and IS 398;2013 Part 1, Testing & Categorization Protocol. Sample examined with hand lens and bionocular microscope.

## Bulk Sample

## Sample Description

Aggregate consists of sandstone/siltstone with fine grained grey/brown coatings. No evidence of mineralogical changes, encrustations (e.g. gypsum) or deleterious constituents (e.g. calcareous mudstone or shale) in the sample provided. Sample in a dry state.

## Riffled & Quartered Sub-Sample

## Washed Fragments Sub-Sample Characteristics

**Particle Sizes Estimation (mm):**

| Max | Mean | Min. |
|---|---|---|
| 170 | 30 | 10 |

**Particle Shape:**

Angular to subangular, tabular

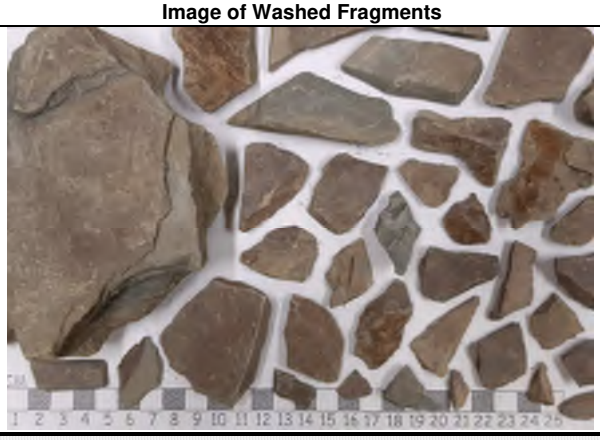
**Nature of Fines:**

Grey/brown, silt or clay size

**Nature of Coatings:**

Grey/brown, fine sand & silt / clay size

## Image of Washed Fragments



## Assessed Rock Types (lithologies) in Bulk Sample

| Rock Types | % Present |
|---|---|
| **Type 1:** Sandstone/Siltstone | 100% |
| | |
| | |
| | |

***Note:*** *Rock types and proportions assesed by examining bulk sample and washing the fragments and examining by naked eye, hand lens and binocular microscope.*

| Project No. | GEOLOGICAL CLASSIFICATION / SIMPLIFIED PETROLOGY © | Sheet 2 of 2 |
|---|---|---|



**ROCK Type 1**

| | | | | | |
|---|---|---|---|---|---|
| Dominant Particle size: | | 10-110mm | | | |
| Colour: | | Blueish grey | | | |
| Strength: | | Strong | | | |
| Apparent Porosity / Water Absorption: | | Low | | | |
| Reaction to dilute HCL (Dry Sample): | | N/A | | | |
| Presence of Laminations in hand specimen | YES | ☐ | NO | ☑ | If YES, Laminar Spacing |
| Surface Coatings | YES | ☑ | NO | ☐ | Clay/silt |
| Staining | YES | ☑ | NO | ☐ | Common Iron-Oxide |
| Secondary Mineral Present | YES | ☐ | NO | ☑ | |
| Carbonate Mineralisation | YES | ☐ | NO | ☑ | |
| Sulphate Mineralisation | YES | ☐ | NO | ☑ | |

**ROCK Type 2**

| | | | | | |
|---|---|---|---|---|---|
| Dominant Particle size: | | | | | |
| Colour: | | | | | |
| Strength: | | | | | |
| Apparent Porosity / Water Absorption: | | | | | |
| Reaction to dilute HCL (Dry Sample): | | | | | |
| Presence of Laminations in hand specimen | YES | ☐ | NO | ☐ | If YES, Laminar Spacing |
| Surface Coatings | YES | ☐ | NO | ☐ | |
| Staining | YES | ☐ | NO | ☐ | |
| Secondary Mineral Present | YES | ☐ | NO | ☐ | |
| Carbonate Mineralisation | YES | ☐ | NO | ☐ | |
| Sulphate Mineralisation | YES | ☐ | NO | ☐ | |

**ROCK Type 3**

| | | | | | |
|---|---|---|---|---|---|
| Dominant Particle size: | | | | | |
| Colour: | | | | | |
| Strength: | | | | | |
| Apparent Porosity / Water Absorption: | | | | | |
| Reaction to dilute HCL (Dry Sample): | | | | | |
| Presence of Laminations in hand specimen | YES | ☐ | NO | ☐ | If YES, Laminar Spacing |
| Surface Coatings | YES | ☐ | NO | ☐ | |
| Staining | YES | ☐ | NO | ☐ | |
| Secondary Mineral Present | YES | ☐ | NO | ☐ | |
| Carbonate Mineralisation | YES | ☐ | NO | ☐ | |
| Sulphate Mineralisation | YES | ☐ | NO | ☐ | |

**Selected Microscopy Images**

Haggardstown LRD

Dundalk, Co. Louth



**Appendices**

# Volume III

**CHAPTER 11 Biodiversity**

Appendix 11.1 Legislation & Policy

Appendix 11.2 Evaluation of Ecological Features

Appendix 11.3 Amphibian Report

Appendix 11.4 Bat Survey Results

May 2025

McCutcheon Halley
CHARTERED PLANNING CONSULTANTS

# Appendix 11.1 Legislation & Policy

May 2025

McCutcheon Halley
CHARTERED PLANNING CONSULTANTS

# Appendix 11.1 – Relevant Legislation and Policy

## International Legislation

### EU Birds Directive

The Birds Directive constitutes a level of general protection for all wild birds throughout the European Union. Annex I of the Birds Directive includes a total of 194 bird species that are considered rare, vulnerable to habitat changes or in danger of extinction within the European Union. Article 4 establishes that there should be a sustainable management of hunting of listed species, and that any large scale non-selective killing of birds must be outlawed. The Directive requires the designation of Special Protection Areas (SPAs) for: listed and rare species, regularly occurring migratory species and for wetlands which attract large numbers of birds. There are 25 Annex I species that regularly occur in Ireland.

### EU Habitats Directive

The Habitats Directive aims to protect some 220 habitats and approx. 1000 species through-out Europe. The habitats and species are listed in the Directives annexes where Annex I covers habitats and Annex II, IV and V cover species. There are 59 Annex I habitats in Ireland and 33 Annex IV species which require strict protection wherever they occur. The Directive requires the designation of Special Areas of Conservation (SACs) for areas of habitat deemed to be of European interest. The SACs together with the SPAs from the Birds Directive from a network of protected sites called Natura 2000.

### Bern and Bonn Convention

The Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention 1982) was enacted to conserve all species and their habitats. The Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention 1979, enacted 1983) was introduced in order to give protection to migratory species across borders in Europe.

### Ramsar Convention

The Ramsar Convention on Wetlands is an intergovernmental treaty signed in Ramsar, Iran, in 1971. The treaty is a commitment for national action and international cooperation for the conservation of wetlands and their resources. In Ireland there are currently 45 Ramsar sites which cover a total area of 66,994ha.

### Water Framework Directive

The EU Water Framework Directive (WFD) 2000/60/EC is an important piece of environmental legislation which aims to protect and improve water quality. It applies to rivers, lakes, groundwater, estuaries, and coastal waters. The Water Framework Directive was agreed by all individual EU member states in 2000, and its first cycle ran from 2009 – 2015. The Directive runs in 6-year cycles; the second cycle ran from 2016 – 2021, and the current (third) cycle runs from 2022-2027. The aim of the WFD is to prevent any deterioration in the existing status of water quality, including the protection of good and high-water quality status where it exists. The WFD requires member states to manage their water resources on an integrated basis to achieve at least 'good' ecological status, through River Basin Management Plans (RBMP), by 2027.

## National Legislation



### Wildlife Act 1976 and amendments

The Wildlife Act 1976 was enacted to provide protection to birds, animals, and plants in Ireland and to control activities which may have an adverse impact on the conservation of wildlife. With regard to the listed species, it is an offence to disturb, injure or damage their breeding or resting place wherever these occur without an appropriate licence from the National Parks and Wildlife Service (NPWS). This list includes all wild birds along with their nests and eggs. Intentional destruction of an active nest from the building stage up until the chicks have fledged is an offence. This includes the cutting of hedgerows from the 1st of March to the 31st of August. The act also provides a mechanism to give statutory protection to Natural Heritage Areas (NHAs). The Wildlife Amendment Act 2000 widened the scope of the Act to include most species, including the majority of fish and aquatic invertebrate species which were excluded from the 1976 Act.

The current list of plant species protected by Section 21 of the Wildlife Act, 1976 (and amendments) is set out in the Flora (Protection) Order, 2015 (S.I. No. 356/2015). The Flora (Protection) Order affords protection to several species of plant in Ireland, including 68 vascular plants, 40 mosses, 25 liverworts, 1 stonewort and 1 lichen. This Act makes it illegal for anyone to uproot, cut or damage any of the listed plant species and it also forbids anyone from altering, interfering, or damaging their habitats. This protection is not confined to within designated conservation sites and applies wherever the plants are found.

### EU Habitats Directive 1992 and EC (Birds and Natural Habitats) Regulations 2011

The EU Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (Habitats Directive 1992) provides protection to particular species and habitats throughout Europe. The Habitats Directive has been transposed into Irish law through the EC (Birds and Natural Habitats) Regulations 2011.

Annex IV of the EU Habitats Directive provides protection to a number of listed species, wherever they occur. Under Regulation 23 of the Habitats Directive, any person who, in regard to the listed species, *"Deliberately captures or kills any specimen of these species in the wild, deliberately disturbs these species particularly during the period of breeding, rearing, hibernation and migration, deliberately takes or destroys eggs from the wild or damages or destroys a breeding site or resting place of such an animal shall be guilty of an offence."*

### Invasive Species Legislation

Certain plant species and their hybrids are listed as Invasive Alien Plant Species in the Third Schedule of the *European Communities (Birds and Natural Habitats) Regulations* 2011 (SI 477 of 2011, as amended) and in the First Schedule of the *European Union (Invasive Alien Species) Regulations 2024* (S.I. No. 374 of 2024, as amended).

In addition, soils and other material containing such invasive plant material, are classified in Part 3 of the Third Schedule of SI 477 of 2011, and in the Second Schedule of S.I. No. 374 of 2024, as vector materials and are subject to the same strict legal controls.

Failure to comply with the legal requirements set down in this legislation can result in either civil or criminal prosecution, or both, with very severe penalties accruing. Convicted parties under the Act can be fined up to €500,000.00, jailed for up to 3 years, or both.



Extracts from the relevant sections of the regulations are reproduced below.

*'49(2) Save in accordance with a licence granted* [by the Department of Arts, Heritage and the Gaeltacht]*, any person who plants, disperses, allows or causes to disperse, spreads or otherwise causes to grow in anyplace* [a restricted non-native plant]*, shall be guilty of an offence.*

*49(3) … it shall be a defence to a charge of committing an offence under paragraph (1) or (2) to prove that the accused took all reasonable steps and exercised all due diligence to avoid committing the offence.*

*50(1) Save in accordance with a licence, a person shall be guilty of an offence if he or she […] offers or exposes for sale, transportation, distribution, introduction, or release—*

*(a) an animal or plant listed in Part 1 or Part 2 of the Third Schedule,*

*(b) anything from which an animal or plant referred to in subparagraph (a) can be reproduced or propagated, or*

*(c) a vector material listed in the Third Schedule, in any place in the State specified in the third column of the Third Schedule in relation to such an animal, plant or vector material.'*

**National Biodiversity Action Plan 2023-2030**

The National Biodiversity Plan (NBAP) 2023-2030, the fourth such plan for Ireland, captures the objectives, targets and actions for biodiversity that will be undertaken by a wide range of government, civil society and private sectors. Actions required to achieve the strategic objectives as well as the lead and key partners responsible for their implementation are set out for each of the objectives and their outcomes (Table A1).

**Table A1: Objectives and targets of the National Biodiversity Action Plan 2023-2030.**

| Objective | Outcome |
|---|---|
| 1: Adopt a Whole-of-Government, Whole-of-Society Approach to Biodiversity | 1A. Governance structures and reporting outputs have improved. |
| | 1B. Organisational capacity and resources for biodiversity have increased at all levels of Government. |
| | 1C: Responsibility for biodiversity is shared across the whole of government. |
| | 1D: Biodiversity initiatives are supported across the whole of society. |
| | 1E. The legislative framework for biodiversity conservation is robust, clear and enforceable. |
| 2: Meet Urgent Conservation and Restoration Needs | 2A: The protection of existing designated areas and protected species is strengthened and conservation and restoration within the existing protected area network are enhanced. |

| | |
|---|---|
| | 2B: Biodiversity and ecosystem services in the wider countryside are conserved and restored – agriculture & forestry. |
| | 2C: Biodiversity and ecosystem services in the wider countryside are conserved and restored – peatlands & climate action. |
| | 2D: Biodiversity and ecosystem services in the marine and freshwater environment are conserved and restored. |
| | 2E: Genetic diversity of wild and domesticated species is safeguarded. |
| | 2F: A National Restoration Plan is in place to contribute to the ambition of the EU Biodiversity Strategy 2030 and global restoration targets. |
| | 2H: Invasive alien species (IAS) are controlled and managed on an all-island basis to reduce the harmful impact they have on biodiversity and measures are undertaken to tackle the introduction and spread of new IAS to the environment. |
| 3. Secure Nature's Contribution to People | 3A: Ireland's natural heritage and biocultural diversity is recognised, valued, enhanced and promoted in policy and practice. |
| | 3B: The role of biodiversity in supporting wellbeing, livelihoods, enterprise and employment is recognised and enhanced. |
| | 3C: Planning and development will facilitate and secure biodiversity's contributions to people. |
| 4. Enhance the Evidence Base for Action on Biodiversity | 4A: Research funding bodies will have an improved understanding of the research and skills required to address biodiversity research gaps. |
| | 4B: Data relevant to biodiversity and ecosystems, including conservation needs, is widely accessible and standardised. |
| | 4C: Long-term monitoring programmes are in place to guide conservation and restoration goals. |
| | 4D: Ireland has prepared national assessments of ecosystem services. |
| 5. Strengthen Ireland's Contribution to International Biodiversity Initiatives | 5A: Science, policy and action on biodiversity conservation and restoration is effectively coordinated in an all-island approach. |
| | 5B: Ireland takes action internationally to cooperate with other countries, sectors, disciplines and communities to address the biodiversity crisis. |
| | 5C: Ireland enhances its contributions to the international biodiversity data drive. |



**Louth County Development Plan**

Policies and objectives of the Louth County Development Plan (CDP) 2021-2027 that are of relevance to this Biodiversity Chapter are outlined below:

- **NBG 3:** To protect and conserve Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) designated under the EU Habitats and Birds Directives.

- **NBG 4:** To ensure that all proposed developments comply with the requirements set out in the DECLG 'Appropriate Assessment of Plans and Projects in Ireland – Guidance for Planning Authorities 2010'.
- **NBG 5:** To ensure that no plan, programme, or project giving rise to significant cumulative, direct, indirect or secondary impacts on European sites arising from their size or scale, land take, proximity, resource requirements, emissions (disposal to land, water or air), transportation requirements, duration of construction, operation, decommissioning or from any other effects shall be permitted on the basis of this Plan, either individually or in combination with other plans, programmes or projects.
- **NBG 6:** To ensure a screening for Appropriate Assessment (AA) on all plans and/or projects and/or Stage 2 Appropriate Assessment (Natura Impact Report/ Natura Impact Assessment) where appropriate, is undertaken to make a determination. European Sites located outside of the County but within 15km of the proposed development site shall be included in such screenings as should those to which there are pathways, for example, hydrological links for potential effects.
- **NGB 7:** To co-operate with the Regional Planning Assembly and adjoining local authorities, public agencies and community interests to protect regionally significant heritage assets, environmental quality, and to identify threats to existing environmental quality in a transboundary context throughout the region including Northern Ireland.
- **NGB 10:** To ensure that development proposals, where relevant, improve the ecological coherence of the Natura 2000 Network of European Sites and encourage the retention and management of landscape features as per Article 10 of the Habitats Directive.



**Louth Biodiversity Action Plan**

The Louth Biodiversity Local Action Plan (2021-2026) is set out to protect and improve biodiversity through specific objectives:

- **Objective 1:** Mainstream biodiversity into decision-making across all sectors.
- **Objective 2:** Strengthen the knowledge base for conservation, management, and sustainable use of biodiversity.
- **Objective 3:** Increase awareness and appreciation of biodiversity and ecosystem services.
- **Objective 4:** Conserve and restore biodiversity and ecosystem services in the wider countryside.
- **Objective 5:** Conserve and restore biodiversity and ecosystem services in the marine environment.
- **Objective 6:** Expand and improve management of protected areas and species.

# Appendix 11.2 Evaluation of Ecological Features

May 2025

McCutcheon Halley
CHARTERED PLANNING CONSULTANTS

# Appendix 11.2 – Value of Ecological Resources

The criteria outlined in the table below, taken from the *Guidelines for Assessment of Ecological Impacts of National Road Schemes* published by the NRA, were used for assigning value to designated sites, habitats and species within the Site of the Proposed Development and surrounding area.

**Table B1. Description of values for ecological resources based on geographic hierarchy of importance (NRA, 2009b).**

| Importance | Criteria |
|---|---|
| **International Importance** | - 'European Site' including Special Area of Conservation (SAC), Site of Community Importance (SCI), Special Protection Area (SPA) or proposed Special Area of Conservation.<br>- Proposed Special Protection Area (pSPA). - Site that fulfils the criteria for designation as a 'European Site' (see Annex III of the Habitats Directive, as amended).<br>- Features essential to maintaining the coherence of the Natura 2000 Network<br>- Site containing 'best examples' of the habitat types listed in Annex I of the Habitats Directive.<br>- Resident or regularly occurring populations (assessed to be important at the national level) of the following:<br>  o Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; and/or<br>  o Species of animal and plants listed in Annex II and/or IV of the Habitats Directive<br>- Ramsar Site (Convention on Wetlands of International Importance Especially Waterfowl Habitat 1971).<br>- World Heritage Site (Convention for the Protection of World Cultural & Natural Heritage, 1972).<br>- Biosphere Reserve (UNESCO Man & The Biosphere Programme)<br>- Site hosting significant species populations under the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals, 1979).<br>- Site hosting significant populations under the Berne Convention (Convention on the Conservation of European Wildlife and Natural Habitats, 1979).<br>- Biogenetic Reserve under the Council of Europe.<br>- European Diploma Site under the Council of Europe.<br>- Salmonid water designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988, (S.I. No. 293 of 1988). |
| **National Importance** | - Site designated or proposed as a Natural Heritage Area (NHA).<br>- Statutory Nature Reserve.<br>- Refuge for Fauna and Flora protected under the Wildlife Acts.<br>- National Park.<br>- Undesignated site fulfilling the criteria for designation as a Natural Heritage Area (NHA); Statutory Nature Reserve; Refuge for Fauna and Flora protected under the Wildlife Act; and/or a National Park.<br>- Resident or regularly occurring populations (assessed to be important at the national level) of the following:<br>  o Species protected under the Wildlife Acts; and/or<br>  o Species listed on the relevant Red Data list.<br>  o Site containing 'viable areas' of the habitat types listed in Annex I of the Habitats Directive |
| **County Importance** | - Area of Special Amenity.<br>- Area subject to a Tree Preservation Order.<br>- Area of High Amenity, or equivalent, designated under the County Development Plan. |

| | |
|---|---|
| | - Resident or regularly occurring populations (assessed to be important at the County level) of the following:<br>  o Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive;<br>  o Species of animal and plants listed in Annex II and/or IV of the Habitats Directive;<br>  o Species protected under the Wildlife Acts; and/or<br>  o Species listed on the relevant Red Data list.<br>  o Site containing area or areas of the habitat types listed in Annex I of the Habitats Directive that do not fulfil the criteria for valuation as of International or National importance.<br>- County important populations of species; or viable areas of semi-natural habitats; or natural heritage features identified in the National or Local BAP; if this has been prepared.<br>- Sites containing semi-natural habitat types with high biodiversity in a county context and a high degree of naturalness, or populations of species that are uncommon within the county.<br>- Sites containing habitats and species that are rare or are undergoing a decline in quality or extent at a national level. |
| **Local Importance (higher value)** | - Locally important populations of priority species or habitats or natural heritage features identified in the Local BAP, if this has been prepared;<br>- Resident or regularly occurring populations (assessed to be important at the Local level) of the following:<br>  o Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive;<br>  o Species of animal and plants listed in Annex II and/or IV of the Habitats Directive;<br>  o Species protected under the Wildlife Acts; and/or o<br>  o Species listed on the relevant Red Data list.<br>  o Sites containing semi-natural habitat types with high biodiversity in a local context and a high degree of naturalness, or populations of species that are uncommon in the locality;<br>- Sites or features containing common or lower value habitats, including naturalised species that are nevertheless essential in maintaining links and ecological corridors between features of higher ecological value. |
| **Local Importance (lower value)** | - Sites containing small areas of semi-natural habitat that are of some local importance for wildlife;<br>- Sites or features containing non-native species that is of some importance in maintaining habitat links. |

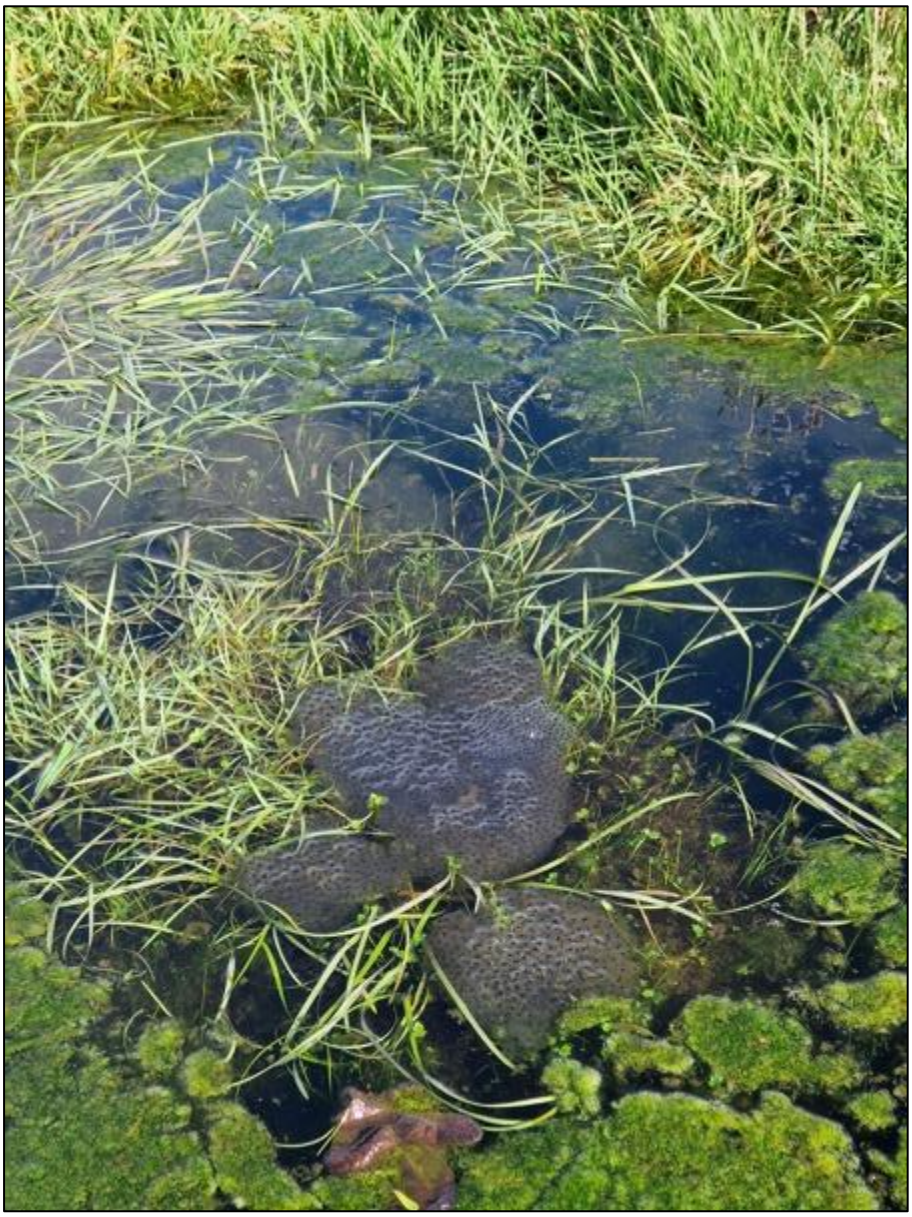
# Appendix 11.3 Amphibian Report

May 2025

McCutcheon Halley
CHARTERED PLANNING CONSULTANTS

# Amphibian Survey Report
# Haggardstown, Co. Louth
**February - April 2025**





**Rob Gandola – Herpetological Surveys**

**Mountain View Lodge, Laragh, Co. Wicklow, A98X628**

**Email: robgandola@gmail.com**

**Tel:+353868629113**

## Executive Summary



This amphibian report has been prepared by R Gandola on behalf of Enviroguide, a DNV Company to inform an associated EIAR as part of a planning application for a new Large-scale Residential Development (LRD) on lands at Haggardstown, Dundalk, Co. Louth. This report details the results of specialist amphibian surveys undertaken in the context of the overall development masterplan and provides realistic and workable recommendations on future impact mitigation where they may arise.

The survey site at Haggardstown is located in a coastal suburban landscape at the edge of Dundalk Bay SAC and bounded by existing residential, green amenity and improved grassland areas. The survey area incorporates areas of dry grassland, wet grassland, wet woodland, mature hedgerows and cleared bare ground.

Evidence of a small resident breeding population of the common frog, *Rana temporaria*, was obtained within a ponding area to the south east of the site. The smooth newt, *Lissotriton vulgaris*, was not detected in any of the surveyed habitats or waterlogged features on-site. While the pond habitat is currently the only known area capable of sustaining any amphibian populations, this habitat is likely to be ephemeral in nature and capable of only supporting a small resident population as evidenced by the low spawn clump count (n=17). Most, if not all, of the other "wet" features- generally flooded piling pits and heavy machine rutting, were ephemeral in nature and had disappeared by the final survey.

The wet, grassy south-eastern "arm" of the site initially appeared to offer marginally suitable habitat for amphibians and potentially also common lizards, however our surveys revealed that this suitability is likely to be superficial.

The proposed development will result in the clearance of most of the site and the construction of residential properties, internal roads and amenity space. The use of heavy machinery in areas prone to water-logging after pluvial events present a risk of increasing the suitability of the site for breeding amphibians. To off-set the chances of creating a problem all trial and piling pits should be backfilled as soon as feasible or covered with sheeting to prevent access. Heavy machine depressions should be smoothed out with a bucket where possible. These simple measures should ensure that wildlife is not permitted to colonise these features once construction works begin. Subject to these measures, any long-term impacts on amphibian populations in the vicinity from this development is likely to be negligible.

## LICENCE

All surveys and handling of wildlife was conducted under licence from the National Parks and Wildlife Service No. **C028/2025** (R Gandola)

## COPYRIGHT



## THIRD PARTY DISCLAIMER

# TABLE OF CONTENTS

**THINGS TO CONSIDER WHEN READING THIS REPORT**



1. Unless explicitly stated, it would be inappropriate to use the data in this report to infer the total population size of a species detected i.e. any figure provided for a given species is likely to be an underestimate. Spawn counts are an indication of breeding effort in any given year only and can be highly variable from year to year depending on a wide range of factors.

2. While it is difficult to definitively rule out the presence or absence of any widespread and cryptic species, the methodologies employed and experience of the surveyor does enable a realistic and confident opinion to be made on the likelihood of the presence or absence of a particular species. However, it is advised that developers employ the precautionary principle when dealing with widespread species and always assume that there is potential for such species to be discovered during development works and be prepared to mitigate.

3. Regarding the requirement of licensing for deliberate disturbance, destruction or modification of a known breeding and foraging habitat of a species protected under the Wildlife Act 1976 (2000 & amendments), but not an Annex IV (EU Habitats Directive) listed species, a derogation license is **not** necessary and a possible exemption also exists:
***"S23.7 (c)- Notwithstanding subsection (5) of this section, it shall not be an offence for a person— while constructing a road or while carrying on any archaeological operation, building operation or work of engineering construction, or while constructing or carrying on such other operation or work as may be prescribed, [to] unintentionally to kill or injure such an animal or unintentionally to destroy or injure the breeding place or resting place] of such an animal".*** While this contradicts S23.5 (d) of the Wildlife Act – it remains a grey area that is yet to be tested in court yet may be clarified in forthcoming amendments to the Wildlife Act. Therefore, current working norms suggest that derogation licences are not required for native herpetofauna species other than Natterjack toad, *Epidalea calamita*.

Nevertheless, best practice dictates that where a known breeding habitat is to be disturbed, or lost entirely for a protected amphibian species (as in the case for *R. temporaria* and *L. vulgaris* in Ireland), then mitigation measures in the form of provision of - substitute wetland habitat(s), habitat enhancement(s), or other features that may be considered "no net loss" or even "net gain" for the species should be incorporated into the final landscape design.

# 1. INTRODUCTION



## 1.1 BACKGROUND

As part of informing an EIAR to accompany an application for a Large-scale Residential Development, R Gandola was commissioned by Enviroguide, a DNV Company to carry out a series of amphibian surveys within the boundaries of the proposed development site at Haggardstown, Co. Louth. The aim of these surveys was to provide an assessment on the occupancy and distribution, and identify any features of importance, for any resident amphibian populations that maybe be present within the site boundaries.

Two species – Common frog (*Rana temporaria*), smooth newt (*Lissotriton vulgaris*) comprise the native amphibian fauna of County Louth. Of these species, the common frog is the most widespread and inhabits a wide array of habitats, both terrestrial and aquatic, including urban wetlands, greenspaces, and gardens. The smooth newt, while also widely distributed tends to prefer habitats in proximity to vegetated pools and ponds, where they must return to breed.

The proposed site comprises a small number of wetland and terrestrial habitat types and ecotone features potentially suitable for both species. It is also in close proximity to Dundalk Bay SAC (<10m) with regular movement of wildlife between the two sites highly likely.

Based on the results of these surveys, the potential impacts of the proposed development on any resident amphibian species are assessed in Section 4 of this report. Recommendations are also made in relation towards reducing the need to mitigate against impacts on native amphibian fauna.

## 1.2 STATEMENT OF AUTHORITY

All surveying and report writing was conducted by R Gandola. He has an MSc in Ecology from Bangor University, Wales and a BSc (hons) Zoology from UCD. He provides training and professional advice to Local and National Authorities, heritage rangers, eNGOs, and

community groups in Ireland and Northern Ireland, and regularly carries out surveys and implements monitoring projects on their behalf.



### 1.3 CONSERVATION AND LEGAL STATUS OF AMPHIBIANS AND REPTILES (HERPETOFAUNA) IN IRELAND

Both amphibian species in this assessment are protected under the Wildlife Act and amendments (1976, 2000) whereby it is an offence to kill, to deliberately disturb during breeding, rearing, hibernation or migration, or to damage a breeding site or resting place. The common frog is also protected under international legislation (EU Habitats Directive 92/43/EEC [Article 17 / Annex V]). Both common frogs and smooth newts have a listed status of "Least Concern" on the Irish Red List.

## 2. METHODOLOGY

### 2.1 SURVEY AREA

The proposed site for development is located in a coastal suburban landscape at the edge of a development and Finnabair industrial zone (north), the town of Blackrock (south), Dundalk Golf Club (west) and Dundalk Bay to the east in Co. Louth, to which it has a hydrological connection. The survey area incorporates approximately 18ha of grassland, mature hedgerows, wet grassland, wet woodland, and cleared bare ground. The site also contains smaller elements of wet grassland (GS4), a pond (FL8), wet woodland (WN6) and scrub habitats (WS1) that potentially provide suitable habitats for amphibians (habitat codes as per Fossitt, 2000).

### 2.2 DESKTOP STUDY

A comprehensive search of all relevant and publicly accessible databases (NBDC, iNaturalist, etc.), grey literature, and other sources was conducted prior to the onset of surveys. Search criteria was limited to approximately a 2km buffer from the proposed development site. This limitation is based on realistic dispersal capabilities of the species being surveyed and the

availability of dispersal corridors in this area. Any records west of the N52 or M1 were excluded for the same reasons.



### 2.3 FIELD SURVEYS

Standard survey methods and minimum survey effort appropriate for detecting amphibians i.e. a minimum of four visits with diurnal and nocturnal visual encounter searches and dip netting, were employed (Sewell et al. 2013). Due to the presence of only a single pond, BO trapping was not utilised. All pools and flooded areas of standing water were inspected visually and, where deep enough, netted. Any natural or artificial refugia present on site were inspected where possible. All surveys were conducted under optimal weather conditions for native amphibians with a minimum of a seven (7) day interval between surveys. This was to ensure that all parts of the site had an equal opportunity to be appraised under optimal survey conditions (i.e all potentially important landscape features were surveyed during the onset of the amphibian breeding season). All sightings of a focal species were recorded on a Garmin 60CSx GPS unit or suitably equipped smart phone.

## 3. RESULTS

### 3.1 SURVEY AREA

In addition to the small pond in the south east of the site, shallow pools of a variety of sizes and depths were present within the small block of wet woodland, wet grassland. Machine clearance and excavations towards the centre of the site also created multiple flooded and ponding areas. All of these waterbodies potentially offered suitable breeding habitats for amphibians irrespective of their ephemerality. The subsoil on site appeared to be dominated by heavy boulder-clay which has naturally low permeability and will have aided the formation of the flooded ruts and depressions seen on-site. The sloping topography, high water-table and small stream that drains the south-eastern most section of the site will have aided with the formation of the wet grassland and small wet woodland habitats in this area.

## 3.2 DESKTOP STUDY

A total of five (5) historical records were discovered within a 2km radius of the proposed development (Annex A1.1). All of these (4 X common frog & 1 X smooth newt) were identified as being of relevance to this assessment. Four of the five records have been provided as records from to private gardens. Only one record (that of common frog sighted on the adjoining Dundalk golf course) is likely to be of any significance to this survey.



## 3.3 FIELD SURVEYS

Surveying took place on four occasions during periods of suitable weather between February and April 2025 **(**Table 1**).**

**TABLE 1. TIMINGS AND CLIMATIC CONDITIONS ON SURVEY OCCASSIONS**

| DATE | AIR TEMP (°C) | CLOUD COVER (%) | WIND | RAIN |
|---|---|---|---|---|
| **25/02/2025** | 10 | 0 | light | N |
| **10/03/2025** | 10 | 10 | strong | N |
| **24/03/2025** | 10 | 100 | light | N |
| **1/04/2025** | 11 | 0 | strong | N |

A raft of common frog spawn, composed of approximately seventeen (17) clumps were detected over the course of the first (n = 10) and second (n= 7) surveys within the pond to the south east of the site. No other encounters with common frog or their spawn occurred in this wet grassland area or any of the other habitats present within the site boundaries. These findings classify the resident frog population as being of "lower value" yet that doesn't not necessarily reduce their local importance.

The smooth newt, *Lissotriton vulgaris*, was not detected during surveying. The pond was the only habitat capable of offering suitable breeding habitat for *L. vulgaris*. Almost all the other areas with standing water had completely dried out before the final survey.

While the availability of scrub and grassland habitats initially appeared to be suitable terrestrial habitat for both amphibian species, closer inspection revealed that the scrub habitats in particular are likely recent growth with little connectivity and a high likelihood of being superficially suitable i.e. it appears to have some suitable elements (gorse) but these are too small in size and lack the overall structural complexity and connectivity required by either *Rana temporaria* or *Lissotriton vulgaris*.



## OTHER SPECIES

### Common lizard, *Zootoca vivipara*

The wet grassland scrub area at the most south-eastern boundary offers suitable basking and foraging habitat for the common lizard. However, the most suitable sections of this area are limited in size. No common lizards were detected with the boundaries of the entire site when surveyed under optimal conditions.

### Wetland flora

A limited survey of the wetland flora present on site did not reveal any unusual or rare species. The species most frequently encountered were typical natives of wet grassland, ditch and wet woodland habitats and comprised Yellow Flag, *Iris pseudacorous*, *Ranunculus sp*, Alder, (*Alnus glutinosa*), *Arum sp.*, Fool's Watercress (*Helosciadium nodiflorum*), Brooklime (*Veronica beccabunga*), Rushes (*Juncus sp.)* and rank grass (*Glyercia sp*).

The pond area was suffering from eutrophication with heavy algal growth. However, *Calltriche stagnalis*, *Ranunculus sp.*, *Potamogeton sp.* were identified with the latter species found in only the deepest part of the pond (30-40cm),

### Avifauna

Ten individual singing skylarks (*Alauda arvensis*) were detected towards the center of the site. While still early in the known breeding season, this may indicate that they were beginning to hold territories. Proximity to the Dundalk Bay SAC the coastal habitats therein is likely to be a draw for this species.




**Figure 1. A map detailing the site boundary line at Haggardstown and potential areas of importance to amphibians**

# 4. IMPACT ASSESSMENT



## 4.1 POTENTIAL DETRIMENTAL IMPACTS

**Inadvertently creating dead-end breeding habitats**

The use of heavy machinery in permanently, frequently water-logged or other areas where the water table is close to the surface presents a risk that works could in fact increase the suitability of the site via flooded excavations or machine track depressions for breeding amphibians, particularly common frogs. Therefore, caution is needed during the construction phase as any hollows or depressions created are likely to form suitable breeding habitats for the resident frog population due to the nature of the underlying topography, soil type, and hydrology.

**Accidental mortality & population decline**

As stated above, the clearance and construction works would undoubtedly pose a risk of accidental killing or injury of common frogs and or smooth newts should they migrate into the construction zone. As this type of mortality is in contravention of both the Wildlife Act 1976 (and amendments) and the EU Habitats Directive it would be prudent to ensure that the wetland habitats and any temporary waterlogged features are not inadvertently allowed to offer suitable breeding habitat for prolonged periods of times. This includes leaving heavy machinery tracks and typical construction endeavours (e.g percolation test pits, excavations for footings etc.) uncovered .Therefore all excavation works should be completed as soon is feasible or at least covered with sheeting to prevent access by wildlife. Where possible, heavy machine depressions should be smoothed out. The specific aim of appropriate mitigation at this site should be to ensure that the construction works do not make the site more favourable to any amphibian populations that may exist either on-site or on the adjoining golf course.

## 4.2 MITIGATION MEASURES FOR AMPHIBIANS

To mitigate the against colonisation of the construction zone by native amphibians, excavation works should begin after the dispersal period of the current year's cohort of young amphibians (i.e excavation works should be completed between the period of September and early February). If feasible, an appropriate exclusion barrier to prevent entry and divert any amphibians away from the works may also offer increased certainty that the site retains an

"amphibian free" status. Any installed fencing should be accompanied by an accompanying precautionary survey to ensure that amphibians are not present prior to the initiation of clearance works. This ensures animals will not be locked into the works area. In the event that amphibians (of any life stage) are detected, they should be captured and / or translocated from the site by the Ecological Clerk of Works (ECoW). Immature or adult frogs or newts should be moved beyond the exclusion fence whereas tadpoles and spawn should be translocated to the nearest suitable waterbody within 1-2km distance. If any habitats, waterbody or flooded depressions need to be drained or pumped to facilitate works, it should be done under the supervision of a suitably experienced ecologist/ EcoW to ensure that no amphibians or their larvae are present before the habitat is infilled or otherwise destroyed. Mechanical pumps should be fitted with a fine mesh screen in order to negate the chances of frogs or their larvae being sucked into the impeller mechanism. All capture and translocation works should be undertaken immediately in advance of site clearance works and under specific licence from National Parks and Wildlife Service.



The long-term impact of this development at Haggardstown on any amphibian populations (known or unknown) that may exist onsite or on adjoining sites of this development is likely to be negligible with little to no long term negative impacts. This assessment is qualified by reasoning that the Dundalk Golf Course is likely offering better quality habitats for any resident amphibian populations and there is no barrier to dispersal from the proposed development site into the golf course.

It is advisable that all options be considered prior to the initiation of works to reduce the chances of negative interactions with protected native amphibian species. A suitably qualified and licenced Ecological Clerk of Works should be retained for the duration of the construction phase of the development.

# 5. RECOMMENDATIONS



- Institute and adhere to a code of best practice when operating heavy machinery in the areas identified as vulnerable to accidental creation of amphibian suitable ponds, pools and flooded depressions

- Retain a suitably qualified and licenced Ecological Clerk of Works during the construction phase to safely move any amphibians encountered away from the works zone

- Employ the precautionary principle when dealing with widespread and cryptic species i.e assume they are there and plan appropriately with the ECoW

- Install any exclusion barriers and/or temporary landscaping prior to the breeding season to divert amphibians away from the works zone.

- Where possible, work from the middle of the site outwards towards the boundaries with controlled removal of the scrub areas and hedgerows i.e sequentially rather than all at once.

- Where possible, create appropriately designed SuDs to manage rainfall and surface water

- Silt/petrol traps should be installed upstream of any SUDs or surface water or drainage infrastructure. This is particularly pertinent due to the proximity of the site to Dundalk bay SAC

# 6. CONCLUSION

If planning permission is granted to the proposed development at Haggardstown, with cognisance of the recommendations and mitigation options provided herein, then any impacts on any amphibian populations that may exist within the scope of this development, are likely to be negligible with no long-term impacts.

# APPENDIX 1



**Table A1.1 Results of Desk study to within 2km of the proposed development**

| Species | Common name | Lat | Lon | Year | Distance from development (m) | Source |
|---|---|---|---|---|---|---|
| Rana temporaria | Common frog | 53.974494 | -6.3789625 | 2018 | 325 | NBDC |
| Rana temporaria | Common frog | 53.965389 | -6.3701717 | 2005 | 1160 | NBDC |
| Rana temporaria | Common frog | 53.970269 | -6.3989411 | 2018 | 1700 | NBDC |
| Rana temporaria | Common frog | 53.98053 | -6.38167 | 2024 | 500 | iNaturalist |
| Lissotriton vulgaris | Smooth newt | 53.998949 | -6.3932648 | 2023 | 2670 | NBDC |
| | | | | | | |

# Appendix 11.4 Bat Survey Results

May 2025

McCutcheon Halley
CHARTERED PLANNING CONSULTANTS

# APPENDIX 11.4: Bat Survey Results

**Table 1: Dusk Transect Bat Survey Results – 25th May 2023**

**Table 2: Dusk Transect Bat Survey Results – 13th June 2023**

**Table 3: Dusk Transect Bat Survey Results – 21st June 2023**

**Table 4: Emergence Bat Survey Results – 30th May 2023 (Results of both structures combined)**

**Table 5: Dusk Transect Bat Survey Results – 7th October 2024**

**Table 1: Dusk Transect Bat Survey Results – 25th May 2023**

| Recording | Timestamp | Species Text | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] | Latitude [WGS84] | Longitude [WGS84] |
|---|---|---|---|---|---|---|---|---|---|---|
| 3750005 | 25 May 2023 21:46:00 | Leisler's Bat | 3 | 25.8 | 26.9 | 23.5 | 8.7 | 817 | 53.97778 | -6.37679 |
| 3750006 | 25 May 2023 21:46:02 | Leisler's Bat | 3 | 22.3 | 23.4 | 21.1 | 13.7 | 437 | 53.97778 | -6.37679 |
| 3750021 | 25 May 2023 21:50:59 | Soprano Pipistrelle | 11 | 54.5 | 58.9 | 53.9 | 6 | 260 | 53.97778 | -6.37676 |
| 3750022 | 25 May 2023 21:57:46 | Leisler's Bat | 9 | 22.2 | 23 | 21.3 | 15 | 370 | 53.97641 | -6.37546 |
| 3750023 | 25 May 2023 22:00:20 | Leisler's Bat | 2 | 20.4 | 21.4 | 19.5 | 18.4 | 495 | 53.97609 | -6.37532 |
| 3750024 | 25 May 2023 22:00:34 | Leisler's Bat | 9 | 23.9 | 25.8 | 22.9 | 16 | 210 | 53.97608 | -6.37532 |
| 3750025 | 25 May 2023 22:00:37 | Leisler's Bat | 5 | 23.2 | 24.4 | 21.7 | 16 | 471 | 53.97608 | -6.37532 |
| 3750030 | 25 May 2023 22:05:25 | Leisler's Bat | 1 | 22.5 | 24 | 21.8 | 16.5 | 0 | 53.97523 | -6.37439 |
| 3750032 | 25 May 2023 22:05:46 | Leisler's Bat | 17 | 24.8 | 28.3 | 22.7 | 13 | 200 | 53.97523 | -6.3744 |
| 3750033 | 25 May 2023 22:05:51 | Leisler's Bat | 4 | 23.9 | 24.8 | 22 | 15.7 | 331 | 53.97522 | -6.37439 |
| 3750034 | 25 May 2023 22:05:52 | Leisler's Bat | 3 | 23 | 24.8 | 21.9 | 16 | 375 | 53.97522 | -6.37439 |

| Recording | Timestamp | Species Text | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] | Latitude [WGS84] | Longitude [WGS84] |
|---|---|---|---|---|---|---|---|---|---|---|
| 3750037 | 25 May 2023 22:06:56 | Leisler's Bat | 3 | 23.6 | 24.6 | 22.6 | 14.8 | 751 | 53.97492 | -6.37432 |
| 3750038 | 25 May 2023 22:06:59 | Leisler's Bat | 3 | 24.5 | 28.8 | 20.3 | 9.1 | 180 | 53.97491 | -6.37432 |
| 3750039 | 25 May 2023 22:07:03 | Leisler's Bat | 6 | 24.9 | 27.5 | 23.9 | 12 | 295 | 53.9749 | -6.37429 |
| 3750045 | 25 May 2023 22:09:20 | Soprano Pipistrelle | 14 | 52.5 | 79.1 | 51.7 | 3 | 80 | 53.97476 | -6.37413 |
| 3750046 | 25 May 2023 22:09:30 | Soprano Pipistrelle | 8 | 53.3 | 69.9 | 52.4 | 2 | 160 | 53.97476 | -6.37412 |
| 3750057 | 25 May 2023 22:11:48 | Soprano Pipistrelle | 3 | 61.6 | 67.5 | 60.8 | 4.3 | 50 | 53.97475 | -6.37412 |
| 3750058 | 25 May 2023 22:11:49 | Soprano Pipistrelle | 17 | 61.3 | 73.4 | 60.6 | 3 | 80 | 53.97474 | -6.37412 |
| 3750060 | 25 May 2023 22:12:31 | Leisler's Bat | 9 | 24.3 | 25.5 | 23.1 | 13 | 230 | 53.97475 | -6.37409 |
| 3750061 | 25 May 2023 22:12:40 | Leisler's Bat | 0 | 0 | 0 | 0 | 0 | 0 | 53.97475 | -6.37411 |
| 3750062 | 25 May 2023 22:13:01 | Leisler's Bat | 3 | 24 | 24.6 | 23.1 | 12.4 | 336 | 53.97472 | -6.37413 |
| 3750063 | 25 May 2023 22:13:21 | Soprano Pipistrelle | 17 | 66.5 | 104.8 | 65.1 | 3 | 80 | 53.97473 | -6.37416 |

| Recording | Timestamp | Species Text | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] | Latitude [WGS84] | Longitude [WGS84] |
|---|---|---|---|---|---|---|---|---|---|---|
| 3750064 | 25 May 2023 22:13:57 | Soprano Pipistrelle | 20 | 49.4 | 57.7 | 48.5 | 5 | 90 | 53.97477 | -6.374 |
| 3750067 | 25 May 2023 22:20:01 | Leisler's Bat | 0 | 0 | 0 | 0 | 0 | 0 | 53.9762 | -6.37322 |
| 3750088 | 25 May 2023 22:32:51 | Leisler's Bat | 0 | 0 | 0 | 0 | 0 | 0 | 53.97714 | -6.37185 |
| 3750089 | 25 May 2023 22:32:52 | Leisler's Bat | 0 | 0 | 0 | 0 | 0 | 0 | 53.97714 | -6.37185 |
| 3750090 | 25 May 2023 22:32:54 | Leisler's Bat | 0 | 0 | 0 | 0 | 0 | 0 | 53.97714 | -6.37185 |
| 3750091 | 25 May 2023 22:32:56 | Leisler's Bat | 0 | 0 | 0 | 0 | 0 | 0 | 53.97714 | -6.37185 |
| 3750092 | 25 May 2023 22:33:00 | Leisler's Bat | 1 | 21.8 | 22.1 | 21 | 16 | 0 | 53.97714 | -6.37185 |
| 3750111 | 25 May 2023 22:36:38 | Soprano Pipistrelle | 35 | 52.6 | 94.7 | 52 | 4 | 80 | 53.97713 | -6.37186 |
| 3750113 | 25 May 2023 22:48:05 | Soprano Pipistrelle | 3 | 46 | 50.8 | 45.1 | 4.8 | 139 | 53.97567 | -6.37035 |
| 3750119 | 25 May 2023 22:50:16 | Soprano Pipistrelle | 63 | 51.4 | 79.1 | 50.3 | 3 | 80 | 53.97565 | -6.37035 |
| 3750120 | 25 May 2023 22:50:30 | Leisler's Bat | 1 | 22.9 | 23.3 | 22.5 | 19.7 | 0 | 53.97565 | -6.37035 |

| Recording | Timestamp | Species Text | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] | Latitude [WGS84] | Longitude [WGS84] |
|---|---|---|---|---|---|---|---|---|---|---|
| 3750121 | 25 May 2023 22:50:32 | Leisler's Bat | 1 | 22.9 | 23.3 | 22.5 | 17.1 | 0 | 53.97565 | -6.37035 |
| 3750122 | 25 May 2023 22:50:35 | Leisler's Bat | 1 | 25.1 | 25.5 | 24.4 | 21.3 | 0 | 53.97565 | -6.37035 |
| 3750123 | 25 May 2023 22:50:39 | Leisler's Bat | 1 | 22.5 | 23.3 | 22.1 | 17.6 | 0 | 53.97565 | -6.37036 |
| 3750124 | 25 May 2023 22:50:40 | Leisler's Bat | 3 | 27 | 28.1 | 24.8 | 15.8 | 1318 | 53.97565 | -6.37036 |
| 3750125 | 25 May 2023 22:50:44 | Leisler's Bat | 3 | 24.1 | 25.6 | 23.5 | 16.2 | 386 | 53.97565 | -6.37035 |
| 3750126 | 25 May 2023 22:50:49 | Soprano Pipistrelle | 7 | 51.9 | 81.1 | 50.7 | 3 | 70 | 53.97565 | -6.37035 |
| 3750128 | 25 May 2023 22:51:19 | Soprano Pipistrelle | 9 | 51.1 | 78.3 | 50.3 | 4 | 70 | 53.97565 | -6.37036 |
| 3750137 | 25 May 2023 22:59:26 | Soprano Pipistrelle | 22 | 56.8 | 80.7 | 55.9 | 5 | 50 | 53.97621 | -6.36825 |
| 3750141 | 25 May 2023 23:02:12 | Soprano Pipistrelle | 22 | 54 | 78.5 | 53.3 | 6 | 90 | 53.97654 | -6.36708 |
| 3750145 | 25 May 2023 23:03:32 | Soprano Pipistrelle | 19 | 49.2 | 81 | 48.4 | 5 | 90 | 53.97654 | -6.36705 |
| 3750146 | 25 May 2023 23:04:28 | Soprano Pipistrelle | 6 | 50.8 | 61 | 49.9 | 3 | 175 | 53.9766 | -6.36675 |

| Recording | Timestamp | Species Text | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] | Latitude [WGS84] | Longitude [WGS84] |
|---|---|---|---|---|---|---|---|---|---|---|
| 3750148 | 25 May 2023 23:05:04 | Soprano Pipistrelle | 37 | 51.4 | 72.8 | 49.5 | 4 | 84 | 53.97667 | -6.36653 |
| 3750149 | 25 May 2023 23:06:01 | Soprano Pipistrelle | 4 | 46.9 | 50.4 | 46.1 | 5.6 | 336 | 53.97669 | -6.36651 |
| 3750150 | 25 May 2023 23:06:14 | Soprano Pipistrelle | 1 | 62.3 | 63.4 | 61.9 | 4.3 | 0 | 53.97669 | -6.36651 |
| 3750151 | 25 May 2023 23:06:15 | Soprano Pipistrelle | 17 | 62.6 | 79.4 | 61.3 | 6 | 80 | 53.97669 | -6.36651 |
| 3750152 | 25 May 2023 23:06:19 | Soprano Pipistrelle | 24 | 61.5 | 84.6 | 60.7 | 5 | 80 | 53.97669 | -6.36651 |
| 3750154 | 25 May 2023 23:08:28 | Soprano Pipistrelle | 13 | 49.4 | 78.2 | 48.8 | 5 | 158 | 53.97686 | -6.36584 |
| 3750155 | 25 May 2023 23:09:00 | Common Pipistrelle | 5 | 45.5 | 46.8 | 44.9 | 8.4 | 409 | 53.97688 | -6.36571 |
| 3750156 | 25 May 2023 23:09:21 | Common Pipistrelle | 10 | 47.6 | 48.9 | 46.9 | 7 | 225 | 53.97689 | -6.36567 |
| 3750157 | 25 May 2023 23:10:30 | Soprano Pipistrelle | 12 | 45.2 | 50.8 | 44.3 | 4 | 185 | 53.97694 | -6.36539 |
| 3750158 | 25 May 2023 23:10:35 | Soprano Pipistrelle | 7 | 49.7 | 54.8 | 48.8 | 4.5 | 395 | 53.97694 | -6.36538 |
| 3750159 | 25 May 2023 23:10:47 | Soprano Pipistrelle | 12 | 45.5 | 52.8 | 44.6 | 4 | 100 | 53.97694 | -6.36537 |

| Recording | Timestamp | Species Text | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] | Latitude [WGS84] | Longitude [WGS84] |
|---|---|---|---|---|---|---|---|---|---|---|
| 3750160 | 25 May 2023 23:10:49 | Soprano Pipistrelle | 14 | 45.6 | 54.4 | 44.8 | 4 | 86 | 53.97695 | -6.36537 |
| 3750161 | 25 May 2023 23:11:02 | Soprano Pipistrelle | 10 | 46.2 | 58.8 | 45.4 | 4 | 90 | 53.97695 | -6.36536 |
| 3750162 | 25 May 2023 23:11:03 | Soprano Pipistrelle | 39 | 45.5 | 54.1 | 44.7 | 4 | 90 | 53.97695 | -6.36536 |
| 3750163 | 25 May 2023 23:11:48 | Soprano Pipistrelle | 25 | 53.5 | 60.4 | 52.6 | 6 | 84 | 53.97696 | -6.36535 |
| 3750164 | 25 May 2023 23:12:05 | Soprano Pipistrelle | 5 | 48.1 | 53.2 | 47.3 | 7.8 | 144 | 53.97696 | -6.36535 |
| 3750165 | 25 May 2023 23:12:07 | Soprano Pipistrelle | 27 | 47.1 | 64 | 46.2 | 6 | 95 | 53.97696 | -6.36535 |
| 3750166 | 25 May 2023 23:12:32 | Soprano Pipistrelle | 27 | 45.4 | 57.7 | 44.6 | 5 | 90 | 53.977 | -6.36523 |
| 3750167 | 25 May 2023 23:13:03 | Common Pipistrelle | 14 | 43.3 | 49 | 42.8 | 4 | 182 | 53.97702 | -6.3651 |
| 3750168 | 25 May 2023 23:13:24 | Common Pipistrelle | 21 | 44.1 | 52 | 43.4 | 4 | 90 | 53.97702 | -6.36506 |
| 3750169 | 25 May 2023 23:13:34 | Common Pipistrelle | 7 | 44.3 | 50.2 | 43.9 | 4.7 | 203 | 53.97702 | -6.36506 |
| 3750170 | 25 May 2023 23:13:41 | Soprano Pipistrelle | 25 | 44.6 | 54.4 | 44 | 3 | 90 | 53.97702 | -6.36506 |

| Recording | Timestamp | Species Text | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] | Latitude [WGS84] | Longitude [WGS84] |
|---|---|---|---|---|---|---|---|---|---|---|
| 3750171 | 25 May 2023 23:13:55 | Soprano Pipistrelle | 19 | 45.8 | 59.1 | 45.1 | 3 | 90 | 53.97702 | -6.36506 |
| 3750172 | 25 May 2023 23:14:10 | Soprano Pipistrelle | 18 | 44.4 | 52.7 | 43.7 | 4 | 100 | 53.97702 | -6.36505 |
| 3750173 | 25 May 2023 23:15:16 | Common Pipistrelle | 5 | 42.9 | 47.6 | 42.4 | 4 | 158 | 53.97702 | -6.36506 |
| 3750174 | 25 May 2023 23:15:18 | Common Pipistrelle | 12 | 44.7 | 52.1 | 44.2 | 4 | 70 | 53.97702 | -6.36506 |
| 3750175 | 25 May 2023 23:15:21 | Common Pipistrelle | 23 | 43.1 | 59.5 | 42.3 | 5 | 93 | 53.97702 | -6.36506 |
| 3750176 | 25 May 2023 23:16:07 | Common Pipistrelle | 16 | 43.1 | 50.9 | 42.4 | 5 | 150 | 53.97702 | -6.36506 |
| 3750177 | 25 May 2023 23:16:16 | Common Pipistrelle | 14 | 43.3 | 51.8 | 42.6 | 4 | 130 | 53.97702 | -6.36506 |
| 3750178 | 25 May 2023 23:16:25 | Common Pipistrelle | 7 | 43.9 | 50 | 43.2 | 4 | 206 | 53.97702 | -6.36506 |
| 3750179 | 25 May 2023 23:16:37 | Common Pipistrelle | 11 | 44.2 | 53.5 | 43.5 | 3 | 75 | 53.97702 | -6.36505 |
| 3750180 | 25 May 2023 23:16:47 | Common Pipistrelle | 12 | 43.8 | 52.5 | 42.7 | 5 | 175 | 53.97705 | -6.36498 |
| 3750181 | 25 May 2023 23:17:22 | Common Pipistrelle | 2 | 43.1 | 43.9 | 42.4 | 7.2 | 357 | 53.97715 | -6.36476 |

| Recording | Timestamp | Species Text | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] | Latitude [WGS84] | Longitude [WGS84] |
|---|---|---|---|---|---|---|---|---|---|---|
| 3750186 | 25 May 2023 23:19:20 | Soprano Pipistrelle | 3 | 49.9 | 57.9 | 48.8 | 3.4 | 445 | 53.97719 | -6.36476 |
| 3750187 | 25 May 2023 23:19:23 | Soprano Pipistrelle | 1 | 48.8 | 51 | 46.9 | 3.2 | 0 | 53.9772 | -6.36476 |
| 3750189 | 25 May 2023 23:19:50 | Soprano Pipistrelle | 6 | 48.4 | 55.9 | 47.5 | 6 | 473 | 53.9772 | -6.36475 |
| 3750192 | 25 May 2023 23:20:32 | Soprano Pipistrelle | 15 | 48 | 64.1 | 47.4 | 4 | 140 | 53.9772 | -6.36476 |
| 3750194 | 25 May 2023 23:21:07 | Soprano Pipistrelle | 12 | 50.2 | 67.4 | 48.6 | 5 | 90 | 53.9772 | -6.36477 |
| 3750204 | 25 May 2023 23:22:27 | Soprano Pipistrelle | 8 | 48.1 | 55.5 | 47.5 | 4 | 157 | 53.9772 | -6.36476 |
| 3750219 | 25 May 2023 23:27:15 | Soprano Pipistrelle | 11 | 46.7 | 53.2 | 46.1 | 4 | 85 | 53.9769 | -6.36567 |
| 3750220 | 25 May 2023 23:27:22 | Soprano Pipistrelle | 22 | 46.2 | 57.5 | 45.5 | 6 | 90 | 53.97689 | -6.36572 |
| 3750221 | 25 May 2023 23:27:37 | Soprano Pipistrelle | 18 | 46.1 | 57.6 | 45.4 | 6 | 90 | 53.97688 | -6.36587 |
| 3750222 | 25 May 2023 23:27:48 | Soprano Pipistrelle | 10 | 46 | 57.2 | 45.5 | 6 | 160 | 53.97686 | -6.36598 |
| 3750223 | 25 May 2023 23:28:00 | Soprano Pipistrelle | 10 | 47.2 | 58.4 | 46.1 | 6 | 137 | 53.97684 | -6.36608 |

| Recording | Timestamp | Species Text | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] | Latitude [WGS84] | Longitude [WGS84] |
|---|---|---|---|---|---|---|---|---|---|---|
| 3750225 | 25 May 2023 23:28:50 | Soprano Pipistrelle | 25 | 57.4 | 84.9 | 56.6 | 4 | 80 | 53.97665 | -6.36662 |
| 3750226 | 25 May 2023 23:28:55 | Soprano Pipistrelle | 5 | 64.3 | 74.7 | 63 | 3 | 133 | 53.97665 | -6.36665 |
| 3750244 | 25 May 2023 23:38:03 | Leisler's Bat | 2 | 28.5 | 31.1 | 27.9 | 4.8 | 291 | 53.97714 | -6.36855 |
| 3750247 | 25 May 2023 23:38:30 | Leisler's Bat | 1 | 26.6 | 28.5 | 26.3 | 8 | 0 | 53.97715 | -6.36856 |
| 3750261 | 25 May 2023 23:47:31 | Soprano Pipistrelle | 15 | 52.3 | 72.9 | 50.7 | 4 | 214 | 53.97863 | -6.369 |
| 3750262 | 25 May 2023 23:48:35 | Soprano Pipistrelle | 8 | 50.8 | 62.6 | 49 | 4 | 184 | 53.97878 | -6.36903 |
| 3750263 | 25 May 2023 23:48:47 | Soprano Pipistrelle | 44 | 49.9 | 61.4 | 49 | 4 | 80 | 53.97882 | -6.36905 |
| 3750264 | 25 May 2023 23:48:56 | Soprano Pipistrelle | 57 | 45.3 | 68.3 | 44.2 | 5 | 90 | 53.97883 | -6.36908 |
| 3750265 | 25 May 2023 23:49:13 | Soprano Pipistrelle | 13 | 46.3 | 58.4 | 45.2 | 3 | 86 | 53.97885 | -6.36908 |
| 3750266 | 25 May 2023 23:49:16 | Soprano Pipistrelle | 34 | 45.6 | 67.7 | 44.5 | 5 | 94 | 53.97884 | -6.36909 |
| 3750267 | 25 May 2023 23:49:28 | Soprano Pipistrelle | 48 | 45.2 | 63.8 | 43.9 | 5 | 90 | 53.97885 | -6.36909 |

| Recording | Timestamp | Species Text | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] | Latitude [WGS84] | Longitude [WGS84] |
|---|---|---|---|---|---|---|---|---|---|---|
| 3750268 | 25 May 2023 23:49:44 | Soprano Pipistrelle | 69 | 46.1 | 66 | 44.8 | 4 | 90 | 53.97885 | -6.36909 |
| 3750269 | 25 May 2023 23:49:59 | Soprano Pipistrelle | 45 | 45.2 | 75.1 | 44.1 | 4 | 90 | 53.97884 | -6.36911 |
| 3750270 | 25 May 2023 23:50:07 | Common Pipistrelle | 19 | 42.4 | 78.8 | 41.8 | 5 | 90 | 53.97884 | -6.36912 |
| 3750271 | 25 May 2023 23:50:11 | Soprano Pipistrelle | 19 | 54.5 | 61.3 | 53.6 | 5 | 80 | 53.97884 | -6.36911 |
| 3750272 | 25 May 2023 23:50:23 | Common Pipistrelle | 19 | 44.7 | 57.4 | 43.4 | 6 | 275 | 53.97885 | -6.36911 |
| 3750273 | 25 May 2023 23:50:34 | Soprano Pipistrelle | 6 | 56.2 | 64.8 | 54.9 | 4 | 133 | 53.97886 | -6.36911 |
| 3750274 | 25 May 2023 23:50:37 | Soprano Pipistrelle | 17 | 55.4 | 74.5 | 53.6 | 5 | 80 | 53.97886 | -6.36911 |
| 3750275 | 25 May 2023 23:50:46 | Common Pipistrelle | 71 | 50.4 | 69.7 | 48.9 | 6 | 85 | 53.97887 | -6.36911 |
| 3750276 | 25 May 2023 23:50:58 | Soprano Pipistrelle | 3 | 58.9 | 66 | 56.9 | 5.7 | 77 | 53.97887 | -6.36911 |
| 3750277 | 25 May 2023 23:50:59 | Soprano Pipistrelle | 12 | 58.7 | 64.2 | 56.7 | 5 | 80 | 53.97887 | -6.36911 |
| 3750278 | 25 May 2023 23:51:11 | Soprano Pipistrelle | 15 | 54.1 | 61.1 | 52.2 | 6 | 140 | 53.97886 | -6.36911 |

| Recording | Timestamp | Species Text | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] | Latitude [WGS84] | Longitude [WGS84] |
|---|---|---|---|---|---|---|---|---|---|---|
| 3750279 | 25 May 2023 23:51:16 | Soprano Pipistrelle | 34 | 57.3 | 72.7 | 55.4 | 6 | 140 | 53.97886 | -6.36911 |
| 3750280 | 25 May 2023 23:51:30 | Soprano Pipistrelle | 51 | 58.7 | 72.4 | 56.9 | 6 | 80 | 53.97886 | -6.3691 |
| 3750281 | 25 May 2023 23:51:45 | Soprano Pipistrelle | 6 | 59.8 | 80.6 | 56.3 | 5.6 | 99 | 53.97885 | -6.36911 |
| 3750282 | 25 May 2023 23:51:47 | Soprano Pipistrelle | 3 | 58.3 | 64.4 | 57.5 | 3.4 | 191 | 53.97885 | -6.36911 |
| 3750283 | 25 May 2023 23:51:49 | Soprano Pipistrelle | 13 | 59.9 | 71.4 | 58.9 | 3 | 65 | 53.97886 | -6.3691 |
| 3750284 | 25 May 2023 23:51:52 | Soprano Pipistrelle | 29 | 59 | 73.8 | 57.8 | 5 | 80 | 53.97885 | -6.3691 |
| 3750285 | 25 May 2023 23:52:06 | Soprano Pipistrelle | 50 | 54.1 | 67.8 | 52.8 | 6 | 83 | 53.97885 | -6.36911 |
| 3750286 | 25 May 2023 23:52:20 | Soprano Pipistrelle | 58 | 55.3 | 78.8 | 53.3 | 6 | 75 | 53.97886 | -6.3691 |
| 3750287 | 25 May 2023 23:52:36 | Soprano Pipistrelle | 15 | 53.3 | 55.2 | 52 | 7 | 100 | 53.97892 | -6.36919 |
| 3750288 | 25 May 2023 23:52:41 | Soprano Pipistrelle | 79 | 55.3 | 82.6 | 53.5 | 5 | 80 | 53.97893 | -6.36922 |
| 3750289 | 25 May 2023 23:52:55 | Soprano Pipistrelle | 14 | 53.5 | 62.6 | 52.5 | 6 | 85 | 53.97896 | -6.3693 |

| Recording | Timestamp | Species Text | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] | Latitude [WGS84] | Longitude [WGS84] |
|---|---|---|---|---|---|---|---|---|---|---|
| 3750290 | 25 May 2023 23:52:58 | Soprano Pipistrelle | 27 | 54.1 | 71.1 | 52.8 | 5 | 86 | 53.97897 | -6.36929 |
| 3750291 | 25 May 2023 23:53:06 | Soprano Pipistrelle | 64 | 54.7 | 71.7 | 53.1 | 6 | 90 | 53.97898 | -6.3693 |
| 3750292 | 25 May 2023 23:53:19 | Soprano Pipistrelle | 42 | 55.4 | 66 | 53.3 | 6 | 85 | 53.97897 | -6.36931 |
| 3750293 | 25 May 2023 23:53:25 | Soprano Pipistrelle | 46 | 53.8 | 63.2 | 52.9 | 5 | 90 | 53.97897 | -6.36931 |
| 3750294 | 25 May 2023 23:53:34 | Soprano Pipistrelle | 15 | 54.6 | 63.9 | 53.6 | 4 | 84 | 53.97899 | -6.36933 |
| 3750295 | 25 May 2023 23:53:56 | Soprano Pipistrelle | 8 | 53.8 | 56.6 | 52.5 | 6 | 100 | 53.97909 | -6.36949 |
| 3750296 | 25 May 2023 23:54:14 | Common Pipistrelle | 43 | 45 | 67.5 | 43.5 | 4 | 80 | 53.97916 | -6.3696 |
| 3750297 | 25 May 2023 23:54:27 | Common Pipistrelle | 10 | 44.7 | 53.4 | 43.5 | 5 | 90 | 53.9792 | -6.36971 |
| 3750299 | 25 May 2023 23:56:45 | Soprano Pipistrelle | 14 | 48.8 | 79.7 | 47.4 | 4 | 90 | 53.97929 | -6.37022 |
| 3750307 | 25 May 2023 23:58:53 | Soprano Pipistrelle | 20 | 47.3 | 53.8 | 46.3 | 4 | 160 | 53.97929 | -6.37024 |
| 3750308 | 25 May 2023 23:59:00 | Soprano Pipistrelle | 6 | 48.1 | 50.1 | 47.3 | 5 | 239 | 53.97929 | -6.37023 |

| Recording | Timestamp | Species Text | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] | Latitude [WGS84] | Longitude [WGS84] |
|---|---|---|---|---|---|---|---|---|---|---|
| 3750309 | 25 May 2023 23:59:01 | Soprano Pipistrelle | 5 | 48.2 | 49.6 | 47.3 | 6 | 117 | 53.97929 | -6.37023 |
| 3750310 | 25 May 2023 23:59:03 | Soprano Pipistrelle | 4 | 49.1 | 55.6 | 48.1 | 5 | 215 | 53.97929 | -6.37023 |
| 3750311 | 25 May 2023 23:59:05 | Soprano Pipistrelle | 16 | 49.5 | 58.2 | 48.1 | 4 | 85 | 53.97929 | -6.37023 |
| 3750313 | 25 May 2023 23:59:41 | Soprano Pipistrelle | 1 | 47.6 | 48.8 | 46.9 | 6.4 | 0 | 53.97929 | -6.37024 |
| 3750318 | 26 May 2023 00:02:12 | Soprano Pipistrelle | 4 | 47.3 | 51 | 46.6 | 6 | 183 | 53.97929 | -6.37023 |
| 3750319 | 26 May 2023 00:02:14 | Soprano Pipistrelle | 36 | 48.3 | 57.9 | 47 | 5 | 90 | 53.97929 | -6.37023 |
| 3750320 | 26 May 2023 00:02:26 | Soprano Pipistrelle | 5 | 49.4 | 57.7 | 48.7 | 3.9 | 177 | 53.97929 | -6.37024 |
| 3750322 | 26 May 2023 00:08:11 | Leisler's Bat | 4 | 25.3 | 27.2 | 24.1 | 8.5 | 535 | 53.97763 | -6.37064 |
| 3750323 | 26 May 2023 00:08:13 | Leisler's Bat | 1 | 25.9 | 29.3 | 25.5 | 8 | 0 | 53.97764 | -6.37064 |
| 3750352 | 26 May 2023 00:22:02 | Soprano Pipistrelle | 7 | 54.9 | 61 | 53.5 | 6.5 | 219 | 53.97809 | -6.37245 |
| 3750353 | 26 May 2023 00:22:05 | Soprano Pipistrelle | 4 | 54.8 | 56.4 | 53.9 | 5.3 | 447 | 53.97809 | -6.37245 |

| Recording | Timestamp | Species Text | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] | Latitude [WGS84] | Longitude [WGS84] |
|---|---|---|---|---|---|---|---|---|---|---|
| 3750354 | 26 May 2023 00:22:09 | Soprano Pipistrelle | 12 | 55.2 | 64 | 54.5 | 5 | 229 | 53.97809 | -6.37245 |
| 3750358 | 26 May 2023 00:23:41 | Soprano Pipistrelle | 11 | 52.4 | 72.5 | 51.2 | 4 | 260 | 53.97809 | -6.37244 |
| 3750364 | 26 May 2023 00:31:25 | Soprano Pipistrelle | 23 | 47.2 | 69.9 | 46.5 | 4 | 90 | 53.97848 | -6.37541 |
| 3750365 | 26 May 2023 00:31:32 | Soprano Pipistrelle | 14 | 48.2 | 57.9 | 47.3 | 3 | 90 | 53.97848 | -6.37541 |
| 3750367 | 26 May 2023 00:31:50 | Common Pipistrelle | 2 | 43.5 | 50.8 | 43.1 | 3.5 | 166 | 53.97849 | -6.3754 |
| 3750368 | 26 May 2023 00:32:15 | Common Pipistrelle | 7 | 43.5 | 53.9 | 43 | 4 | 100 | 53.97848 | -6.3754 |
| 3750369 | 26 May 2023 00:32:17 | Common Pipistrelle | 16 | 43.6 | 56.8 | 43 | 3 | 94 | 53.97848 | -6.3754 |
| 3750370 | 26 May 2023 00:32:25 | Common Pipistrelle | 6 | 44.8 | 51 | 44.1 | 3 | 80 | 53.97848 | -6.37539 |

**Table 2: Dusk Transect Bat Survey Results – 13th June 2023**

| Recording | Timestamp | Species Text | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] | Latitude [WGS84] | Longitude [WGS84] |
|---|---|---|---|---|---|---|---|---|---|---|
| 7370014 | 13 Jun 2023 22:22:45 | Common Pipistrelle | 13 | 43.3 | 46.3 | 42.5 | 6 | 90 | 53.97664 | -6.36666 |
| 7370015 | 13 Jun 2023 22:28:14 | Common Pipistrelle | 1 | 43.1 | 43.9 | 42.4 | 4.3 | 0 | 53.97714 | -6.3648 |
| 7370016 | 13 Jun 2023 22:28:20 | Common Pipistrelle | 16 | 43.7 | 78.2 | 42.9 | 4 | 100 | 53.97718 | -6.36477 |
| 7370017 | 13 Jun 2023 22:29:13 | Common Pipistrelle | 11 | 43.2 | 49.6 | 42.4 | 6 | 100 | 53.97717 | -6.36477 |
| 7370018 | 13 Jun 2023 22:29:33 | Common Pipistrelle | 20 | 42.5 | 63.3 | 41.7 | 8 | 95 | 53.97717 | -6.36478 |
| 7370019 | 13 Jun 2023 22:29:44 | Common Pipistrelle | 63 | 44.2 | 67.4 | 43.2 | 7 | 95 | 53.97716 | -6.36478 |
| 7370020 | 13 Jun 2023 22:29:59 | Common Pipistrelle | 8 | 43.9 | 74.7 | 43.3 | 6 | 90 | 53.97716 | -6.36476 |
| 7370021 | 13 Jun 2023 22:30:03 | Common Pipistrelle | 37 | 45.2 | 84.6 | 44.5 | 6 | 80 | 53.97716 | -6.36476 |
| 7370022 | 13 Jun 2023 22:30:16 | Common Pipistrelle | 29 | 45.1 | 77.8 | 44.3 | 7 | 86 | 53.97716 | -6.36476 |
| 7370023 | 13 Jun 2023 22:30:26 | Common Pipistrelle | 19 | 45.2 | 56.2 | 44.5 | 6 | 100 | 53.97717 | -6.36476 |
| 7370024 | 13 Jun 2023 22:30:32 | Common Pipistrelle | 19 | 45.1 | 57.2 | 44.3 | 4 | 93 | 53.97717 | -6.36475 |

| Recording | Timestamp | Species Text | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] | Latitude [WGS84] | Longitude [WGS84] |
|---|---|---|---|---|---|---|---|---|---|---|
| 7370025 | 13 Jun 2023 22:30:41 | Soprano Pipistrelle | 53 | 44.4 | 71 | 43.5 | 6 | 94 | 53.97717 | -6.36476 |
| 7370026 | 13 Jun 2023 22:31:01 | Common Pipistrelle | 15 | 43.5 | 73.7 | 43 | 6 | 100 | 53.97717 | -6.36475 |
| 7370027 | 13 Jun 2023 22:31:08 | Soprano Pipistrelle | 55 | 45 | 81.7 | 44.2 | 5 | 95 | 53.97716 | -6.36475 |
| 7370028 | 13 Jun 2023 22:31:25 | Common Pipistrelle | 12 | 45.2 | 69.4 | 43.6 | 6 | 100 | 53.97717 | -6.36475 |
| 7370029 | 13 Jun 2023 22:31:31 | Common Pipistrelle | 34 | 43.6 | 81.7 | 42.9 | 4 | 70 | 53.97716 | -6.36475 |
| 7370030 | 13 Jun 2023 22:31:44 | Common Pipistrelle | 25 | 43 | 76.2 | 42.3 | 6 | 90 | 53.97716 | -6.36476 |
| 7370031 | 13 Jun 2023 22:31:51 | Common Pipistrelle | 5 | 43.3 | 48.6 | 42.6 | 5.1 | 154 | 53.97717 | -6.36476 |
| 7370032 | 13 Jun 2023 22:32:00 | Common Pipistrelle | 9 | 42.5 | 50.6 | 41.9 | 5 | 190 | 53.97717 | -6.36476 |
| 7370033 | 13 Jun 2023 22:32:12 | Common Pipistrelle | 10 | 44.1 | 51.5 | 43.5 | 4 | 100 | 53.97717 | -6.36477 |
| 7370034 | 13 Jun 2023 22:32:23 | Soprano Pipistrelle | 26 | 45.3 | 84 | 44.1 | 4 | 83 | 53.97717 | -6.36476 |
| 7370035 | 13 Jun 2023 22:32:45 | Common Pipistrelle | 21 | 43.5 | 60.3 | 42.8 | 5 | 70 | 53.97717 | -6.36477 |

| Recording | Timestamp | Species Text | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] | Latitude [WGS84] | Longitude [WGS84] |
|---|---|---|---|---|---|---|---|---|---|---|
| 7370036 | 13 Jun 2023 22:32:51 | Common Pipistrelle | 11 | 44.2 | 66.8 | 43.5 | 4 | 50 | 53.97717 | -6.36477 |
| 7370037 | 13 Jun 2023 22:32:53 | Common Pipistrelle | 3 | 43.5 | 54.1 | 43 | 4.1 | 179 | 53.97717 | -6.36477 |
| 7370038 | 13 Jun 2023 22:33:04 | Common Pipistrelle | 24 | 43.5 | 76.9 | 42.8 | 5 | 90 | 53.97717 | -6.36478 |
| 7370039 | 13 Jun 2023 22:33:13 | Common Pipistrelle | 9 | 43.5 | 78.5 | 42.8 | 5 | 110 | 53.97717 | -6.36478 |
| 7370040 | 13 Jun 2023 22:33:19 | Common Pipistrelle | 25 | 43.6 | 75.3 | 43 | 6 | 100 | 53.97717 | -6.36478 |
| 7370041 | 13 Jun 2023 22:33:30 | Soprano Pipistrelle | 25 | 55 | 86.2 | 54.1 | 5 | 85 | 53.97717 | -6.36478 |
| 7370042 | 13 Jun 2023 22:33:39 | Common Pipistrelle | 16 | 43.3 | 59.1 | 42.6 | 5 | 85 | 53.97717 | -6.36479 |
| 7370043 | 13 Jun 2023 22:33:46 | Common Pipistrelle | 36 | 43.8 | 67.1 | 42.5 | 6 | 90 | 53.97718 | -6.36479 |
| 7370044 | 13 Jun 2023 22:33:54 | Common Pipistrelle | 45 | 43.4 | 72.3 | 42.6 | 7 | 90 | 53.97717 | -6.36478 |
| 7370045 | 13 Jun 2023 22:34:08 | Common Pipistrelle | 16 | 43.5 | 78.5 | 42.8 | 5 | 90 | 53.97717 | -6.36477 |
| 7370046 | 13 Jun 2023 22:34:36 | Common Pipistrelle | 14 | 44.3 | 55.2 | 43.4 | 4 | 70 | 53.97716 | -6.36477 |

| Recording | Timestamp | Species Text | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] | Latitude [WGS84] | Longitude [WGS84] |
|---|---|---|---|---|---|---|---|---|---|---|
| 7370047 | 13 Jun 2023 22:34:49 | Common Pipistrelle | 24 | 43.3 | 69.4 | 42.5 | 5 | 94 | 53.97716 | -6.36477 |
| 7370048 | 13 Jun 2023 22:34:57 | Common Pipistrelle | 5 | 44.4 | 52.5 | 43.7 | 3 | 90 | 53.97716 | -6.36477 |
| 7370049 | 13 Jun 2023 22:34:59 | Common Pipistrelle | 22 | 44.1 | 78.1 | 43.1 | 4 | 90 | 53.97716 | -6.36477 |
| 7370050 | 13 Jun 2023 22:35:15 | Common Pipistrelle | 54 | 44.3 | 81.8 | 43.4 | 4 | 95 | 53.97716 | -6.36476 |
| 7370051 | 13 Jun 2023 22:35:38 | Common Pipistrelle | 21 | 43.2 | 72.5 | 42.5 | 6 | 93 | 53.97711 | -6.3648 |
| 7370052 | 13 Jun 2023 22:35:44 | Common Pipistrelle | 19 | 44 | 65.9 | 43.4 | 6 | 110 | 53.97709 | -6.36482 |
| 7370053 | 13 Jun 2023 22:35:55 | Common Pipistrelle | 17 | 45.3 | 87.2 | 44.7 | 4 | 86 | 53.97706 | -6.3649 |
| 7370054 | 13 Jun 2023 22:36:12 | Common Pipistrelle | 20 | 43.9 | 61.1 | 43.3 | 4 | 90 | 53.97704 | -6.36499 |
| 7370055 | 13 Jun 2023 22:38:49 | Common Pipistrelle | 27 | 43.3 | 65.2 | 42.7 | 6 | 90 | 53.97675 | -6.3662 |
| 7370056 | 13 Jun 2023 22:39:00 | Common Pipistrelle | 14 | 44 | 56.8 | 43.3 | 3 | 90 | 53.97674 | -6.36628 |
| 7370057 | 13 Jun 2023 22:39:12 | Soprano Pipistrelle | 54 | 45.7 | 83.8 | 45 | 4 | 90 | 53.97674 | -6.36634 |

| Recording | Timestamp | Species Text | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] | Latitude [WGS84] | Longitude [WGS84] |
|---|---|---|---|---|---|---|---|---|---|---|
| 7370059 | 13 Jun 2023 22:41:54 | Soprano Pipistrelle | 59 | 56.1 | 85.6 | 55.2 | 6 | 80 | 53.97645 | -6.36771 |
| 7370060 | 13 Jun 2023 22:42:08 | Soprano Pipistrelle | 6 | 57.6 | 62.1 | 56.4 | 4 | 345 | 53.97644 | -6.36776 |
| 7370064 | 13 Jun 2023 22:50:38 | Soprano Pipistrelle | 38 | 50.5 | 55.8 | 49.8 | 4 | 90 | 53.97711 | -6.3686 |
| 7370067 | 13 Jun 2023 22:58:28 | Soprano Pipistrelle | 17 | 55.9 | 67.4 | 55.4 | 5 | 90 | 53.9783 | -6.36956 |
| 7370070 | 13 Jun 2023 23:00:20 | Soprano Pipistrelle | 5 | 47.3 | 58.7 | 46.7 | 3 | 181 | 53.97848 | -6.36927 |
| 7370071 | 13 Jun 2023 23:00:25 | Soprano Pipistrelle | 7 | 47.1 | 64.4 | 46.2 | 3 | 142 | 53.97849 | -6.36924 |
| 7370072 | 13 Jun 2023 23:00:41 | Soprano Pipistrelle | 8 | 47.5 | 55.4 | 46.4 | 3 | 118 | 53.97854 | -6.36913 |
| 7370073 | 13 Jun 2023 23:02:23 | Soprano Pipistrelle | 22 | 52 | 80.6 | 51.2 | 7 | 64 | 53.97889 | -6.36922 |
| 7370074 | 13 Jun 2023 23:06:26 | Common Pipistrelle | 19 | 43.3 | 49.5 | 42.4 | 7 | 110 | 53.97923 | -6.37013 |
| 7370076 | 13 Jun 2023 23:12:27 | Common Pipistrelle | 16 | 42.6 | 50.1 | 41.9 | 5 | 90 | 53.97889 | -6.37022 |
| 7370077 | 13 Jun 2023 23:13:04 | Soprano Pipistrelle | 29 | 46.6 | 70 | 45.9 | 5 | 86 | 53.97873 | -6.37031 |

| Recording | Timestamp | Species Text | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] | Latitude [WGS84] | Longitude [WGS84] |
|---|---|---|---|---|---|---|---|---|---|---|
| 7370078 | 13 Jun 2023 23:15:30 | Soprano Pipistrelle | 35 | 46.4 | 68.7 | 45.7 | 6 | 90 | 53.97826 | -6.37076 |
| 7370079 | 13 Jun 2023 23:18:06 | Soprano Pipistrelle | 17 | 53.9 | 55.6 | 52.6 | 8 | 347 | 53.97776 | -6.37091 |
| 7370082 | 13 Jun 2023 23:25:53 | Soprano Pipistrelle | 26 | 52.7 | 54.4 | 52 | 6 | 180 | 53.97752 | -6.37134 |
| 7370088 | 13 Jun 2023 23:44:37 | Leisler's bat | 3 | 24.5 | 25.6 | 22.8 | 11 | 455 | 53.97798 | -6.37526 |
| 7370091 | 13 Jun 2023 23:52:08 | Soprano Pipistrelle | 11 | 45.8 | 51.3 | 45.1 | 4 | 95 | 53.9778 | -6.37672 |
| 7370092 | 13 Jun 2023 23:52:11 | Soprano Pipistrelle | 3 | 48.4 | 58.5 | 47.6 | 2.5 | 174 | 53.9778 | -6.37672 |
| 7370093 | 13 Jun 2023 23:52:13 | Soprano Pipistrelle | 11 | 45.6 | 53 | 45 | 3 | 100 | 53.9778 | -6.37672 |
| 7370094 | 13 Jun 2023 23:57:49 | Soprano Pipistrelle | 4 | 46.3 | 49.5 | 45.5 | 6.8 | 314 | 53.97776 | -6.37675 |
| 7370098 | 14 Jun 2023 00:10:07 | Soprano Pipistrelle | 29 | 56.7 | 67.4 | 56.1 | 4 | 86 | 53.97472 | -6.37421 |
| 7370099 | 14 Jun 2023 00:12:44 | Soprano Pipistrelle | 4 | 62.7 | 67.1 | 61.4 | 3 | 90 | 53.97477 | -6.37422 |
| 7370100 | 14 Jun 2023 00:12:46 | Soprano Pipistrelle | 8 | 62.6 | 71.5 | 61.1 | 2 | 229 | 53.97477 | -6.37422 |

**Table 3: Dusk Transect Bat Survey Results – 21st June 2023**

| Recording | Timestamp | Species Text | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] | Latitude [WGS84] | Longitude [WGS84] |
|---|---|---|---|---|---|---|---|---|---|---|
| 3750003 | 21 Jun 2023 22:27:35 | Soprano Pipistrelle | 19 | 42.7 | 45.8 | 41.8 | 7 | 100 | 53.97779 | -6.37671 |
| 3750004 | 21 Jun 2023 22:27:43 | Soprano Pipistrelle | 23 | 44.1 | 48.7 | 43.5 | 9 | 106 | 53.97778 | -6.37671 |
| 3750006 | 21 Jun 2023 22:33:45 | Soprano Pipistrelle | 20 | 49.3 | 62.1 | 48.3 | 6 | 80 | 53.97764 | -6.37666 |
| 3750012 | 21 Jun 2023 22:42:45 | Soprano Pipistrelle | 20 | 49.7 | 78.3 | 48.9 | 3 | 76 | 53.97486 | -6.37427 |
| 3750013 | 21 Jun 2023 22:42:51 | Soprano Pipistrelle | 16 | 52.6 | 79.9 | 51.9 | 3 | 75 | 53.97482 | -6.37425 |
| 3750017 | 21 Jun 2023 22:44:48 | Soprano Pipistrelle | 11 | 62.5 | 70.8 | 61.6 | 4 | 160 | 53.97471 | -6.37414 |
| 3750022 | 21 Jun 2023 22:47:44 | Soprano Pipistrelle | 1 | 50.3 | 54 | 49.1 | 5.3 | 0 | 53.97472 | -6.37414 |
| 3750023 | 21 Jun 2023 22:47:46 | Soprano Pipistrelle | 29 | 51.9 | 71.3 | 50.4 | 3 | 80 | 53.97472 | -6.37414 |
| 3750077 | 21 Jun 2023 23:27:02 | Soprano Pipistrelle | 4 | 53.5 | 60.8 | 52.5 | 3 | 85 | 53.97563 | -6.37035 |
| 3750078 | 21 Jun 2023 23:27:22 | Soprano Pipistrelle | 10 | 52.6 | 62.2 | 51.6 | 3 | 80 | 53.97563 | -6.37036 |
| 3750080 | 21 Jun 2023 23:27:35 | Soprano Pipistrelle | 9 | 52.1 | 61.4 | 51.2 | 3 | 80 | 53.97563 | -6.37036 |

| Recording | Timestamp | Species Text | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] | Latitude [WGS84] | Longitude [WGS84] |
|---|---|---|---|---|---|---|---|---|---|---|
| 3750082 | 21 Jun 2023 23:28:26 | Soprano Pipistrelle | 10 | 52.1 | 64.1 | 51.4 | 3 | 80 | 53.97564 | -6.37035 |
| 3750086 | 21 Jun 2023 23:30:24 | Soprano Pipistrelle | 3 | 52.1 | 55.3 | 51.3 | 4.3 | 280 | 53.97563 | -6.37033 |
| 3750087 | 21 Jun 2023 23:30:36 | Soprano Pipistrelle | 19 | 51.4 | 76.6 | 50.2 | 5 | 83 | 53.97563 | -6.37033 |
| 3750092 | 21 Jun 2023 23:32:01 | Soprano Pipistrelle | 8 | 53.7 | 63.6 | 52.9 | 3 | 65 | 53.97563 | -6.37033 |
| 3750093 | 21 Jun 2023 23:39:20 | Soprano Pipistrelle | 4 | 58 | 61.8 | 57.2 | 5.5 | 105 | 53.97683 | -6.36599 |
| 3750095 | 21 Jun 2023 23:42:25 | Leisler's Bat | 4 | 25.6 | 26 | 23.7 | 14 | 357 | 53.97707 | -6.36496 |
| 3750096 | 21 Jun 2023 23:42:28 | Leisler's Bat | 4 | 24.9 | 25.6 | 24.1 | 12.5 | 518 | 53.97707 | -6.36496 |
| 3750102 | 21 Jun 2023 23:44:06 | Soprano Pipistrelle | 20 | 46.9 | 58.9 | 46.4 | 5 | 90 | 53.97707 | -6.36497 |
| 3750107 | 21 Jun 2023 23:45:29 | Soprano Pipistrelle | 40 | 49.2 | 63.8 | 48.3 | 4 | 80 | 53.97706 | -6.36497 |
| 3750111 | 21 Jun 2023 23:48:33 | Soprano Pipistrelle | 14 | 48.4 | 50.3 | 47.6 | 7 | 184 | 53.97696 | -6.36553 |
| 3750116 | 21 Jun 2023 23:50:29 | Soprano Pipistrelle | 19 | 46.4 | 50 | 45.7 | 6 | 185 | 53.97667 | -6.36652 |

| Recording | Timestamp | Species Text | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] | Latitude [WGS84] | Longitude [WGS84] |
|---|---|---|---|---|---|---|---|---|---|---|
| 3750185 | 22 Jun 2023 00:19:21 | Leisler's Bat | 4 | 24 | 26.4 | 22.5 | 9.5 | 309 | 53.97847 | -6.37101 |
| 3750186 | 22 Jun 2023 00:20:27 | Soprano Pipistrelle | 31 | 46.4 | 56.6 | 45.6 | 5 | 90 | 53.97836 | -6.37157 |

**Table 4: Emergence Bat Survey Results – 30th May 2023 (Results of both structures combined)**

| Recording | Timestamp | Species Text | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] | Latitude [WGS84] | Longitude [WGS84] |
|---|---|---|---|---|---|---|---|---|---|---|
| 7370001 | 30 May 2023 21:48:20 | Leisler's Bat | 11 | 22.5 | 24.1 | 21.3 | 14 | 230 | 53.97775 | -6.37673 |
| 7370002 | 30 May 2023 21:50:45 | Leisler's Bat | 1 | 21 | 21.4 | 20.6 | 10.7 | 0 | 53.97776 | -6.37673 |
| 7370003 | 30 May 2023 21:50:55 | Leisler's Bat | 13 | 22.1 | 23 | 21 | 15 | 230 | 53.97776 | -6.37672 |
| 7370004 | 30 May 2023 21:50:59 | Leisler's Bat | 4 | 21.1 | 21.8 | 20 | 16 | 458 | 53.97776 | -6.37672 |
| 3750009 | 30 May 2023 21:51:11 | Leisler's Bat | 9 | 22.2 | 24.8 | 21.5 | 17 | 260 | 53.97773 | -6.36916 |
| 7370005 | 30 May 2023 21:56:33 | Leisler's Bat | 7 | 24.2 | 25.2 | 23.2 | 12 | 287 | 53.97777 | -6.37672 |
| 3750010 | 30 May 2023 21:57:26 | Leisler's Bat | 15 | 22.6 | 23.9 | 21.8 | 14 | 270 | 53.97773 | -6.36912 |
| 7370007 | 30 May 2023 22:00:42 | Leisler's Bat | 6 | 22.3 | 23.8 | 21.3 | 16.8 | 250 | 53.97778 | -6.37672 |
| 7370008 | 30 May 2023 22:00:44 | Leisler's Bat | 9 | 21.1 | 21.8 | 19.5 | 18 | 408 | 53.97778 | -6.37672 |
| 7370009 | 30 May 2023 22:00:50 | Leisler's Bat | 7 | 20.8 | 21.9 | 20.1 | 18 | 320 | 53.97778 | -6.37672 |
| 7370010 | 30 May 2023 22:04:44 | Leisler's Bat | 5 | 20.6 | 21.2 | 19.7 | 17.8 | 397 | 53.97778 | -6.37672 |

| Recording | Timestamp | Species Text | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] | Latitude [WGS84] | Longitude [WGS84] |
|---|---|---|---|---|---|---|---|---|---|---|
| 7370013 | 30 May 2023 22:08:55 | Soprano Pipistrelle | 9 | 54.2 | 56.6 | 53.4 | 4 | 165 | 53.97776 | -6.37671 |
| 3750011 | 30 May 2023 22:09:02 | Common Pipistrelle | 28 | 43.8 | 47.2 | 43.1 | 8 | 105 | 53.97773 | -6.36914 |
| 7370015 | 30 May 2023 22:12:15 | Common Pipistrelle | 17 | 43.7 | 47.9 | 42.2 | 5 | 90 | 53.97778 | -6.37672 |
| 7370016 | 30 May 2023 22:13:07 | Soprano Pipistrelle | 11 | 45.3 | 48.6 | 44.5 | 6 | 100 | 53.97779 | -6.37672 |
| 7370017 | 30 May 2023 22:13:15 | Soprano Pipistrelle | 11 | 54.8 | 61.9 | 53.7 | 6 | 90 | 53.97778 | -6.37672 |
| 7370018 | 30 May 2023 22:14:59 | Soprano Pipistrelle | 12 | 50.3 | 53 | 49.4 | 5 | 170 | 53.97779 | -6.37671 |
| 7370020 | 30 May 2023 22:15:51 | Soprano Pipistrelle | 20 | 56.1 | 65.9 | 55.4 | 5 | 170 | 53.97778 | -6.37672 |
| 7370021 | 30 May 2023 22:15:56 | Soprano Pipistrelle | 4 | 55 | 58.9 | 54.6 | 5.1 | 198 | 53.97778 | -6.37672 |
| 7370022 | 30 May 2023 22:16:59 | Common Pipistrelle | 18 | 44.5 | 48.7 | 42.9 | 5 | 97 | 53.97776 | -6.37671 |
| 7370023 | 30 May 2023 22:17:19 | Soprano Pipistrelle | 19 | 49.6 | 63.3 | 48.4 | 5 | 90 | 53.97776 | -6.37671 |
| 7370024 | 30 May 2023 22:19:00 | Common Pipistrelle | 33 | 43.8 | 47.2 | 42.8 | 4 | 100 | 53.97778 | -6.37672 |

| Recording | Timestamp | Species Text | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] | Latitude [WGS84] | Longitude [WGS84] |
|---|---|---|---|---|---|---|---|---|---|---|
| 7370025 | 30 May 2023 22:19:07 | Soprano Pipistrelle | 18 | 49.1 | 64.6 | 48 | 6 | 86 | 53.97778 | -6.37672 |
| 7370026 | 30 May 2023 22:19:30 | Soprano Pipistrelle | 16 | 56.9 | 68.9 | 56.4 | 4 | 90 | 53.97778 | -6.37672 |
| 7370027 | 30 May 2023 22:19:50 | Common Pipistrelle | 11 | 45.2 | 48.8 | 44 | 3 | 90 | 53.97777 | -6.37673 |
| 7370028 | 30 May 2023 22:21:03 | Common Pipistrelle | 21 | 44.6 | 72.8 | 43.9 | 4 | 85 | 53.97779 | -6.37671 |
| 7370029 | 30 May 2023 22:22:25 | Soprano Pipistrelle | 15 | 49.4 | 55.1 | 48.5 | 5 | 180 | 53.9778 | -6.3767 |
| 7370030 | 30 May 2023 22:23:15 | Common Pipistrelle | 31 | 51 | 64.1 | 48.6 | 4 | 90 | 53.9778 | -6.3767 |
| 7370031 | 30 May 2023 22:24:55 | Soprano Pipistrelle | 14 | 55.5 | 63.5 | 54.8 | 4 | 90 | 53.9778 | -6.3767 |
| 3750013 | 30 May 2023 22:27:43 | Soprano Pipistrelle | 14 | 54.6 | 72.6 | 53.9 | 5 | 80 | 53.97775 | -6.36914 |
| 7370032 | 30 May 2023 22:32:46 | Soprano Pipistrelle | 3 | 54.9 | 59 | 54.1 | 6.6 | 247 | 53.97778 | -6.37672 |
| 7370033 | 30 May 2023 22:32:53 | Soprano Pipistrelle | 17 | 54.3 | 58.5 | 53.3 | 6 | 90 | 53.97778 | -6.37672 |
| 7370034 | 30 May 2023 22:33:00 | Soprano Pipistrelle | 4 | 52.7 | 53.4 | 52.1 | 6.3 | 260 | 53.97779 | -6.37672 |

| Recording | Timestamp | Species Text | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] | Latitude [WGS84] | Longitude [WGS84] |
|---|---|---|---|---|---|---|---|---|---|---|
| 7370035 | 30 May 2023 22:33:03 | Soprano Pipistrelle | 3 | 55.9 | 61.9 | 55.1 | 5 | 170 | 53.97779 | -6.37672 |
| 7370036 | 30 May 2023 22:33:42 | Soprano Pipistrelle | 14 | 55.2 | 58.2 | 54.6 | 6 | 100 | 53.97779 | -6.37671 |
| 7370037 | 30 May 2023 22:33:47 | Soprano Pipistrelle | 9 | 55.8 | 57.7 | 54.9 | 5 | 230 | 53.97778 | -6.37671 |
| 7370038 | 30 May 2023 22:33:50 | Soprano Pipistrelle | 10 | 56.4 | 59.9 | 55.4 | 5 | 180 | 53.97778 | -6.37671 |
| 7370039 | 30 May 2023 22:34:07 | Soprano Pipistrelle | 6 | 61.8 | 74.1 | 60.9 | 2 | 113 | 53.97779 | -6.37672 |
| 7370040 | 30 May 2023 22:35:22 | Soprano Pipistrelle | 37 | 55.2 | 63.2 | 54.2 | 6 | 70 | 53.97778 | -6.37671 |
| 7370041 | 30 May 2023 22:35:56 | Soprano Pipistrelle | 2 | 54.6 | 57.2 | 54.2 | 5.6 | 95 | 53.97778 | -6.37671 |
| 7370042 | 30 May 2023 22:36:12 | Soprano Pipistrelle | 8 | 56 | 60.6 | 55.3 | 5 | 160 | 53.97778 | -6.37671 |
| 7370043 | 30 May 2023 22:37:20 | Soprano Pipistrelle | 11 | 54.2 | 56.5 | 53.5 | 6 | 180 | 53.97779 | -6.3767 |
| 7370045 | 30 May 2023 22:38:41 | Soprano Pipistrelle | 18 | 53.9 | 57.3 | 53.1 | 7 | 90 | 53.97777 | -6.37669 |
| 7370046 | 30 May 2023 22:38:50 | Soprano Pipistrelle | 11 | 55.6 | 58.6 | 55 | 4 | 164 | 53.97777 | -6.37669 |

| Recording | Timestamp | Species Text | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] | Latitude [WGS84] | Longitude [WGS84] |
|---|---|---|---|---|---|---|---|---|---|---|
| 7370047 | 30 May 2023 22:39:30 | Soprano Pipistrelle | 11 | 54.5 | 56.4 | 53.7 | 6 | 260 | 53.97779 | -6.37669 |
| 7370048 | 30 May 2023 22:39:45 | Soprano Pipistrelle | 5 | 54.6 | 56.3 | 53.4 | 7 | 428 | 53.97779 | -6.3767 |
| 7370050 | 30 May 2023 22:41:15 | Common Pipistrelle | 30 | 43.1 | 47.9 | 42.2 | 6 | 180 | 53.9778 | -6.3767 |
| 7370051 | 30 May 2023 22:44:29 | Myotis spp. | 0 | 0 | 0 | 0 | 0 | 0 | 53.97779 | -6.37668 |
| 3750015 | 30 May 2023 22:44:39 | Common Pipistrelle | 21 | 43.8 | 50.5 | 42.9 | 6 | 190 | 53.97774 | -6.36912 |
| 3750016 | 30 May 2023 22:47:18 | Common Pipistrelle | 31 | 45.6 | 63.2 | 45 | 3 | 90 | 53.97775 | -6.36913 |
| 7370052 | 30 May 2023 22:48:35 | Soprano Pipistrelle | 5 | 54.7 | 57.5 | 53.5 | 7.4 | 306 | 53.97781 | -6.3767 |
| 7370053 | 30 May 2023 22:50:13 | Brown Long Eared | 6 | 28.6 | 41.5 | 25.3 | 4 | 172 | 53.9778 | -6.37667 |
| 7370054 | 30 May 2023 22:50:35 | Soprano Pipistrelle | 5 | 56.2 | 60.8 | 55.7 | 4 | 210 | 53.97781 | -6.37669 |
| 7370055 | 30 May 2023 22:52:05 | Soprano Pipistrelle | 2 | 53.6 | 54.6 | 52.9 | 6.7 | 187 | 53.97779 | -6.37671 |
| 7370056 | 30 May 2023 22:55:13 | Soprano Pipistrelle | 15 | 56.7 | 65.8 | 56.1 | 4 | 170 | 53.97778 | -6.37671 |

| Recording | Timestamp | Species Text | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] | Latitude [WGS84] | Longitude [WGS84] |
|---|---|---|---|---|---|---|---|---|---|---|
| 7370057 | 30 May 2023 22:58:52 | Leisler's Bat | 17 | 25.5 | 30.7 | 23.8 | 10 | 295 | 53.97778 | -6.37672 |
| 7370058 | 30 May 2023 22:58:58 | Leisler's Bat | 8 | 22.9 | 24.9 | 22.1 | 12 | 361 | 53.97778 | -6.37672 |
| 7370059 | 30 May 2023 22:59:40 | Leisler's Bat | 3 | 23.3 | 25.4 | 22.8 | 9.6 | 227 | 53.97779 | -6.37671 |
| 7370060 | 30 May 2023 23:02:10 | Leisler's Bat | 10 | 22.8 | 23.7 | 21.4 | 9 | 477 | 53.97779 | -6.3767 |
| 7370061 | 30 May 2023 23:02:38 | Leisler's Bat | 7 | 23.8 | 24.9 | 23 | 8 | 366 | 53.97781 | -6.3767 |
| 7370062 | 30 May 2023 23:02:40 | Leisler's Bat | 5 | 25.4 | 28.4 | 24.5 | 7 | 230 | 53.97781 | -6.3767 |
| 7370063 | 30 May 2023 23:10:16 | Soprano Pipistrelle | 2 | 52.7 | 53.8 | 51.8 | 8 | 344 | 53.97779 | -6.37672 |
| 7370064 | 30 May 2023 23:11:40 | Leisler's Bat | 4 | 25.2 | 26 | 24.6 | 8.5 | 383 | 53.97779 | -6.37672 |
| 7370065 | 30 May 2023 23:11:43 | Leisler's Bat | 4 | 25.5 | 26.8 | 23.9 | 10.4 | 470 | 53.97779 | -6.37672 |
| 7370066 | 30 May 2023 23:11:48 | Leisler's Bat | 4 | 26 | 27.2 | 25.1 | 7.2 | 518 | 53.97779 | -6.37672 |
| 3750023 | 30 May 2023 23:14:08 | Brown Long Eared | 3 | 26.4 | 43.4 | 17 | 6 | 221 | 53.97776 | -6.36913 |

| Recording | Timestamp | Species Text | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] | Latitude [WGS84] | Longitude [WGS84] |
|---|---|---|---|---|---|---|---|---|---|---|
| 3750024 | 30 May 2023 23:14:40 | Myotis spp. | 6 | 61.3 | 70.3 | 56.1 | 2 | 111 | 53.97776 | -6.36914 |
| 3750025 | 30 May 2023 23:14:44 | Myotis spp. | 1 | 59.3 | 67.5 | 55.1 | 2.1 | 0 | 53.97776 | -6.36914 |
| 7370068 | 30 May 2023 23:15:06 | Common Pipistrelle | 10 | 46.3 | 57.7 | 45.4 | 5 | 297 | 53.97778 | -6.37671 |
| 7370069 | 30 May 2023 23:15:52 | Brown Long Eared | 10 | 26.9 | 34.2 | 22.5 | 3 | 209 | 53.97777 | -6.3767 |
| 7370072 | 30 May 2023 23:20:15 | Leisler's Bat | 2 | 21.4 | 22.5 | 21 | 10.7 | 0 | 53.97778 | -6.37668 |
| 7370073 | 30 May 2023 23:23:48 | Common Pipistrelle | 1 | 46.5 | 52.5 | 46.1 | 4.3 | 0 | 53.97779 | -6.37674 |
| 7370074 | 30 May 2023 23:24:22 | Common Pipistrelle | 19 | 47.2 | 60.3 | 46.5 | 4 | 90 | 53.97779 | -6.37674 |
| 7370075 | 30 May 2023 23:24:27 | Common Pipistrelle | 12 | 46.3 | 50.3 | 45.7 | 4 | 100 | 53.97779 | -6.37674 |
| 7370076 | 30 May 2023 23:25:01 | Leisler's Bat | 7 | 23.9 | 25.6 | 23.4 | 7 | 518 | 53.97778 | -6.37674 |
| 7370077 | 30 May 2023 23:25:05 | Leisler's Bat | 6 | 25.7 | 27.7 | 24.9 | 6.3 | 576 | 53.97778 | -6.37674 |
| 7370078 | 30 May 2023 23:32:06 | Common Pipistrelle | 9 | 47 | 52.6 | 46.3 | 4 | 180 | 53.97779 | -6.37675 |

| Recording | Timestamp | Species Text | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] | Latitude [WGS84] | Longitude [WGS84] |
|---|---|---|---|---|---|---|---|---|---|---|
| 7370079 | 30 May 2023 23:32:10 | Common Pipistrelle | 5 | 47 | 52 | 46.4 | 3 | 90 | 53.97779 | -6.37677 |
| 7370080 | 30 May 2023 23:32:33 | Soprano Pipistrelle | 16 | 56.7 | 62.3 | 55.9 | 3 | 83 | 53.97782 | -6.37679 |
| 7370081 | 30 May 2023 23:33:55 | Common Pipistrelle | 17 | 47.7 | 76.6 | 46.8 | 4 | 90 | 53.97785 | -6.37688 |
| 7370082 | 30 May 2023 23:34:09 | Soprano Pipistrelle | 1 | 56.6 | 61.1 | 55.9 | 2.7 | 0 | 53.97785 | -6.37688 |
| 7370083 | 30 May 2023 23:34:43 | Myotis spp. | 26 | 39.6 | 75.2 | 27.2 | 6 | 114 | 53.97778 | -6.3768 |

**Table 5: Dusk Transect Bat Survey Results – 7th October 2024**

| Timestamp | Species Text | Recording | Latitude [WGS84] | Longitude [WGS84] | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] |
|---|---|---|---|---|---|---|---|---|---|---|
| 07/10/2024 19:20 | Soprano pipistrelle | 3750005 | 53.97788 | -6.3767 | 6 | 57.7 | 70.7 | 56.4 | 4.1 | 216 |
| 07/10/2024 19:24 | Leisler's bat | 3750007 | 53.97702 | -6.37594 | 6 | 24 | 26.3 | 22.6 | 9.7 | 537 |
| 07/10/2024 19:51 | Common pipistrelle | 3750015 | 53.9757 | -6.37052 | 20 | 48 | 88 | 46.3 | 4 | 180 |
| 07/10/2024 20:11 | Common pipistrelle | 3750016 | 53.9761 | -6.36869 | 9 | 45.5 | 56 | 44.8 | 6 | 206 |
| 07/10/2024 20:19 | Common pipistrelle | 3750017 | 53.97705 | -6.36501 | 4 | 46.3 | 49.1 | 44.9 | 6.4 | 508 |

| Timestamp | Species Text | Recording | Latitude [WGS84] | Longitude [WGS84] | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] |
|---|---|---|---|---|---|---|---|---|---|---|
| 07/10/2024 20:19 | Common pipistrelle | 3750018 | 53.97705 | -6.36498 | 11 | 45.4 | 64 | 43.8 | 4 | 90 |
| 07/10/2024 20:20 | Common pipistrelle | 3750019 | 53.97705 | -6.36497 | 27 | 44.8 | 72.5 | 43.9 | 4 | 93 |
| 07/10/2024 20:20 | Common pipistrelle | 3750020 | 53.97707 | -6.3649 | 18 | 45.8 | 83.4 | 43.5 | 4 | 85 |
| 07/10/2024 20:20 | Common pipistrelle | 3750021 | 53.97708 | -6.3649 | 16 | 44.9 | 77.3 | 43.3 | 4 | 234 |
| 07/10/2024 20:21 | Common pipistrelle | 3750022 | 53.97708 | -6.36491 | 43 | 45.8 | 87.5 | 43.5 | 4 | 90 |
| 07/10/2024 20:21 | Common pipistrelle | 3750023 | 53.97708 | -6.36491 | 9 | 44.4 | 66.7 | 43.3 | 5 | 191 |
| 07/10/2024 20:21 | Common pipistrelle | 3750024 | 53.97708 | -6.36491 | 53 | 44.5 | 73.2 | 43.1 | 5 | 100 |
| 07/10/2024 20:21 | Common pipistrelle | 3750025 | 53.97707 | -6.36491 | 24 | 45.1 | 75.8 | 43.3 | 5 | 86 |
| 07/10/2024 20:22 | Common pipistrelle | 3750026 | 53.97706 | -6.3649 | 48 | 44.5 | 76.2 | 43.2 | 5 | 94 |
| 07/10/2024 20:22 | Common pipistrelle | 3750027 | 53.97707 | -6.3649 | 59 | 49 | 79.2 | 47.3 | 4 | 90 |
| 07/10/2024 20:22 | Soprano pipistrelle | 3750028 | 53.97707 | -6.3649 | 8 | 54.1 | 89.8 | 53.1 | 9.8 | 177 |
| 07/10/2024 20:22 | Common pipistrelle | 3750029 | 53.97708 | -6.3649 | 54 | 44.6 | 72.3 | 43.2 | 5 | 94 |
| 07/10/2024 20:23 | Soprano pipistrelle | 3750030 | 53.97708 | -6.36491 | 11 | 54.1 | 71.3 | 53.2 | 6.8 | 331 |

| Timestamp | Species Text | Recording | Latitude [WGS84] | Longitude [WGS84] | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] |
|---|---|---|---|---|---|---|---|---|---|---|
| 07/10/2024 20:23 | Common pipistrelle | 3750031 | 53.97708 | -6.3649 | 14 | 51.5 | 62.2 | 50.3 | 6 | 214 |
| 07/10/2024 20:23 | Common pipistrelle | 3750032 | 53.97707 | -6.3649 | 46 | 44.9 | 74.8 | 43.5 | 5 | 95 |
| 07/10/2024 20:23 | Common pipistrelle | 3750033 | 53.97708 | -6.36491 | 40 | 47.5 | 76.6 | 46.4 | 4 | 90 |
| 07/10/2024 20:24 | Common pipistrelle | 3750034 | 53.97708 | -6.36491 | 18 | 50.3 | 82.9 | 47.7 | 4 | 80 |
| 07/10/2024 20:24 | Common pipistrelle | 3750035 | 53.97708 | -6.36491 | 16 | 49.8 | 67.3 | 48.5 | 3 | 80 |
| 07/10/2024 20:24 | Common pipistrelle | 3750036 | 53.97708 | -6.36491 | 34 | 44.1 | 66.7 | 43.1 | 6 | 110 |
| 07/10/2024 20:24 | Common pipistrelle | 3750037 | 53.97708 | -6.36493 | 46 | 44.7 | 75.1 | 42.8 | 5 | 94 |
| 07/10/2024 20:25 | Common pipistrelle | 3750038 | 53.97708 | -6.36492 | 12 | 44 | 67 | 43.3 | 4 | 232 |
| 07/10/2024 20:25 | Common pipistrelle | 3750039 | 53.97708 | -6.36492 | 45 | 45.1 | 76.4 | 43.4 | 5 | 90 |
| 07/10/2024 20:25 | Common pipistrelle | 3750040 | 53.97708 | -6.36493 | 24 | 45.1 | 74.8 | 43.6 | 4 | 90 |
| 07/10/2024 20:25 | Common pipistrelle | 3750041 | 53.97707 | -6.36492 | 42 | 44.6 | 74.8 | 43.6 | 5 | 90 |
| 07/10/2024 20:26 | Common pipistrelle | 3750042 | 53.97708 | -6.36491 | 58 | 44.8 | 75.6 | 43.1 | 5 | 95 |
| 07/10/2024 20:26 | Common pipistrelle | 3750043 | 53.97708 | -6.36492 | 41 | 44.3 | 68.6 | 42.9 | 5 | 100 |

| Timestamp | Species Text | Recording | Latitude [WGS84] | Longitude [WGS84] | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] |
|---|---|---|---|---|---|---|---|---|---|---|
| 07/10/2024 20:26 | Common pipistrelle | 3750044 | 53.97707 | -6.36491 | 32 | 43.9 | 64.9 | 42.6 | 6 | 96 |
| 07/10/2024 20:26 | Common pipistrelle | 3750045 | 53.97707 | -6.36491 | 23 | 44.8 | 73.9 | 43.8 | 4 | 94 |
| 07/10/2024 20:27 | Common pipistrelle | 3750046 | 53.97707 | -6.36491 | 46 | 45.1 | 70 | 43.6 | 5 | 94 |
| 07/10/2024 20:27 | Common pipistrelle | 3750047 | 53.97705 | -6.36491 | 70 | 44.9 | 82.9 | 43.4 | 5 | 105 |
| 07/10/2024 20:27 | Common pipistrelle | 3750048 | 53.97704 | -6.36489 | 18 | 44.7 | 72.2 | 43.3 | 5 | 142 |
| 07/10/2024 20:27 | Common pipistrelle | 3750049 | 53.97706 | -6.36491 | 36 | 44.8 | 71.6 | 43.7 | 4 | 90 |
| 07/10/2024 20:28 | Common pipistrelle | 3750050 | 53.97706 | -6.36492 | 52 | 44 | 64.5 | 42.7 | 5 | 96 |
| 07/10/2024 20:28 | Common pipistrelle | 3750051 | 53.97706 | -6.36492 | 47 | 44.8 | 73.6 | 43.9 | 5 | 104 |
| 07/10/2024 20:28 | Common pipistrelle | 3750052 | 53.97706 | -6.36493 | 23 | 44.5 | 69.3 | 43.5 | 4 | 95 |
| 07/10/2024 20:28 | Common pipistrelle | 3750053 | 53.97706 | -6.36493 | 25 | 49.4 | 80.1 | 47.4 | 4 | 90 |
| 07/10/2024 20:29 | Soprano pipistrelle | 3750054 | 53.97706 | -6.36492 | 15 | 58.4 | 71.9 | 57.7 | 6 | 260 |
| 07/10/2024 20:29 | Common pipistrelle | 3750055 | 53.97707 | -6.36492 | 44 | 49.4 | 71.2 | 47 | 5 | 90 |
| 07/10/2024 20:29 | Common pipistrelle | 3750056 | 53.97707 | -6.3649 | 31 | 48.1 | 78.3 | 46.9 | 5 | 85 |

| Timestamp | Species Text | Recording | Latitude [WGS84] | Longitude [WGS84] | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] |
|---|---|---|---|---|---|---|---|---|---|---|
| 07/10/2024 20:30 | Common pipistrelle | 3750057 | 53.97707 | -6.3649 | 42 | 49.1 | 72.5 | 47.1 | 4 | 85 |
| 07/10/2024 20:30 | Soprano pipistrelle | 3750058 | 53.977 | -6.36506 | 10 | 59.8 | 69 | 59 | 6 | 129 |
| 07/10/2024 20:37 | Common pipistrelle | 3750060 | 53.97712 | -6.36861 | 19 | 47.8 | 65.5 | 46.7 | 4 | 85 |
| 07/10/2024 20:38 | Brown long eared bat | 3750063 | 53.97721 | -6.36859 | 11 | 27.7 | 35.3 | 21.2 | 5 | 140 |
| 07/10/2024 20:40 | Soprano pipistrelle | 3750065 | 53.97721 | -6.3686 | 19 | 59.9 | 83.7 | 58.3 | 5 | 80 |
| 07/10/2024 20:40 | Soprano pipistrelle | 3750066 | 53.9772 | -6.36861 | 9 | 60.3 | 69.6 | 58.8 | 5 | 169 |
| 07/10/2024 20:40 | Soprano pipistrelle | 3750067 | 53.9772 | -6.36861 | 8 | 60.3 | 67.3 | 58.9 | 3 | 436 |
| 07/10/2024 20:40 | Soprano pipistrelle | 3750068 | 53.9772 | -6.36861 | 18 | 59.7 | 70.7 | 58.1 | 3 | 76 |
| 07/10/2024 20:42 | Common pipistrelle | 3750069 | 53.97721 | -6.3686 | 10 | 46 | 51.7 | 44.6 | 5 | 120 |
| 07/10/2024 20:42 | Soprano pipistrelle | 3750070 | 53.97721 | -6.3686 | 19 | 52.4 | 55.4 | 51.6 | 6 | 100 |
| 07/10/2024 20:42 | Soprano pipistrelle | 3750071 | 53.97722 | -6.3686 | 3 | 52.1 | 53 | 51.3 | 7.8 | 285 |
| 07/10/2024 20:42 | Common pipistrelle | 3750072 | 53.97722 | -6.3686 | 27 | 43.9 | 48.5 | 43 | 6 | 110 |
| 07/10/2024 20:42 | Common pipistrelle | 3750073 | 53.97721 | -6.3686 | 14 | 44.1 | 50 | 43.2 | 5 | 100 |

| Timestamp | Species Text | Recording | Latitude [WGS84] | Longitude [WGS84] | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] |
|---|---|---|---|---|---|---|---|---|---|---|
| 07/10/2024 20:42 | Common pipistrelle | 3750074 | 53.97721 | -6.3686 | 11 | 45.1 | 57.5 | 43.5 | 7 | 120 |
| 07/10/2024 20:43 | Common pipistrelle | 3750075 | 53.9772 | -6.36861 | 33 | 44.3 | 55.4 | 43.3 | 5 | 110 |
| 07/10/2024 20:43 | Common pipistrelle | 3750076 | 53.97719 | -6.3686 | 30 | 46.5 | 55.6 | 45.3 | 6 | 116 |
| 07/10/2024 20:43 | Common pipistrelle | 3750077 | 53.97719 | -6.3686 | 10 | 46 | 51.8 | 45 | 6 | 184 |
| 07/10/2024 20:43 | Common pipistrelle | 3750078 | 53.97719 | -6.3686 | 16 | 46.5 | 57.9 | 45.3 | 5 | 100 |
| 07/10/2024 20:43 | Common pipistrelle | 3750079 | 53.9772 | -6.36859 | 10 | 47.7 | 69.2 | 46.5 | 4 | 243 |
| 07/10/2024 20:43 | Common pipistrelle | 3750080 | 53.9772 | -6.36859 | 55 | 46.3 | 69.8 | 45.1 | 5 | 100 |
| 07/10/2024 20:44 | Soprano pipistrelle | 3750081 | 53.9772 | -6.36858 | 27 | 54.8 | 80.7 | 53.4 | 5 | 86 |
| 07/10/2024 20:44 | Soprano pipistrelle | 3750082 | 53.97721 | -6.36858 | 18 | 54.6 | 64.3 | 53.4 | 5 | 83 |
| 07/10/2024 20:44 | Soprano pipistrelle | 3750083 | 53.97721 | -6.36858 | 11 | 55.5 | 63 | 54.5 | 3 | 90 |
| 07/10/2024 20:44 | Soprano pipistrelle | 3750084 | 53.97721 | -6.36858 | 30 | 54.6 | 82.4 | 53 | 6 | 84 |
| 07/10/2024 20:44 | Soprano pipistrelle | 3750085 | 53.9772 | -6.36858 | 24 | 54.2 | 66.8 | 52.6 | 6 | 83 |
| 07/10/2024 20:44 | Soprano pipistrelle | 3750086 | 53.9772 | -6.36859 | 20 | 55.1 | 89.2 | 53.4 | 6 | 80 |

| Timestamp | Species Text | Recording | Latitude [WGS84] | Longitude [WGS84] | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] |
|---|---|---|---|---|---|---|---|---|---|---|
| 07/10/2024 20:46 | Soprano pipistrelle | 3750087 | 53.97721 | -6.36857 | 24 | 54.6 | 75.6 | 53.3 | 6 | 90 |
| 07/10/2024 20:46 | Soprano pipistrelle | 3750088 | 53.97725 | -6.36861 | 8 | 54.9 | 69.5 | 53.6 | 5.3 | 370 |
| 07/10/2024 20:47 | Soprano pipistrelle | 3750089 | 53.97726 | -6.36861 | 10 | 55.4 | 68.3 | 53.4 | 6 | 241 |
| 07/10/2024 20:47 | Soprano pipistrelle | 3750090 | 53.97728 | -6.36863 | 9 | 53.8 | 59.1 | 52.8 | 5 | 182 |
| 07/10/2024 20:47 | Soprano pipistrelle | 3750091 | 53.97737 | -6.36883 | 8 | 21.3 | 35.1 | 16.1 | 2.3 | 499 |
| 07/10/2024 20:47 | Soprano pipistrelle | 3750092 | 53.9774 | -6.36887 | 2 | 24.8 | 29.6 | 12 | 1.6 | 0 |
| 07/10/2024 20:51 | Common pipistrelle | 3750095 | 53.97859 | -6.36924 | 47 | 46.9 | 57 | 45.7 | 5 | 150 |
| 07/10/2024 20:52 | Common pipistrelle | 3750096 | 53.9786 | -6.36926 | 10 | 43.8 | 50.9 | 42.8 | 4 | 263 |
| 07/10/2024 20:52 | Common pipistrelle | 3750097 | 53.9786 | -6.36926 | 12 | 44.3 | 56.2 | 42.5 | 5 | 203 |
| 07/10/2024 20:52 | Common pipistrelle | 3750098 | 53.9786 | -6.36926 | 9 | 43.1 | 52.8 | 42.4 | 5 | 301 |
| 07/10/2024 20:52 | Common pipistrelle | 3750099 | 53.97865 | -6.36926 | 9 | 43.7 | 52.3 | 42.9 | 5 | 177 |
| 07/10/2024 20:52 | Common pipistrelle | 3750100 | 53.97867 | -6.36926 | 75 | 45.2 | 61.7 | 44.1 | 5 | 94 |
| 07/10/2024 20:52 | Common pipistrelle | 3750101 | 53.97869 | -6.36924 | 19 | 43.8 | 57.2 | 42.8 | 4 | 83 |

| Timestamp | Species Text | Recording | Latitude [WGS84] | Longitude [WGS84] | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] |
|---|---|---|---|---|---|---|---|---|---|---|
| 07/10/2024 20:52 | Common pipistrelle | 3750102 | 53.97869 | -6.36924 | 98 | 47 | 60 | 45.9 | 5 | 95 |
| 07/10/2024 20:53 | Common pipistrelle | 3750103 | 53.97869 | -6.36923 | 23 | 53.9 | 81.2 | 52.7 | 6 | 90 |
| 07/10/2024 20:53 | Common pipistrelle | 3750104 | 53.97868 | -6.36923 | 71 | 47.4 | 63.7 | 46.3 | 5 | 95 |
| 07/10/2024 20:53 | Common pipistrelle | 3750105 | 53.97869 | -6.36923 | 52 | 48.1 | 62.5 | 46.7 | 4 | 80 |
| 07/10/2024 20:53 | Common pipistrelle | 3750106 | 53.97869 | -6.36922 | 83 | 47.1 | 66.5 | 45.7 | 4 | 84 |
| 07/10/2024 20:54 | Common pipistrelle | 3750107 | 53.9787 | -6.36922 | 29 | 45.2 | 65.2 | 44.1 | 5 | 94 |
| 07/10/2024 20:54 | Common pipistrelle | 3750109 | 53.97876 | -6.36948 | 13 | 44.3 | 54.1 | 42.9 | 6 | 90 |
| 07/10/2024 20:54 | Common pipistrelle | 3750110 | 53.97879 | -6.36949 | 4 | 43.4 | 51.5 | 42.4 | 5.9 | 294 |
| 07/10/2024 20:54 | Common pipistrelle | 3750111 | 53.97881 | -6.36951 | 4 | 47.1 | 62.9 | 46.1 | 5.3 | 304 |
| 07/10/2024 20:54 | Common pipistrelle | 3750112 | 53.97883 | -6.36954 | 12 | 45.9 | 57.2 | 44.9 | 5 | 287 |
| 07/10/2024 20:54 | Soprano pipistrelle | 3750113 | 53.97884 | -6.36955 | 14 | 52.8 | 64.1 | 51.7 | 5 | 191 |
| 07/10/2024 20:55 | Common pipistrelle | 3750114 | 53.97884 | -6.36956 | 13 | 50 | 59.7 | 49 | 4 | 197 |
| 07/10/2024 20:55 | Common pipistrelle | 3750115 | 53.97884 | -6.36957 | 5 | 46.6 | 59.6 | 45.1 | 4.6 | 697 |

| Timestamp | Species Text | Recording | Latitude [WGS84] | Longitude [WGS84] | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] |
|---|---|---|---|---|---|---|---|---|---|---|
| 07/10/2024 20:55 | Common pipistrelle | 3750116 | 53.97886 | -6.36959 | 2 | 19.1 | 35.6 | 16.9 | 3.7 | 0 |
| 07/10/2024 20:55 | Common pipistrelle | 3750117 | 53.97888 | -6.36961 | 17 | 44.8 | 54.6 | 43.4 | 4 | 229 |
| 07/10/2024 20:55 | Common pipistrelle | 3750118 | 53.9789 | -6.36963 | 2 | 42.8 | 46.3 | 41.4 | 6.7 | 289 |
| 07/10/2024 20:55 | Soprano pipistrelle | 3750119 | 53.97894 | -6.36966 | 7 | 53.3 | 58.9 | 51.7 | 5.3 | 261 |
| 07/10/2024 20:55 | Common pipistrelle | 3750120 | 53.97897 | -6.36975 | 3 | 44.4 | 50.3 | 43.1 | 6.4 | 602 |
| 07/10/2024 20:55 | Common pipistrelle | 3750121 | 53.97907 | -6.36977 | 43 | 44.7 | 57.2 | 43.6 | 4 | 96 |
| 07/10/2024 20:55 | Common pipistrelle | 3750122 | 53.97906 | -6.36978 | 29 | 44.7 | 56 | 43.6 | 4 | 95 |
| 07/10/2024 20:55 | Common pipistrelle | 3750123 | 53.97906 | -6.36978 | 16 | 46.7 | 55.1 | 45.4 | 4 | 420 |
| 07/10/2024 20:56 | Common pipistrelle | 3750124 | 53.97906 | -6.36978 | 20 | 46.5 | 54.4 | 45.3 | 7 | 190 |
| 07/10/2024 20:56 | Common pipistrelle | 3750125 | 53.97905 | -6.36978 | 7 | 44.3 | 52.1 | 43.3 | 4 | 100 |
| 07/10/2024 20:56 | Soprano pipistrelle | 3750126 | 53.97905 | -6.36978 | 5 | 56.3 | 71.4 | 55.1 | 5.3 | 163 |
| 07/10/2024 20:56 | Soprano pipistrelle | 3750127 | 53.97906 | -6.36978 | 2 | 58.1 | 72.8 | 57 | 4 | 86 |
| 07/10/2024 20:56 | Common pipistrelle | 3750128 | 53.97906 | -6.36978 | 15 | 46.5 | 53.3 | 45.1 | 6 | 90 |

| Timestamp | Species Text | Recording | Latitude [WGS84] | Longitude [WGS84] | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] |
|---|---|---|---|---|---|---|---|---|---|---|
| 07/10/2024 20:56 | Soprano pipistrelle | 3750129 | 53.97906 | -6.36978 | 9 | 57.7 | 68 | 56.6 | 4 | 301 |
| 07/10/2024 20:56 | Common pipistrelle | 3750130 | 53.97908 | -6.3698 | 14 | 46.6 | 52.9 | 45.5 | 3 | 199 |
| 07/10/2024 20:56 | Common pipistrelle | 3750131 | 53.97906 | -6.36979 | 18 | 44.7 | 52.8 | 43.7 | 4 | 105 |
| 07/10/2024 20:57 | Common pipistrelle | 3750132 | 53.97905 | -6.3698 | 22 | 44.5 | 53.4 | 43.7 | 3 | 200 |
| 07/10/2024 20:57 | Common pipistrelle | 3750133 | 53.97905 | -6.3698 | 41 | 46.7 | 54 | 45.5 | 7 | 100 |
| 07/10/2024 20:57 | Common pipistrelle | 3750134 | 53.97905 | -6.3698 | 27 | 44.8 | 57.5 | 43.6 | 4 | 95 |
| 07/10/2024 20:57 | Soprano pipistrelle | 3750135 | 53.97905 | -6.36981 | 35 | 53.2 | 59.6 | 52.3 | 6 | 86 |
| 07/10/2024 20:57 | Common pipistrelle | 3750136 | 53.97905 | -6.36981 | 52 | 45.4 | 54.8 | 44.3 | 6 | 95 |
| 07/10/2024 20:58 | Common pipistrelle | 3750137 | 53.97906 | -6.36982 | 23 | 47 | 57.3 | 46 | 5 | 170 |
| 07/10/2024 20:58 | Common pipistrelle | 3750138 | 53.97905 | -6.36981 | 39 | 44.6 | 55.5 | 43.5 | 4 | 100 |
| 07/10/2024 20:58 | Common pipistrelle | 3750139 | 53.97906 | -6.36981 | 13 | 44 | 50.3 | 42.5 | 7 | 190 |
| 07/10/2024 20:58 | Common pipistrelle | 3750140 | 53.97906 | -6.36981 | 63 | 45.4 | 54.7 | 44.3 | 4 | 100 |
| 07/10/2024 20:58 | Common pipistrelle | 3750141 | 53.97905 | -6.36982 | 56 | 44.8 | 55.1 | 43.8 | 4 | 100 |

| Timestamp | Species Text | Recording | Latitude [WGS84] | Longitude [WGS84] | Calls [#] | Mean Peak Frequency [kHz] | Mean Max Frequency [kHz] | Mean Min Frequency [kHz] | Mean Call Length [ms] | Mean Call Distance [ms] |
|---|---|---|---|---|---|---|---|---|---|---|
| 07/10/2024 20:59 | Common pipistrelle | 3750142 | 53.97905 | -6.36983 | 0 | 0 | 0 | 0 | 0 | 0 |
| 07/10/2024 20:59 | Common pipistrelle | 3750143 | 53.97906 | -6.36982 | 17 | 44.8 | 56.2 | 43.8 | 5 | 105 |
| 07/10/2024 20:59 | Common pipistrelle | 3750144 | 53.97906 | -6.36982 | 24 | 44.9 | 57.3 | 44.1 | 4 | 103 |
| 07/10/2024 21:00 | Common pipistrelle | 3750145 | 53.97906 | -6.36982 | 54 | 45.6 | 51.1 | 44.3 | 6 | 105 |
| 07/10/2024 21:00 | Common pipistrelle | 3750146 | 53.97906 | -6.36981 | 41 | 46.2 | 59.3 | 45.2 | 5 | 95 |
| 07/10/2024 21:00 | Common pipistrelle | 3750147 | 53.97905 | -6.36982 | 41 | 45.7 | 54.6 | 44.1 | 6 | 95 |
| 07/10/2024 21:00 | Common pipistrelle | 3750148 | 53.97906 | -6.36982 | 24 | 46.4 | 48.8 | 44.9 | 6 | 180 |
| 07/10/2024 21:00 | Common pipistrelle | 3750149 | 53.97906 | -6.36982 | 22 | 41.8 | 50 | 40.3 | 6 | 110 |
| 07/10/2024 21:00 | Common pipistrelle | 3750150 | 53.97905 | -6.36982 | 27 | 47.2 | 57 | 46.1 | 4 | 86 |
| 07/10/2024 21:01 | Common pipistrelle | 3750151 | 53.97904 | -6.36982 | 60 | 44.7 | 58 | 43.5 | 4 | 100 |
| 07/10/2024 21:01 | Soprano pipistrelle | 3750152 | 53.97904 | -6.36982 | 10 | 55.3 | 60.4 | 54.3 | 4 | 203 |
| 07/10/2024 21:01 | Soprano pipistrelle | 3750153 | 53.97904 | -6.36982 | 10 | 55.4 | 64.4 | 54.3 | 5 | 113 |
| 07/10/2024 21:01 | Leisler's bat | 3750154 | 53.97913 | -6.37002 | 6 | 24.8 | 32.1 | 18.7 | 6.4 | 256 |

RECEIVED: 30/05/2025

Haggardstown LRD

Dundalk, Co. Louth



**Appendices**

# Volume III

**CHAPTER 12** **Noise & Vibration**

Appendix 12.1 ProPG: Acoustic Design Statement

May 2025

McCutcheon Halley
CHARTERED PLANNING CONSULTANTS

# Appendix 12.1 ProPG: Acoustic Design Statement

May 2025

McCutcheon Halley
CHARTERED PLANNING CONSULTANTS

# 1 Appendix 12-1


Glenveagh

# PROPOSED LRD AT HAGGARDSTOWN, CO. LOUTH

ProPG: Acoustic Design Statement

604468 (00)

JULY 2023

# EXECUTIVE SUMMARY

RSK Ireland Limited (RSK) was instructed by Glenveagh Ltd to conduct a noise impact assessment in respect of a proposed LRD (Large scale residential development) at Haggardstown, Co. Louth.

This document considers the potential impact of the existing and future noise sources on future residents of the proposed dwellings, in accordance with *The Professional Guidance on Planning & Noise* (ProPG), May 2017.

To assist with this assessment, the baseline noise environment at the development site has been determined through noise surveys over an extended period, between 4th and the 11th July 2023.

The baseline noise survey has been used to assess the sites noise risk category, as per the ProPG "Stage 1" assessment. The noise risk category for the proposed development facades is as follows:

- **Negligible** to **Low** for daytime periods, and;
- **Negligible** to **Low** for night-time periods.

This indicates that "*the site is likely to be acceptable from a noise perspective provided that a good acoustic design process is followed".*

Requirements to mitigate noise emissions, as specified in the ProPG "Stage 2" Acoustic Design Statement, are as follows:

- Provision of glazing with minimum sound insulation properties as outlined in Table 14 of this document. The stated minimum performance will typically be achieved with standard thermal glazing (i.e. 4-12-4 configuration, or similar).

In summary, once consideration is given to the recommendations outlined in this report, the expected noise impact on future residents of the proposed development is not significant.

# RSK GENERAL NOTES



**Project No.:** 604468 (00)

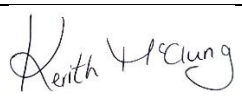
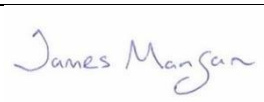
**Title:** Proposed LRD at Haggardstown, Co. Louth Noise Impact Assessment

**Client:** Glenveagh Ltd

**Date:** 25th July 2023

**Office:** Dublin

**Status:** FINAL

| | | | |
|---|---|---|---|
| **Author** | Kerith McClung,<br>(Acoustic Consultant) | **Technical reviewer** | James Mangan, MIOA<br>Associate Director (Acoustics) |
| Signature |  | Signature |  |
| Date: | 25th July 2023 | Date: | 25th July 2023 |

# CONTENTS

# 1 INTRODUCTION



Glenveagh Ltd instructed RSK to conduct an assessment of the potential inward noise impact of existing traffic noise on future occupants of the proposed development, in accordance with the requirements of ProPG.

Mitigation measures are included, where required, to ensure the proposed development is operated in an environmentally sustainable manner in order to protect the amenity of future dwelling occupants.

## 1.1 Aim and Objectives

The aim of the assessment is as follows:

- Quantify the baseline noise environment at locations that are representative of future noise sensitive locations.
- Provide an assessment of the likely impacts of existing traffic noise emissions to future noise sensitive receptors.
- Provide design advice and recommendations for mitigation measures, where necessary, to reduce impacts to an appropriate level for future dwelling occupants.

The objective of this assessment is to provide a performance specification for the proposed building façades to control traffic noise ingress to the proposed dwellings.

# 2 THE PROPOSED DEVELOPMENT



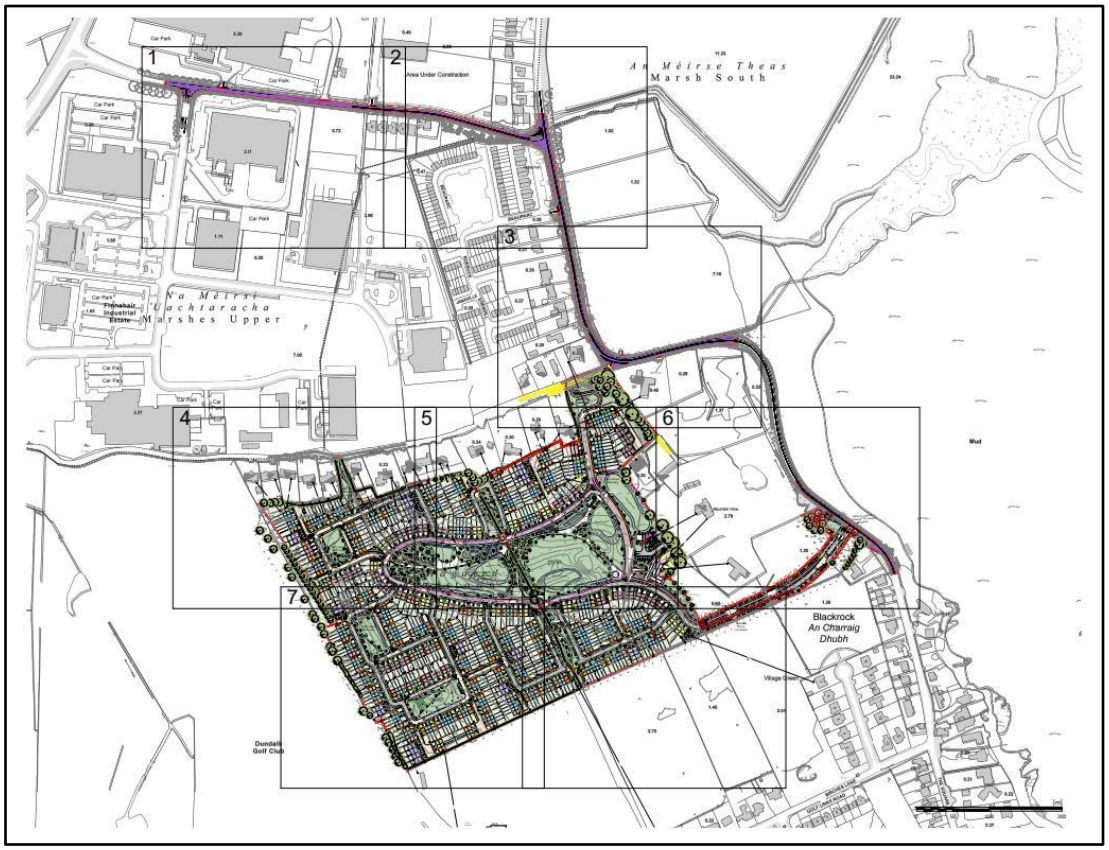
Glenveagh Ltd intend to apply for permission for a large-scale residential development (LRD) at a site a site at Haggardstown, Co. Louth The proposed residential development consists:

- The construction of 502 no. residential units consisting of 2,3 and 4-bedroom residential units.
- A creche/childcare facility;
- The provision of a number of outdoor amenity areas on the site.
- All associated ancillary development including vehicular access on to the Blackrock Road.

The site setting is predominately in a mixed residential area with nearby dwellings to the north, south and some to the east. To the west of the site is the Dundalk Golf Club.

Figure 1 shows the proposed site location in the context of the surrounding environment.

**Figure 1: Proposed Site Layout Plan**



# 3 BASELINE NOISE SURVEY



Environmental noise surveys have been conducted on site in order to establish the baseline noise environment. Noise surveys have been conducted in accordance with ISO 1996-2:2017 "*Acoustics -- Description, measurement and assessment of environmental noise -- Part 2: Determination of sound pressure levels*".

## 3.1 Monitoring Locations

Unattended noise measurements were conducted at Location N1. Attended noise measurements were conducted at locations N2 – N6. The approximate noise measurement locations are shown in Figure 2. A photograph of the measurement position can be seen below.

1.1.1.1.1 Figure 2: Proposed Site Plan Showing Baseline Monitoring Position

**Location N1** To the North-West of the site with the microphone positioned at ground floor level at a location representative of the proposed residential dwellings near the Dundalk Golf Course. This noise survey position comprised attended daytime monitoring.

**Location N2** At the North of the site with the microphone positioned at ground floor level at a location representative of a proposed development façade and proposed amenity space. This noise survey position comprised attended daytime monitoring.

**Location N3** To the North-East of the site with the microphone positioned at a location representative of the proposed development facade that is closest to the nearby main road (R172) and existing residents. This noise survey position comprised of attended daytime monitoring and unattended monitoring for an approximate 7-day period. Noise data, captured at this location is used as reference in order to estimate noise levels at the proposed development façade during both day and night-time periods.

**Location N4** At the South-West of the site with the microphone positioned at a location representative of the proposed development façade and proposed amenity space that is closest to the nearby main road (R172) and existing residents. This noise survey position comprised attended daytime monitoring.

**Location N5** At the Centre of the site with the microphone positioned at ground floor level at a location representative of a proposed amenity space. This noise survey position comprised attended daytime monitoring.

**Location N6** At the South-West of the site with the microphone positioned at ground floor level at a location representative of the proposed residential dwellings near the Dundalk Golf Course. This noise survey position comprised attended daytime monitoring.

## 3.2 Survey Periods



Noise measurements were conducted over the source of the following periods:

**Table 1: Attended Noise Survey Periods**

| Period | Location | Date | Start Time | End Time |
|---|---|---|---|---|
| Daytime 07:00 – 23:00hrs | N1 | 03 July – 04 July 2023 | 03 July at 12:46 | 04 July at 12:36 |
| | N2 | | 03 July at 13:12 | 04 July at 13:07 |
| | N3 | | 03 July at 13:36 | 04 July at 13:36 |
| | N4 | 11 July 2023 | 11 July at 14:33 | 11 July at 17:11 |
| | N5 | | 11 July at 15:01 | 11 July at 17:36 |
| | N6 | | 11 July at 15:26 | 11 July at 18:00 |

**Table 2: Unattended Noise Survey Periods**

| Period | Location | Date | Start Time | Stop Time |
|---|---|---|---|---|
| Daytime 07:00 – 23:00hrs | N3 | 04 July – 11 July 2023 | 04 July at 14:07 | 11 July at 12:03 |
| Night-time 23:00 – 07:00hrs | N3 | 04 July – 11 July 2023 | 04 July at 23:00 | 11 July at 07:00 |

## 3.3 Weather

The weather during the unattended survey of 4th to 11th July 2023 is summarised as follows (ref. https://www.met.ie/climate/available-data/daily-data) from the Dublin Airport met station.

**Table 3: Weather Conditions**

| Date | Period | Temperature Degrees Celsius | Precipitation | Wind Speed m/s | Wind Direction |
|---|---|---|---|---|---|
| 04/07 | Daytime | 12 – 18 | 19:00 – 20:00 | 3 – 9 | WSW |
| 04-05/07 | Night- time | 9 – 12 | No | 4 – 6 | WSW |
| 05/07 | Daytime | 11 – 18 | 16:00 – 17:00 | 3 – 7 | WSW |
| 05-06/07 | Night-time | 11 – 15 | No | 2 – 4 | SSW |
| 06/07 | Daytime | 14 – 18 | No | 3 – 9 | SSW |
| 06-07/07 | Night-time | 17 - 18 | No | 2 – 6 | SSE |
| 07/07 | Daytime | 14 – 20 | No | 2 – 9 | ESE |
| 07-08/07 | Night-time | 14 – 19 | No | 2 – 8 | SSE |

| Date | Period | Temperature Degrees Celsius | Precipitation | Wind Speed m/s | Wind Direction |
|---|---|---|---|---|---|
| 08/07 | Daytime | 14 – 22 | No | 1 – 9 | SSW |
| 08-09/07 | Night-time | 8 – 16 | No | 1 – 4 | ESE |



| Date | Period | Temperature Degrees Celsius | Precipitation | Wind Speed m/s | Wind Direction |
|---|---|---|---|---|---|
| 09/07 | Daytime | 12 – 20 | 12:00 – 13:00 | 2 – 7 | SSW |
| 09-10/07 | Night-time | 12 – 15 | No | 1 – 4 | ESE |
| 10/07 | Daytime | 14 – 17 | 09:00 – 10:00<br>12:00 – 14:00<br>22:00 – 23:00 | 1 – 6 | ESE |
| 10-11/07 | Night-time | 13 – 14 | 11:00 – 12:00 | 2 – 4 | WSW |
| 11/07 | Daytime | 13 – 20 | 17:00 – 18:00 | 2 – 7 | WNW |

In line with best practice, periods of rain and elevated winds have been omitted from the study.

## 3.4 Instrumentation

The noise measurements were undertaken using the following equipment.

**Table 4: Survey Equipment**

| Equipment | Type | Serial No. |
|---|---|---|
| Class 1 Sound Level Meter | Larson Davis LxT | 0004726 |

The equipment used has a calibration history that is traceable to a certified calibration institution. The calibration of the sound level meter was field checked prior to commencing measurements and prior to removing the equipment from site upon completion. A calibration drift of -0.1dB was noted upon commencement of the survey and +0.1 upon survey completion. The sound level meter calibration certificates are available on request.

The sound level meter conformed to the Class 1 requirements of BS EN 61672-1:2013 '*Electroacoustics. Sound level meter, Specifications*'. The calibrator used conforms to the requirements of BS EN IEC 60942:2018 '*Electroacoustics. Sound calibrators*'.

## 3.5 Measurement Parameters

The noise survey results are presented in decibels (dB), using the following parameters:

$L_{Aeq,T}$ is the equivalent continuous sound level and is used to describe a fluctuating

sound as a single value over the sample period (T).

$L_{AFmax,T}$ The maximum A-weighted sound pressure level occurring within a specified time period (T). Measured using the "Fast" time weighting.

$L_{AF10,T}$ Refers to those A-weighted noise levels in the top 10 percentile of the sampling interval; it is the level which is exceeded for 10% of the measurement period (T). It is used to determine the intermittent high noise level features of locally generated noise and usually gives an indicator of the level of road traffic. Measured using the "Fast" time weighting.

$L_{AF90,T}$ Refers to those A-weighted noise levels in the lower 90 percentile of the sampling interval (T). It is the level which is exceeded for 90% of the measurement period. It will therefore exclude the intermittent features of traffic and is used to describe a background level without contribution from intermittent sources.



All sound levels in this report are expressed in terms of decibels (dB) relative to 2x10-5 Pa. Noise measurements use a reference time period (T) of 15-minutes.

## 3.6 Measurement Results

### 3.6.1 Location N1

Table 5 summarises the measured daytime noise levels at Location N1.

**Table 5: Measured Noise Level at Location N1**

| Period | Date | Start Time | Measured Noise Levels (dB re. 2x10$^{-5}$ Pa) | | | | Notes |
|---|---|---|---|---|---|---|---|
| | | | $L_{Aeq}$ | $L_{Amax}$ | $L_{A10}$ | $L_{A90}$ | |
| Daytime | 03/07 | 12:46 | 48 | 60 | 51 | 44 | Tree song + distant traffic |
| | 04/07 | 11:19 | 46 | 67 | 48 | 41 | |
| | | 12:36 | 44 | 69 | 47 | 41 | |

The daytime ambient noise levels were in the range 44 to 48 dB $L_{Aeq,15min}$. Tree song and distant traffic were noted to be the dominant source of noise at this measurement position.

### 3.6.2 Location N2

Table 6 summarises the measured daytime noise levels at Location N2.

**Table 6: Measured Noise Level at Location N2**

| Period | Date | Start Time | Measured Noise Levels (dB re. $2x10^{-5}$ Pa) | | | | Notes |
|---|---|---|---|---|---|---|---|
| | | | $L_{Aeq}$ | $L_{Amax}$ | $L_{A10}$ | $L_{A90}$ | |
| Daytime | 03/07 | 13:12 | 46 | 63 | 48 | 41 | Tree song + distant traffic |
| | 04/07 | 11:42 | 48 | 64 | 51 | 41 | |
| | | 13:07 | 42 | 61 | 45 | 37 | |



The daytime ambient noise levels were in the range 42 to 48 dB $L_{Aeq,15min}$. Tree song and distant traffic were noted to be the dominant source of noise at this measurement position.

### 3.6.3 Location N3

Attended Measurements

Table 7 summarises the measured noise levels at Location N3.

**Table 7: Measured Noise Level at Location N3 (attended survey)**

| Period | Date | Start Time | Measured Noise Levels (dB re. $2x10^{-5}$ Pa) | | | | Notes |
|---|---|---|---|---|---|---|---|
| | | | $L_{Aeq}$ | $L_{Amax}$ | $L_{A10}$ | $L_{A90}$ | |
| Daytime | 03/07 | 13:36 | 53 | 79 | 55 | 48 | Distant road traffic |
| | 04/07 | 12:07 | 49 | 70 | 51 | 45 | |
| | | 13:36 | 48 | 66 | 50 | 44 | |

The daytime ambient noise levels were in the range 48 to 53 dB $L_{Aeq,15min}$. Local road traffic was noted during the survey period.

Unattended Measurements

Table 8 summarises the unattended day and night-time noise levels at Location N3 over the full survey period 4 to 11 July 2023.

**Table 8: Measured Noise Level at Location N3 between 4 – 11 July 2023 (unattended survey)**

| Period | Date | Time | Measured Noise Levels (dB re. $2x10^{-5}$ Pa) | | | |
|---|---|---|---|---|---|---|
| | | | $L_{Aeq}$ | $L_{Amax}$ | $L_{A10}$ | $L_{A90}$ |
| Daytime | 04/07 | 14:07 – 23:00 | 50 | 68 | 45 | 36 |
| Night-time | 04-05/07 | 23:00 – 07:00 | 42 | 68 | 42 | 34 |

| Period | Date | Time | Measured Noise Levels (dB re. $2x10^{-5}$ Pa) | | | |
|---|---|---|---|---|---|---|
| | | | $L_{Aeq}$ | $L_{Amax}$ | $L_{A10}$ | $L_{A90}$ |
| Daytime | 05/07 | 07:00 – 23:00 | 49 | 68 | 51 | 44 |
| Night-time | 05-06/07 | 23:00 – 07:00 | 40 | 60 | 41 | 34 |
| Daytime | 06/07 | 07:00 – 23:00 | 51 | 81 | 51 | 45 |
| Night-time | 06-07/07 | 23:00 – 07:00 | 46 | 70 | 48 | 39 |
| Daytime | 07/07 | 07:00 – 23:00 | 50 | 71 | 51 | 45 |
| Night-time | 07-08/07 | 23:00 – 07:00 | 46 | 74 | 47 | 43 |
| Daytime | 08/07 | 07:00 – 23:00 | 50 | 77 | 50 | 44 |

| Period | Date | Time | Measured Noise Levels (dB re. $2x10^{-5}$ Pa) | | | |
|---|---|---|---|---|---|---|
| | | | $L_{Aeq}$ | $L_{Amax}$ | $L_{A10}$ | $L_{A90}$ |
| Night-time | 08-09/07 | 23:00 – 07:00 | 41 | 60 | 43 | 30 |
| Daytime | 09/07 | 07:00 – 23:00 | 50 | 96 | 49 | 41 |
| Night-time | 09-10/07 | 23:00 – 07:00 | 40 | 65 | 43 | 31 |
| Daytime | 10/07 | 07:00 – 23:00 | 48 | 65 | 50 | 43 |
| Night-time | 10-11/07 | 23:00 – 07:00 | 42 | 66 | 42 | 34 |
| Daytime | 11/07 | 07:00 – 12:03 | 50 | 64 | 53 | 46 |

The daily daytime ambient noise levels were in the range 48 to 51 dB $L_{Aeq,16hr}$. Distant road traffic, tree song and bird song were noted during the survey period.

The night-time ambient noise levels were in the range 40 to 46 dB $L_{Aeq,8hr}$. Distant road traffic, tree song and bird song were noted during the survey period.

Figure 3 shows the time-history graph of day time measured noise levels between 4th and 11th July 2023 at Location N3 and Figure 4 shows the time-history graph of night-time measured noise levels.

**Figure 3: Daytime measured noise levels**

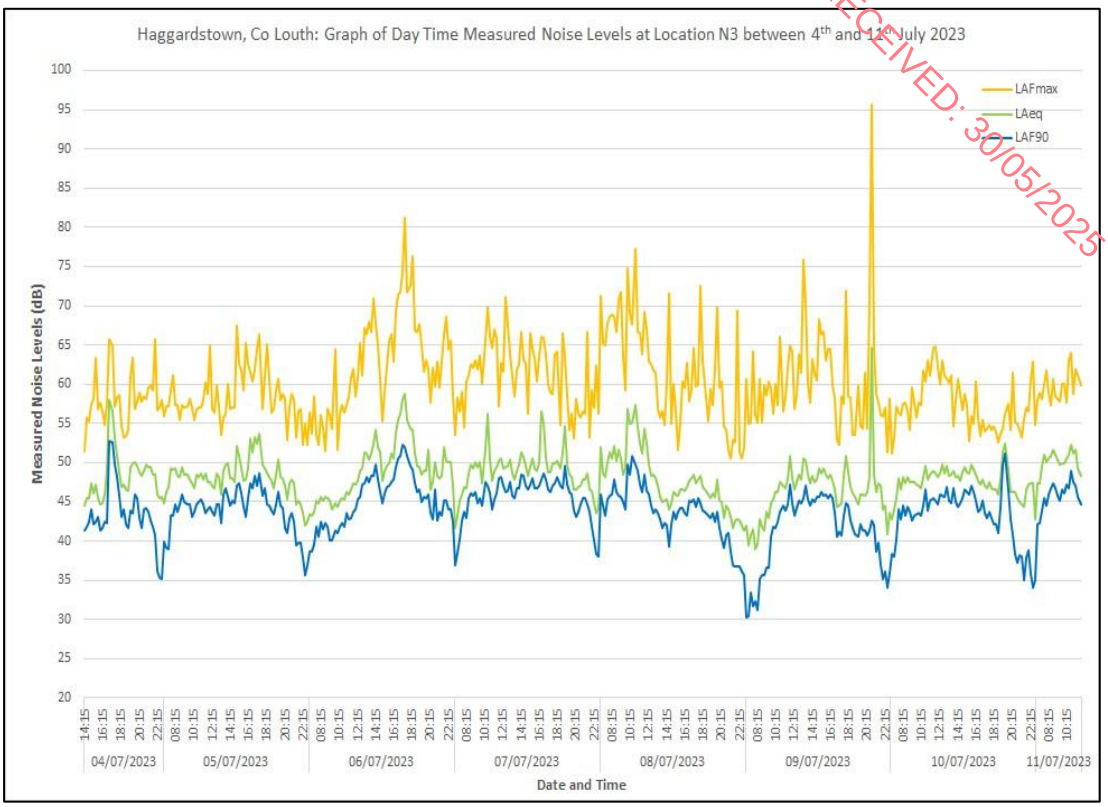
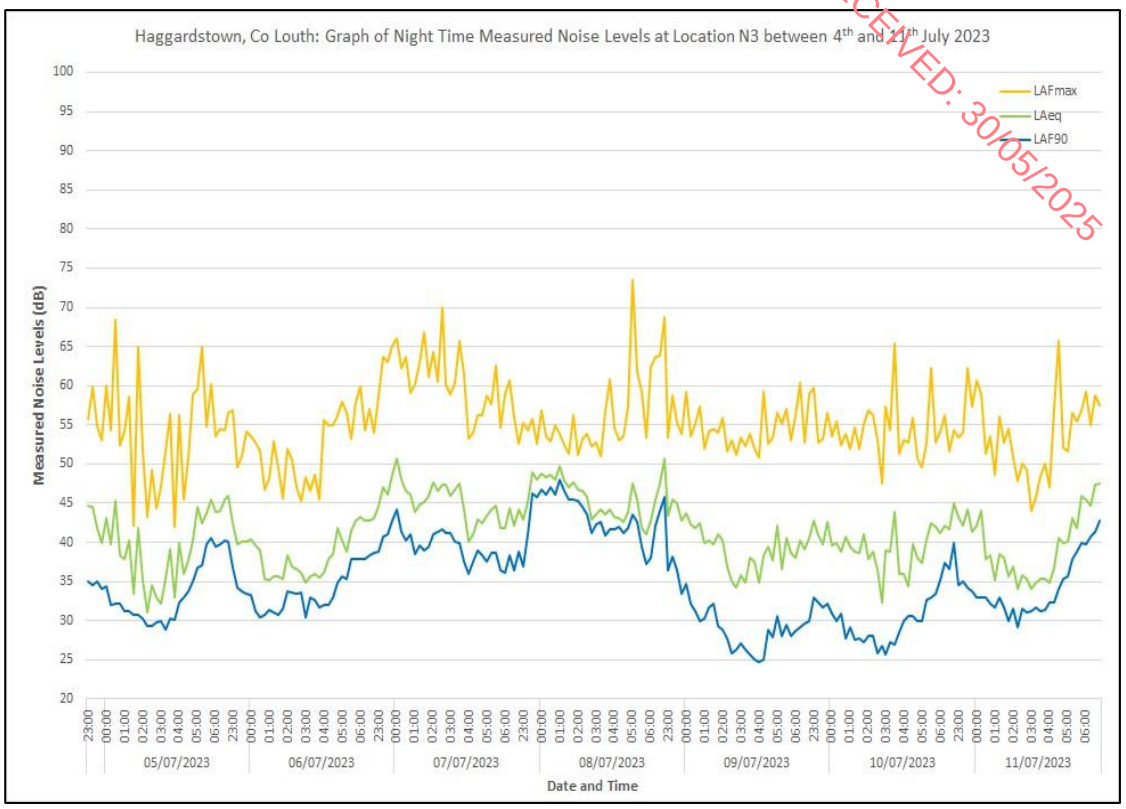


**Figure 4: Night-time measured noise levels**




### 3.6.4 Location N4

Table 9 summarises the measured noise levels at Location N4.

**Table 9: Measured Noise Level at Location N4**

| Period | Date | Start Time | Measured Noise Levels (dB re. 2x10$^{-5}$ Pa) | | | | Notes |
|---|---|---|---|---|---|---|---|
| | | | $L_{Aeq}$ | $L_{Amax}$ | $L_{A10}$ | $L_{A90}$ | |
| Daytime | 11/07 | 14:33 | 44 | 61 | 46 | 40 | Tree song + distant traffic |
| | | 15:57 | 49 | 77 | 52 | 43 | |
| | | 17:11 | 49 | 66 | 52 | 43 | |

The daytime ambient noise levels were in the range 44 to 49 dB $L_{Aeq,15min}$. Tree song and distant traffic were noted to be the dominant source of noise at this measurement position.

### 3.6.5 Location N5

Table 10 summarises the measured noise levels at Location N5.

**Table 10: Measured Noise Level at Location N5**

| Period | Date | Start Time | Measured Noise Levels (dB re. 2x10$^{-5}$ Pa) | | | | Notes |
|---|---|---|---|---|---|---|---|
| | | | $L_{Aeq}$ | $L_{Amax}$ | $L_{A10}$ | $L_{A90}$ | |
| Daytime | 11/07 | 15:01 | 52 | 70 | 56 | 42 | Tree song+ distant traffic |
| | | 16:20 | 45 | 58 | 48 | 41 | |
| | | 17:36 | 47 | 71 | 50 | 42 | |

The daytime ambient noise levels were in the range 45 to 52 dB $L_{Aeq,15min}$. Tree song and distant traffic were noted to be the dominant source of noise at this measurement position.

### 3.6.6 Location N6

Table 11 summarises the attended measured noise levels at Location N6.

**Table 11: Measured Noise Level at Location N6**

| Period | Date | Start Time | Measured Noise Levels (dB re. 2x10$^{-5}$ Pa) | | | | Notes |
|---|---|---|---|---|---|---|---|
| | | | $L_{Aeq}$ | $L_{Amax}$ | $L_{A10}$ | $L_{A90}$ | |
| Daytime | 11/07 | 15:26 | 42 | 58 | 45 | 39 | Local road traffic |
| | | 16:43 | 42 | 73 | 43 | 38 | |
| | | 18:00 | 43 | 68 | 43 | 40 | |

The daytime ambient noise levels were in the range 42 to 43 dB $L_{Aeq,15min}$. Local road traffic was noted during the survey period.

# 4 NOISE CRITERIA



In deriving noise criteria for the development, consideration has been given to the following documents:

- Louth County Council Noise Action Plan 2018 – 2023
- *The Professional Guidance on Planning & Noise* (ProPG), May 2017.
- BS 8233 *Guidance on sound insulation and noise reduction for buildings.*
- BS 4142:2014+A1:2019 *Methods for rating and assessing industrial and commercial sound*.

## 4.1 Louth County Council Noise Action Plan 2018 – 2023

With regard to inward noise impact on the proposed dwellings reference is made to the *Louth County Council Noise Action Plan 2018 – 2023* (NAP) which provides guidance for the scenario whereby a residential development is proposed in an area exposed to pre-existing levels of environmental noise.

Section 7.5.1 of the LCC NAP references ProPG, which is the 'industry standard' guideline for assessing the potential noise impact of a new residential development in an area with an existing climate of environmental noise.

The noise levels measured on site will therefore be compared to relevant guidance for assessing the suitability of the site for residential development i.e. ProPG: *ProPG: Professional Practice guidance on Planning and Noise for new Residential Development* (May 2017).

## 4.2 ProPG: Professional Practice Guidance on Planning and Noise for new Residential Development

ProPG provides a two staged approach for evaluating noise exposure on a proposed residential development. The two stages of the approach can be summarised as follows:

**Stage 1** - Involves a high-level initial noise risk assessment of the proposed site considering either measured and or predicted noise levels.

**Stage 2** – Involves a full detailed appraisal of the proposed development covering four "key elements" that include.:

*Element 1* - Good Acoustic Design Process;

*Element 2* - Noise Level Guidelines;

*Element 3* - External Amenity Area Noise Assessment, and;

*Element 4* - Other Relevant Issues.

An Acoustic Design Statement (ADS) is then prepared for submission to the planning authority. This ADS outlines the findings of the Stage 1 and Stage 2 assessments; and allows the planning authority to make an informed decision on the suitability of the site for development, with

consideration of noise control measures where required. The ProPG document outlines the following potential outcome with respect of the ADS:



A. Planning consent may be granted without any need for noise conditions;

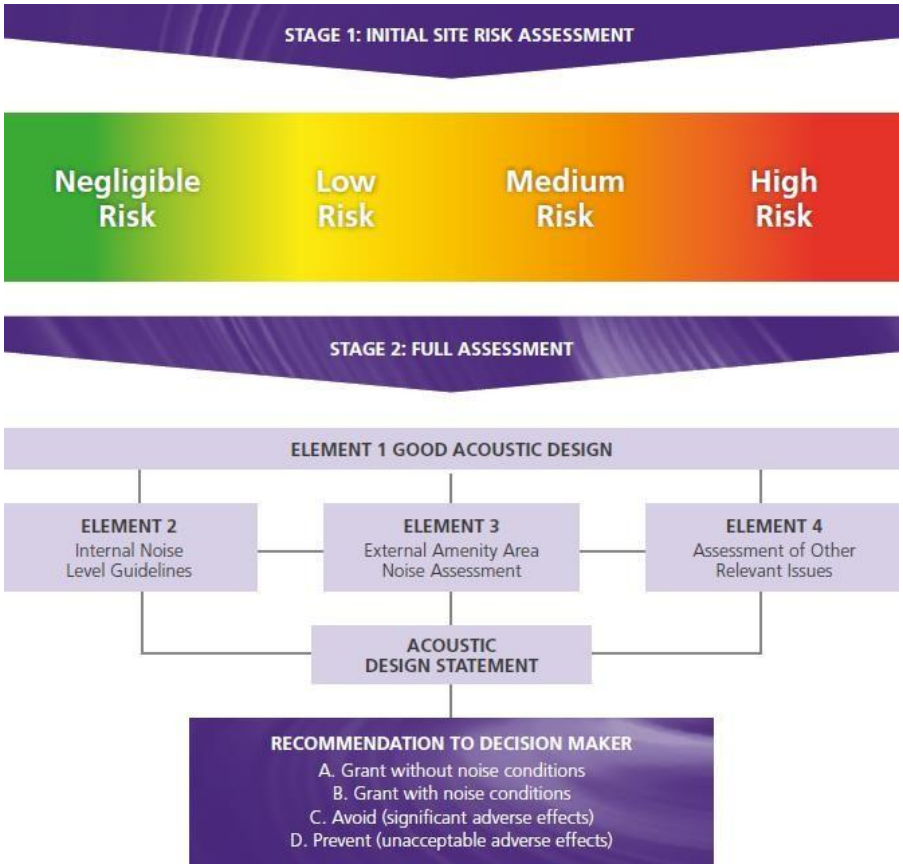
B. Planning consent may be granted subject to the inclusion of suitable noise conditions;

C. Planning consent should be refused on noise grounds in order to avoid significant adverse effects ("avoid"); or,

D. Planning consent should be refused on noise grounds in order to prevent unacceptable adverse effects ("prevent").

A summary of the ProPG approach is illustrated in Figure 5.

**Figure 5: ProPG Assessment Strategy (Source: ProPG)**



## 4.3 ProPG and BS 8233 Guidance on sound insulation and noise reduction for buildings



BS 8233 is referenced in ProPG with regard to internal noise levels within the proposed new dwellings. The following internal noise targets are presented as derived from BS 8233 (2014).

**Table 12: ProPG Internal Noise Targets (derived from BS 8233:2014)**

| Activity | Location | Daytime (07:00 to 23:00hrs) | Night-time (23:00 to 07:00hrs) |
|---|---|---|---|
| Resting | Living room | 35 dB $L_{Aeq,16hr}$ | - |
| Dining | Dining room/area | 40 dB $L_{Aeq,16hr}$ | - |
| Sleeping (daytime resting) | Bedroom | 35 dB $L_{Aeq,16hr}$ | 30 dB $L_{Aeq,8hr}$<br>45 dB $L_{Amax,T}$* |

* internal $L_{AFmax,T}$ noise level may be exceeded up to 10 times per night without a significant impact occurring.

# 5 IMPACT OF EXISTING NOISE SOURCES ON THE PROPOSED DEVELOPMENT



ProPG outlines a systematic risk based 2 stage approach for evaluating noise exposure on prospective sites for residential development. The two primary stages of the approach can be summarised as follows:

Stage 1 - Comprises a high-level initial noise risk assessment of the proposed site considering either measured and or predicted noise levels, and;

Stage 2 – Involves a full detailed appraisal of the proposed development covering four "key elements" that include:

- Element 1 - Good Acoustic Design Process;
- Element 2 - Noise Level Guidelines;
- Element 3 - External Amenity Area Noise Assessment, and;
- Element 4 - Other Relevant Issues.

ProPG is intended to outline the methodology and findings of the assessments, so as the planning authority can make an informed decision on the permission. ProPG outlines the following possible recommendations in relation to the findings:

A. Planning consent may be granted without any need for noise conditions;
B. Planning consent may be granted subject to the inclusion of suitable noise conditions;
C. Planning consent should be refused on noise grounds in order to avoid significant adverse effects ("avoid"); or,
D. Planning consent should be refused on noise grounds in order to prevent unacceptable adverse effects ("prevent").

The following sections present the results of both the Stage 1 and Stage 2 studies.

## 5.1 ProPG Stage 1 (Initial Noise Risk Assessment)

The initial noise risk assessment is intended to provide an early indication of any acoustic issues that may be encountered. It calls for the categorization of the site as a negligible, low, medium or high risk based on the pre-existing noise environment.

Paragraph 2.9 of ProPG states that,

> *"The noise risk assessment may be based on measurements or prediction (or a combination of both) as appropriate and should aim to describe noise levels over a "typical worst case" 24 hour day either now or in the foreseeable future."*

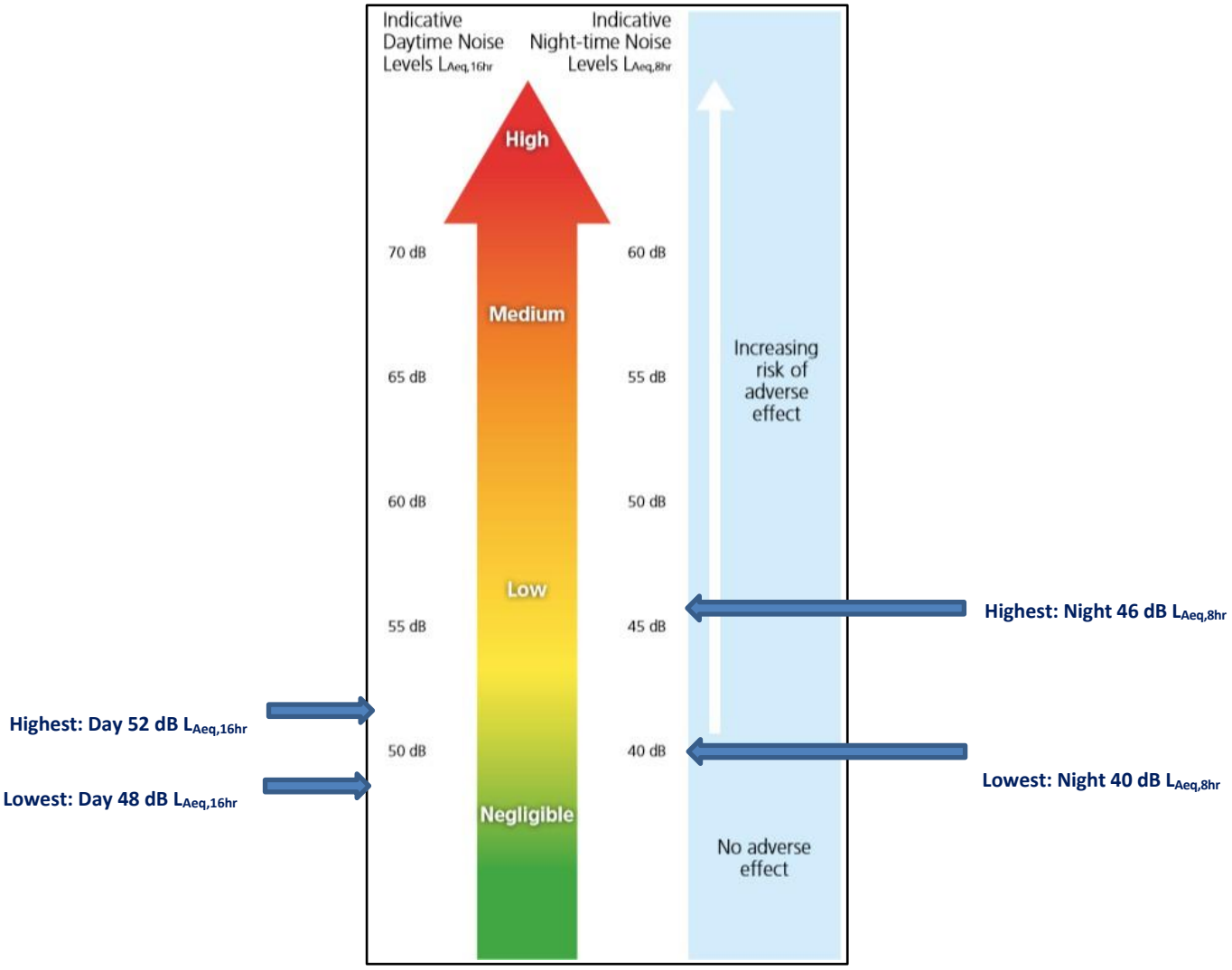
### 5.1.1 Calculated Noise from Existing Sources

In assessing typical noise levels currently present on site, reference is made to the baseline nose survey and associated results presented in Section 3.0.

### 5.1.2 ProPG Stage 1 Noise Risk Categories

Figure 8 presents the basis of the initial noise risk assessment; it provides appropriate risk categories for a range of continuous noise levels measured and/or predicted on site. The range existing noise levels on the site at the location of the unattended noise monitor (Location N3) are indicated on Figure 6.

**Figure 6 ProPG Stage 1 - Noise Risk Assessment Categories with range of measured site noise Levels (Location N3) Indicated**



ProPG also states that a site should not be considered a negligible risk if more than 10 $L_{AFmax}$ events exceed 60 dB during the night period and the site should be considered a high risk if the $L_{AFmax}$ events exceed 80 dB more than 20 times a night. Reference to Figure 4 confirms that 80dB $L_{AFmax}$ was not exceeded on any occasion over the course of the 7-night survey (23:00 – 07:00hrs), thus would not fall within the high risk category.

A Stage 1 noise risk assessment of the proposed site has been conducted, based on measured noise levels on site and expected noise levels on site in the foreseeable future, with comparison to the categories outlined in Figure 6.

With reference to the existing noise levels measured on site (as presented in Tables 5 to 11), the initial ProPG noise risk categories, for the facades most exposed to road traffic noise, are summarised as follows:

Daytime: **Negligible** to **Low**

Night-time **Negligible** to **Low**

## 5.2 ProPG Stage 2 (Acoustic Design Statement)

With consideration of the Stage 1 review, as presented above, it is considered that the site is suitable for residential development, provided that an appraisal of the proposed development is carried out, covering four key elements that include:

- Element 1 - Good Acoustic Design Process.
- Element 2 - Noise Level Guidelines.
- Element 3 - External Amenity Area Noise Assessment.
- Element 4 - Other Relevant Issues.

### 5.2.1 Element 1: Good Acoustic Design (GAD) Process

Good acoustic design should aim to deliver optimum acoustic design for a site without adversely affecting amenity or quality of life or compromising other sustainable design objectives ProPG states that good acoustic design is not equivalent to overdesign of all new development but that it seeks to deliver an optimum acoustic environment for a given site. ProPG outlines the following checklist for GAD:

- Check the feasibility of relocating or reducing noise levels from relevant sources.
- Consider options for planning the site or building layout.
- Consider the orientation of proposed building(s).
- Select construction types and methods for meeting building performance requirements.
- Examine the effects of noise control measures on ventilation, fire regulation, health and safety, cost, CDM (construction, design and management) etc.
- Assess the viability of alternative solutions.
- Assess external amenity area noise.

Each item listed above have been addressed in the following sections.



#### 5.2.1.1 *Relocation or Reduction of Noise from Source*

The dominant noise source impacting upon the site is road traffic from existing roads. Given that the roads are located outside the site boundary, additional reduction of noise as source cannot be considered in respect of this development.

A reduction in noise emissions to the proposed site can sometimes be achieved via the provision of a perimeter barrier screens. However, based upon the measured baseline noise levels on the site, a requirement for perimeter noise barrier(s) is not required.

#### 5.2.1.2 *Planning, Layout and Orientation*

Proposed residential buildings are set back from the nearby transport network in accordance with local planning guidelines. It is considered that the layout and orientation of the proposed development is sufficient in the context of noise emissions and GAD.

#### 5.2.1.3 *Select Construction Types for meeting Building Regulations*

Concrete constructions will be used for external walls of dwellings. Solid concrete constructions provide high levels of sound insulation performance.

Glazing and ventilation paths are typically the weakest façade elements in terms of sound insulation performance. The provision of glazing and ventilators offering an appropriate level of sound insulation will therefore be provided.

Calculation's indicate that it will possible to achieve the desirable internal acoustic environments when windows are open at all building facades.

#### 5.2.1.4 *Impact of noise control measures on fire, health and safety etc*

The proposed noise control measures do not have a significant impact on fire or other health and safety issues.

#### 5.2.1.5 *Assess Viability of Alternative Solutions*

The major noise sources incident on the site are road traffic. Road traffic is mitigated by the distance from the road edge to the building, screening by existing/proposed structures, off and on-site buildings and orientation of windows. All the measures listed above aid in the control of noise intrusion to the living areas and bedrooms across the majority of the development.

#### 5.2.1.6 *Assess External Amenity Area Noise*

ProPG advises the following in relation to external noise levels in amenity areas:

> *The acoustic environment of external amenity areas that are an intrinsic part of the overall design should always be assessed and noise levels should ideally not be above the range 50 – 55 dB $L_{Aeq,16hr}$.*

An assessment of noise within external amenity areas is addressed in the relevant section of this document.

#### 5.2.1.7 *GAD Summary*

It is considered that the principles of Good Acoustic Design have been applied to the development.



### 5.2.2 Element 2: Internal Noise Level Guidelines

#### 5.2.2.1 *Internal Noise Criteria*

ProPG recommends internal noise targets as derived from BS 8233. These internal noise level targets are presented in Table 12.

ProPG acknowledges that there can be some flexibility given in cases where the development is necessary or desirable, and that a relaxation by up to 5dB of the internal $L_{Aeq}$ values can still provide reasonable internal conditions.

#### 5.2.2.2 *Assessed External Noise Levels*

Noise surveys have been conducted across the site in order to establish the range and magnitude of noise levels at various positions on-site. Table 13 presents the free-field noise levels used for assessment purposes.

**Table 13: Worst-case expected Existing Noise Levels at Development Facades**

| Development Zone | Measured Daytime Level (dB $L_{Aeq,16hr}$) | Measured Night-time Level (dB $L_{Aeq,8hr}$) |
|---|---|---|
| Full Site | 52 | 46 |

#### 5.2.2.3 *Façade Acoustic Performance Specification*

The methodology to estimate internal noise level within a building is outlined in Annex G of BS 8233: 2014 and is derived from BS EN 12354-3: 2000: B*uilding acoustics – Estimation of acoustic performance of buildings from the performance of elements – Part 3: Airborne sound insulation against outdoor sound*. The methodology calculates internal noise levels based on a reference external noise level (i.e. octave band frequency data as measured in baseline noise surveys) and proposed façade constructions. The standard takes into account the following site-specific characteristics:

- External noise level;
- Area and type of each façade element (i.e. window, wall, etc.);
- Shape of the façade, and;
- Characteristics of the receiving room (i.e. room volume, reverberation time etc.)

This method has been used to determine the required sound insulation performance for the various building façade elements.

Glazing

Facades shall be provided with glazing that achieves the following minimum sound insulation performance.

**Table 14: Glazing Acoustic Specification**

| Specification (Ref Figure 9) | Sound Reduction Performance Requirements (dB) in Octave Frequency Bands (Hz) | | | | | | Typical Overall dB $R_w$ |
|---|---|---|---|---|---|---|---|
| | 125 | 250 | 500 | 1k | 2k | 4k | |
| Zone A (Magenta) | 15 | 15 | 20 | 23 | 29 | 27 | 22 |

This performance will typically be achieved with standard thermal glazing (i.e. 4-12-4 configuration, or similar).

The overall $R_w$ values outlined above are provided for information purposes only. The over-riding requirement is the Octave Band sound insulation performance values.

The acoustic performance specifications are minimum requirements which apply to the overall glazing system. The 'glazing system' is understood to include any and all of the component parts that form part of the glazed element of the façade, i.e. glass, frames, seals, openable elements etc.

The window supplier shall provide laboratory tests confirming the sound insulation performance, (to British Standard 2750 Part 3:1980 and British Standard 5821, or British Standard EN ISO 140 Part 3 1995 and British Standard EN ISO 717, 1997).

Wall / Roof Constructions

Masonry wall and roof constructions with plasterboard linings typically offer sound insulation performance much greater than that offered by the glazed elements.

The calculated internal noise levels across the building façade have assumed a minimum sound reduction index of 55 dB $R_w$ for these constructions. The performance of non-glazed elements of the façade will be confirmed as part of the detailed design phase.

Acoustic Attenuation to Ventilation Systems

It has been well established that a partially open window will typically offer between 15 dB and 18dB attenuation from external noise sources. If we consider the internal noise criteria as outlined in Table 12 and assume a 15 dB attenuation value for a partially open window, we can conclude that acoustic ventilators are therefore not required.

#### 5.2.2.4 *Element 3: External Amenity Area Noise Assessment*

It is a ProPG requirement, as part of the acoustic design statement, to assess noise levels within external amenity spaces. ProPG refers to guidance contained in BS 8233 (2014) for this element of the assessment, the relevant extract of BS 8233 (2014) states:

> *"The acoustic environment of external amenity areas that are an intrinsic part of the overall design should always be assessed and noise levels should ideally not be above the range 50 – 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited."*

With consideration of the various open amenity spaces / gardens proposed as part of the development, and the measured baseline noise levels, it is concluded that the noise levels in external amenity areas will not exceed the range 50 – 55 dB $L_{Aeq,T}$, thus additional noise mitigation measures are not required.

#### 5.2.2.5 *Element 4: Assessment of Other Relevant Issues*

ProPG defines a number of other issues that should be considered and may prove pertinent to the assessment:

- 4(i) compliance with relevant national and local policy
- 4(ii) magnitude and extent of compliance with ProPG
- 4(iii) likely occupants of the development
- 4(iv) acoustic design v unintended adverse consequences
- 4(v) acoustic design v wider planning objectives

Each of the above considerations are discussed below.

<u>Compliance with Relevant National and Local Policy</u>

The assessment has considered the requirements and recommendations of the Louth County Council *Noise Action Plan* (NAP) *2018 – 2023*, Section 7.5.1 of the LCC NAP references ProPG, which is the 'industry standard' guideline for assessing the potential noise impact of a new residential development in an area with an existing climate of environmental noise.

<u>Magnitude and extent of compliance with ProPG</u>

The following conclusions are made in relation to the magnitude and extent of compliance with ProPG:

- All dwellings have been designed to achieve the good internal noise levels, as specified within ProPG, when windows are closed and opened.

- There are external amenity spaces available for use by residents that have been assessed and are determined to be within the ProPG guidance for noise levels in external amenity areas.

It is therefore concluded that the proposed development is in compliance with the requirements of ProPG.



Likely occupants of the development

The development consists of apartments and is designed for the purpose of residential accommodation. The criteria adopted as part of this assessment are based on those recommended for permanent dwellings and are therefore considered robust and appropriate for the occupants.

Acoustic design v unintended adverse consequences

There have not been any unintended adverse consequences identified resulting from the acoustic design and control measures.

Acoustic design v wider planning objectives

Acoustic design has been considered in the context of wider planning objectives, particularly the National Planning Framework 2040. (NPF) The NPF is taken into consideration in the production of local planning policy/guidelines and plans. In following existing local / national guidelines and policies, it is considered that the acoustic design is compliant with wider planning objectives.

# 6 PLANT NOISE EMISSIONS FROM PROPOSED DEVELOPMENT



Reference is made to BS 4142:2014+A1: 2019 in setting criteria for new mechanical plant items i.e. any proposed extract fans, heat pumps, air conditioning units etc.

Based upon measured day and night-time background sound levels on the site, appropriate plant noise criteria to nearby dwellings are as follows:

- Daytime (07:00 to 23:00hrs) 45 dB $L_{Aeq,1hr}$
- Night-time (23:00 to 07:00hrs) 35 dB $L_{Aeq,15\text{-}min}$

Plant noise emissions should not contain any characteristics that would warrant any acoustic feature penalties under the BS 4142:2014 assessment procedure.

At detailed design stage, noise emissions from new plant servicing the development shall be designed so as not to exceed the above limit values.

# 7 CONCLUSIONS



RSK Ireland Limited (RSK) was instructed by Glenveagh Ltd to conduct a noise impact assessment and Acoustic Design Statement (ADS) in respect of a proposed LRD at Haggardstown, Co. Louth

The aim of this study is to assess the potential impacts to future residents and to provide recommendations, where necessary, to the risk of nuisance arising from existing traffic noise emissions.

Baseline monitoring has found pre-existing noise levels are typical of a rural location with relatively low baseline noise levels measured across the site.

This report considers the potential inward impact of road traffic on the proposed development. Assessment methodologies use guidance from *The Professional Guidance on Planning & Noise* (ProPG), May 2017. The two primary stages of the ProPG assessment are the "Stage 1" initial noise risk assessment of the proposed site and "Stage 2" detailed appraisal of the proposed development and preparation of an Acoustic Design Statement.

The site noise survey has also been used to assess the sites noise risk categories, as per the ProPG "Stage 1" assessment. The ProPG noise risk categories, for façades most exposed to road traffic, are **Negligible** to **Low** for both daytime and night-time periods.

Recommendation to mitigate noise emissions, as specified in the "Stage 2" Acoustic Design Statement, include the following:

- Provision of glazing with minimum sound insulation properties as outlined in this document. The specified performance will typically be achieved with standard thermal glazing (i.e. 4-12-4 configuration, or similar).

In the developments operational phase, criteria have also been set for new building services plant in accordance with the methodologies outlined in BS 4142:2014+A1:2019. It has been concluded that the likely noise impact of the developments in its operational phase is not significant.

In summary, it is considered that the site is suitable for residential development subject to the provision of the noise control recommendations as outlined in this report.

# SERVICE CONSTRAINTS

## 1.1.2RSK ENVIRONMENT LIMITED SERVICE CONSTRAINTS

1. This report (the "Services") was compiled and carried out by RSK Ireland Limited (RSK) for Glenveagh Ltd . (the "client") in accordance with the terms of a contract between RSK and the "client". The Services were performed by RSK with the skill and care ordinarily exercised by a reasonable environmental consultant at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the client.

2. Other than that expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.

3. Unless otherwise agreed the Services were performed by RSK exclusively for the purposes of the client. RSK is not aware of any interest of or reliance by any party other than the client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent or condone any party other than the client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and RSK disclaims any liability to such parties. **Any such party would be** well advised to seek independent advice from a competent environmental consultant and/or lawyer.

4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK 's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date hereof, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.

5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.

6. The observations and conclusions described in this report are based solely upon the Services which were provided pursuant to the agreement between the client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services.

7. The Services are based upon RSK's observations of existing physical conditions at the Site gained from a walk-over survey of the site together with RSK's interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The Services are also based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely. The Services clearly are limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the walk-over survey. Further RSK was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services. RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK save as otherwise provided in the terms of the contract between the client and RSK.

8. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan, but is (are) used to present the general relative locations of features on, and surrounding, the site.

Haggardstown LRD

Dundalk, Co. Louth



**Appendices**

# Volume III

**CHAPTER 15 Cultural Heritage**

Appendix 15.1 Recorded Archaeological Sites Within Study Area

Appendix 15.2 Legislation Protecting the Archaeological Resource

Appendix 15.3 Legislation Protecting the Architectural Resource

Appendix 15.4 Impact Assessment and the Cultural Heritage Resource

Appendix 15.5 Mitigation Measures and the Cultural Heritage Resource

May 2025

McCutcheon Halley
CHARTERED PLANNING CONSULTANTS

# Appendix 15.1 Recorded Archaeological Sites Within Study Area

May 2025

McCutcheon Halley
CHARTERED PLANNING CONSULTANTS

# Appendix 15.1 Recorded Archaeological Sites Within Study Area



| SMR No. | LH007-080 |
|---|---|
| Townland | Marshes Upper |
| Parish | Haggardstown |
| Barony | Upper Dundalk |
| ITM | 706499 804973 |
| Classification | Souterrain |
| Dist. to development | 0m |
| Description | Excavated by P. Gosling in 1980 prior to factory construction. The site consisted of a passage (L 14.5m overall, Wth 1m) extending NW (L 8m) then curving gently E (L 6.5m). A second passage (L 3m, Wth 0.7m) extended N from the middle of the first passage and terminated at the E end of a gallery (L 3.5m, Wth 1m) aligned E-W. |
| Reference | www.archaeology.ie/ SMR file |

| SMR No. | LH007-086 |
|---|---|
| Townland | Marshes Upper |
| Parish | Haggardstown |
| Barony | Upper Dundalk |
| ITM | 706421 804470 |
| Classification | Souterrain |
| Dist. to development | c. 72 metres northwest |
| Description | Excavated by M. Gowen in 1982. The site consisted of an enclosure (LH007-140----) (diam. c. 60m) within which were two souterrains, the second of which was cut by the enclosure ditch and must pre-date it. The first souterrain (LH007-085----) was roughly S-shaped in plan, consisting of a passage (L 22.5m, Wth 1-1.4m, H 1.7m) running E from the original rock-cut ramp entrance, then turning N and terminating at the E end in a sub-rectangular chamber (L 12.5m) aligned E-W. There were a pair of door slots in the walls at the junction of the passage and chamber. The second souterrain (LH007-086----) had a rock-cut ramp entrance 3m S of the entrance to the first souterrain, and consisted of a passage (L 24m, Wth 1-1.1m, H 1.2m) running SSW, with a slight terminal bulge forming a chamber at the SSW end. There was a trap 3.4m from the entrance at the NE end. |
| Reference | www.archaeology.ie/ SMR file |

| SMR No. | LH007-085 |
|---|---|
| Townland | Marshes Upper |
| Parish | Haggardstown |

| | |
|---|---|
| **Barony** | Upper Dundalk |
| **ITM** | 706400 804490 |
| **Classification** | Souterrain |
| **Dist. to development** | c. 108 metres northwest |
| **Description** | Excavated by M. Gowen in 1982. The site consisted of an enclosure (LH007-140----) (diam. c. 60m) within which were two souterrains, the second of which was cut by the enclosure ditch and must pre-date it. The first souterrain (LH007-085----) was roughly S-shaped in plan, consisting of a passage (L 22.5m, Wth 1-1.4m, H 1.7m) running E from the original rock-cut ramp entrance, then turning N and terminating at the E end in a sub-rectangular chamber (L 12.5m) aligned E-W. There were a pair of door slots in the walls at the junction of the passage and chamber. The second souterrain (LH007-086----) had a rock-cut ramp entrance 3m S of the entrance to the first souterrain, and consisted of a passage (L 24m, Wth 1-1.1m, H 1.2m) running SSW, with a slight terminal bulge forming a chamber at the SSW end. There was a trap 3.4m from the entrance at the NE end. |
| **Reference** | www.archaeology.ie/ SMR file |



| **SMR No.** | **LH007-140** |
|---|---|
| **Townland** | Marshes Upper |
| **Parish** | Haggardstown |
| **Barony** | Upper Dundalk |
| **ITM** | 706400 804490 |
| **Classification** | Enclosure |
| **Dist. to development** | c. 108 metres northwest |
| **Description** | Roughly circular area enclosed by single ditch. Excavated by M. Gowen in 1982. Two souterrains (LH007-085----, LH007-086----) within enclosure. |
| **Reference** | www.archaeology.ie/ SMR file |

| **SMR No.** | **LH007-084** |
|---|---|
| **Townland** | Marshes Upper |
| **Parish** | Haggardstown |
| **Barony** | Upper Dundalk |
| **ITM** | 706360 804539 |
| **Classification** | Souterrain |
| **Dist. to development** | c. 164 metres northwest |
| **Description** | Excavated by M. Gowen in 1982 in advance of construction work. The site consisted of two souterrains within an oval enclosure (diam. 40m by 60m) (LH007-139----). The first souterrain (LH007-083----) T-shaped in plan, consisted of a passage (L 11m, Wth 1.1-5m) running W from the original rock-cut ramp entrance at the E. At the W end of the passage is gallery (L 18m, Wth 1.3-1.7m) ran S and another section of the same gallery (L 10m, Wth 1.6-2m) ran |

| | |
|---|---|
| | NW. The second souterrain (LH007-084----), roughly U-shaped in plan, consisted of a simple passage (L 25m, Wth 0.6-1m, H 1.4-1.6m) curving gently N-WSW. |
| **Reference** | www.archaeology.ie/ SMR file |



| **SMR No.** | **LH007-183** |
|---|---|
| **Townland** | Marshes Upper |
| **Parish** | Haggardstown |
| **Barony** | Upper Dundalk |
| **ITM** | 701959 808502 |
| **Classification** | Souterrain |
| **Dist. to development** | c. 203 metres northwest |
| **Description** | Excavated as part of the Dundalk Western by-pass project (Excavation Licence No. 04E0817). A patchy spread (L 7m; Wth 7m; max. D 0.4m) of burnt stone set in a burnt silty sand under which lay a sub-oval trough (L 1.5m; Wth 1m) and a possible post-hole or pit. (Hayes 2007, 267) |
| **Reference** | www.archaeology.ie/ SMR file |

| **SMR No.** | **LH007-139** |
|---|---|
| **Townland** | Marshes Upper |
| **Parish** | Haggardstown |
| **Barony** | Upper Dundalk |
| **ITM** | 706331 804560 |
| **Classification** | Enclosure |
| **Dist. to development** | c. 203 metres northwest |
| **Description** | Oval area enclosed by single ditch. Excavated by M. Gowen in 1982. Two souterrains (LH007-083----, LH007-084----) within enclosure. |
| **Reference** | www.archaeology.ie/ SMR file |

| **SMR No.** | **LH007-082** |
|---|---|
| **Townland** | Marshes Upper |
| **Parish** | Haggardstown |
| **Barony** | Upper Dundalk |
| **ITM** | 706308 804588 |
| **Classification** | Souterrain |
| **Dist. to development** | c. 238 metres northwest |
| **Description** | Excavated by M. Gowen in 1982 in advance of construction work. Situated NW of four other excavated souterrains (LH007-083----, LH007-084----, LH007-085----, LH007-086----), |

| | |
|---|---|
| | apparently in isolation at the base of a small hillock. The souterrain consisted of a passage (L 10m, Wth 0.7-0.9m) at the N end of which was a small recess and a chamber (L 4m, Wth 1m) running at right angles to it towards the W. |
| **Reference** | www.archaeology.ie/ SMR file |



| **SMR No.** | **LH007-081** |
|---|---|
| **Townland** | Marshes Upper |
| **Parish** | Haggardstown |
| **Barony** | Upper Dundalk |
| **ITM** | 706059 804828 |
| **Classification** | Souterrain |
| **Dist. to development** | c. 300 metres southwest |
| **Description** | Excavated by P. Gosling in 1981 and restored by Dundalk UDC. The souterrain consists of a passage (L 4m, Wth 1.4m, H 0.9m) running S from the entrance, then turning into a gallery (L 12.3m overall, Wth 1.4m, H 0.9m) which runs E and then gently curves S. At the junction of the passage and gallery are niches in the walls from floor to roof which probably represent door jambs. |
| **Reference** | www.archaeology.ie/ SMR file |

| **SMR No.** | **LH007-079/107** |
|---|---|
| **Townland** | Marshes Upper |
| **Parish** | Haggardstown |
| **Barony** | Upper Dundalk |
| **ITM** | 706100 805240 |
| **Classification** | Souterrain |
| **Dist. to development** | c. 334 metres northwest |
| **Description** | Excavated by F. McCormick and J. Crone in 1982. The souterrain consisted of the remains of a drystone-built passage, L-shaped in plan (L 3m), leading to a beehive chamber (diam. 1.6m) |
| **Reference** | www.archaeology.ie/ SMR file |

# Appendix 15.2 Legislation Protecting the Archaeological Resource

May 2025

McCutcheon Halley
CHARTERED PLANNING CONSULTANTS

# Appendix 15.2 Legislation Protecting the Archaeological Resource

Protection Of Cultural Heritage

The cultural heritage in Ireland is safeguarded through national and international policy designed to secure the protection of the cultural heritage resource to the fullest possible extent (Department of Arts, Heritage, Gaeltacht and the Islands 1999, 35). This is undertaken in accordance with the provisions of the European Convention on the Protection of the Archaeological Heritage (Valletta Convention), ratified by Ireland in 1997.

The Archaeological Resource

The National Monuments Act 1930 to 2014 and relevant provisions of the National Cultural Institutions Act 1997 are the primary means of ensuring the satisfactory protection of archaeological remains, which includes all man-made structures of whatever form or date except buildings habitually used for ecclesiastical purposes. A National Monument is described as 'a monument or the remains of a monument the preservation of which is a matter of national importance by reason of the historical, architectural, traditional, artistic or archaeological interest attaching thereto' (National Monuments Act 1930 Section 2). A number of mechanisms under the National Monuments Act are applied to secure the protection of archaeological monuments. These include the Register of Historic Monuments, the Record of Monuments and Places, and the placing of Preservation Orders and Temporary Preservation Orders on endangered sites.

Ownership And Guardianship of National Monuments

The Minister may acquire national monuments by agreement or by compulsory order. The state or local authority may assume guardianship of any national monument (other than dwellings). The owners of national monuments (other than dwellings) may also appoint the Minister or the local authority as guardian of that monument if the state or local authority agrees. Once the site is in ownership or guardianship of the state, it may not be interfered with without the written consent of the Minister.

Register Of Historic Monuments

Section 5 of the 1987 Act requires the Minister to establish and maintain a Register of Historic Monuments. Historic monuments and archaeological areas present on the register are afforded statutory protection under the 1987 Act. Any interference with sites recorded on the register is illegal without the permission of the Minister. Two months' notice in writing is required prior to any work being undertaken on or in the vicinity of a registered monument. The register also includes sites under Preservation Orders and Temporary Preservation Orders. All registered monuments are included in the Record of Monuments and Places.

Preservation Orders and Temporary Preservation Orders

Sites deemed to be in danger of injury or destruction can be allocated Preservation Orders under the 1930 Act. Preservation Orders make any interference with the site illegal. Temporary Preservation Orders can be attached under the 1954 Act. These perform the same function as a Preservation Order but have a time limit of six months, after which the situation must be reviewed. Work may only be undertaken on or in the vicinity of sites under Preservation Orders with the written consent, and at the discretion, of the Minister



Record Of Monuments and Places

Section 12(1) of the 1994 Act requires the Minister for Arts, Heritage, Gaeltacht and the Islands (now the Minister for the Department of Housing, Local Government and Heritage) to establish and maintain a record of monuments and places where the Minister believes that such monuments exist. The record comprises a list of monuments and relevant places and a map/s showing each monument and relevant place in respect of each county in the state. All sites recorded on the Record of Monuments and Places receive statutory protection under the National Monuments Act 1994. All recorded monuments on the proposed development site are represented on the accompanying maps.

Section 12(3) of the 1994 Act provides that 'where the owner or occupier (other than the Minister for Arts, Heritage, Gaeltacht and the Islands) of a monument or place included in the Record, or any other person, proposes to carry out, or to cause or permit the carrying out of, any work at or in relation to such a monument or place, he or she shall give notice in writing to the Minister of Arts, Heritage, Gaeltacht and the Islands to carry out work and shall not, except in case of urgent necessity and with the consent of the Minister, commence the work until two months after giving of notice'.

Under the National Monuments (Amendment) Act 2004, anyone who demolishes or in any way interferes with a recorded site is liable to a fine not exceeding €3,000 or imprisonment for up to 6 months. On summary conviction and on conviction of indictment, a fine not exceeding €10,000 or imprisonment for up to 5 years is the penalty. In addition, they are liable for costs for the repair of the damage caused.

In addition to this, under the European Communities (Environmental Impact Assessment) Regulations 1989, Environmental Impact Statements (EIS) are required for various classes and sizes of development project to assess the impact the proposed development will have on the existing environment, which includes the cultural, archaeological and built heritage resources. These document's recommendations are typically incorporated into the conditions under which the proposed development must proceed, and thus offer an additional layer of protection for monuments which have not been listed on the RMP.

The Planning and Development Act 2000

Under planning legislation, each local authority is obliged to draw up a Development Plan setting out their aims and policies with regard to the growth of the area over a five-year period. They cover a range of issues including archaeology and built heritage, setting out their policies and objectives with regard to the protection and enhancement of both. These policies can vary from county to county. The Planning and Development Act 2000 recognises that proper planning and sustainable development includes the protection of the archaeological heritage. Conditions relating to archaeology may be attached to individual planning permissions.

**Louth County Development Plan, 2021-2027**



It is a policy of the plan:

BHC 1 To protect and enhance archaeological sites and monuments, underwater archaeology, and archaeological objects listed in the Record of Monuments and Places (RMP), and/or the Register of Historic Monuments and seek their preservation (i.e. presumption in favour of preservation in situ or in exceptional cases, at a minimum, preservation by record) through the planning process and having regard to the advice and recommendations of the National Monuments Service of the Department of Housing, Local Government and Heritage and the principles as set out in the 'Framework and Principles for the Protection of the Archaeological Heritage' (Department of Arts, Heritage, Gaeltacht and the Islands 1999).

BHC 2 To protect the built heritage assets of the county and ensure they are managed and preserved in a manner that does not adversely impact on the intrinsic value of these assets whilst supporting economic renewal and sustainable development.

BHC 3 To protect known and unknown archaeological areas, sites, monuments, structures and objects, having regard to the advice of the National Monuments Services of the Department of Housing, Local Government and Heritage.

BHC 4 To promote awareness and knowledge of the archaeological resources of the County and support initiatives where appropriate that provide better access to the historic built environment.

BHC 5 To protect all sites and features of archaeological interest discovered subsequent to the publication of the Record of Monuments and Places (i.e. preservation in situ or in exceptional circumstances, at a minimum preservation by record) having regard to the advice and recommendations of the National Monuments Section of the Department of Housing, Local Government and Heritage.

BHC 6 To ensure any development, either above or below ground, adjacent to or in the immediate vicinity of a recorded monument or a Zone of Archaeological Potential (including formerly walled towns) shall not be detrimental to or detract from the character of the archaeological site or its setting and be sited and designed to protect the monument and its setting. Where upstanding remains exist, a visual impact assessment may be required.

BHC 7 To require applicants seeking permission for development within Zones of Archaeological Potential and other sites as listed in the Record of Monuments and Places to include an assessment of the likely archaeological potential as part of the planning application and the Council may require that an on-site archaeological assessment is carried out by trial work, prior to a decision on a planning application being taken.

BHC 8 To protect and preserve in situ all surviving elements of medieval town defences (both upstanding and buried) and associated features in accordance with the Conservation and Management Plans as applicable and with 'National Policy on Town Defences' (Department of Environment, Heritage and Local Government 2008).

BHC 9 To retain the surviving medieval street pattern, building lines and burgage plot widths in historic walled towns.

BHC 10 To require, as part of the development management process, archaeological impact assessments, geophysical surveys, test excavations and monitoring, as appropriate, where development proposals involve ground clearance of more than half a hectare or for linear developments over one kilometre in length or for developments in proximity to areas with a density of known archaeological monuments and history of discovery, as identified by a licensed archaeologist.

# Appendix 15.3 Legislation Protecting the Architectural Resource

May 2025

McCutcheon Halley
CHARTERED PLANNING CONSULTANTS

# Appendix 15.3 Legislation Protecting the Architectural Resource



The main laws protecting the built heritage are the Architectural Heritage (National Inventory) and National Monuments (Miscellaneous Provisions) Act 1999 and the Local Government (Planning and Development) Acts 1963–1999, which has now been superseded by the Planning and Development Act, 2000. The Architectural Heritage Act requires the Minister to establish a survey to identify, record and assess the architectural heritage of the country. The background to this legislation derives from Article 2 of the 1985 Convention for the Protection of Architectural Heritage (Granada Convention). This states that:

For the purpose of precise identification of the monuments, groups of structures and sites to be protected, each member state will undertake to maintain inventories of that architectural heritage.

The National Inventory of Architectural Heritage (NIAH) was established in 1990 to fulfil Ireland's obligation under the Granada Convention, through the establishment and maintenance of a central record, documenting and evaluating the architecture of Ireland (NIAH Handbook 2005:2). As inclusion in the inventory does not provide statutory protection, the survey information is used in conjunction with the Architectural Heritage Protection Guidelines for Planning Authorities to advise local authorities on compilation of a Record of Protected Structures as required by the Planning and Development Act, 2000.

PROTECTION UNDER THE RECORD OF PROTECTED STRUCTURES AND COUNTY DEVELOPMENT PLAN

Structures of architectural, cultural, social, scientific, historical, technical or archaeological interest can be protected under the Planning and Development Act, 2000, where the conditions relating to the protection of the architectural heritage are set out in Part IV of the act. This act superseded the Local Government (Planning and Development) Act, 1999, and came into force on 1st January 2000.

The act provides for the inclusion of Protected Structures into the planning authorities' development plans and sets out statutory regulations regarding works affecting such structures. Under new legislation, no distinction is made between buildings formerly classified under development plans as List 1 and List 2. Such buildings are now all regarded as 'Protected Structures' and enjoy equal statutory protection. Under the act the entire structure is protected, including a structure's interior, exterior, attendant grounds and also any structures within the attendant grounds.

The act defines a Protected Structure as (a) a structure, or (b) a specified part of a structure which is included in a Record of Protected Structures (RPS), and, where that record so indicates, includes any specified feature which is in the attendant grounds of the structure and which would not otherwise be included in this definition. Protection of the structure, or part thereof, includes conservation, preservation, and improvement compatible with maintaining its character and interest. Part IV of the act deals with architectural heritage, and Section 57 deals specifically with works affecting the character of Protected Structures or proposed Protected Structures and states that no works should materially affect the character of the structure or any element of the structure that contributes to its special architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest.

The act does not provide specific criteria for assigning a special interest to a structure. However, the National Inventory of Architectural Heritage (NIAH) offers guidelines to its field workers as to how to designate a building with a special interest, which are not mutually exclusive. This offers guidance by example rather than by definition:



ARCHAEOLOGICAL

It is to be noted that the NIAH is biased towards post-1700 structures. Structures that have archaeological features may be recorded, providing the archaeological features are incorporated within post-1700 elements. Industrial fabric is considered to have technical significance, and should only be attributed archaeological significance if the structure has pre-1700 features.

ARCHITECTURAL

A structure may be considered of special architectural interest under the following criteria:

- Good quality or well executed architectural design
- The work of a known and distinguished architect, engineer, designer, craftsman
- A structure that makes a positive contribution to a setting, such as a streetscape or rural setting
- Modest or vernacular structures may be considered to be of architectural interest, as they are part of the history of the built heritage of Ireland.
- Well-designed decorative features, externally and/or internally

HISTORICAL

A structure may be considered of special historical interest under the following criteria:

- A significant historical event associated with the structure
- An association with a significant historical figure
- Has a known interesting and/or unusual change of use, e.g. a former workhouse now in use as a hotel
- A memorial to a historical event.

TECHNICAL

A structure may be considered of special technical interest under the following criteria:

- Incorporates building materials of particular interest, i.e. the materials or the technology used for construction
- It is the work of a known or distinguished engineer
- Incorporates innovative engineering design, e.g. bridges, canals or mill weirs

- A structure which has an architectural interest may also merit a technical interest due to the structural techniques used in its construction, e.g. a curvilinear glasshouse, early use of concrete, cast-iron prefabrication.
- Mechanical fixtures relating to a structure may be considered of technical significance.



CULTURAL

A structure may be considered of special cultural interest under the following criteria:

- An association with a known fictitious character or event, e.g. Sandycove Martello Tower, which featured in Ulysses.
- Other structure that illustrate the development of society, such as early schoolhouses, swimming baths or printworks.

SCIENTIFIC

A structure may be considered of special scientific interest under the following criteria:

- A structure or place which is considered to be an extraordinary or pioneering scientific or technical achievement in the Irish context, e.g. Mizen Head Bridge, Birr Telescope.

SOCIAL

A structure may be considered of special social interest under the following criteria:

- A focal point of spiritual, political, national or other cultural sentiment to a group of people, e.g. a place of worship, a meeting point, assembly rooms.
- Developed or constructed by a community or organisation, e.g. the construction of the railways or the building of a church through the patronage of the local community
- Illustrates a particular lifestyle, philosophy, or social condition of the past, e.g. the hierarchical accommodation in a country house, philanthropic housing, vernacular structures.

ARTISTIC

A structure may be considered of special artistic interest under the following criteria:

- Work of a skilled craftsman or artist, e.g. plasterwork, wrought-iron work, carved elements or details, stained glass, stations of the cross.
- Well-designed mass-produced structures or elements may also be considered of artistic interest.

(From the NIAH Handbook 2003 & 2005 pages 15–20)

The Local Authority has the power to order conservation and restoration works to be undertaken by the owner of the protected structure if it considers the building to need repair. Similarly, an owner or developer must make a written request to the Local Authority to carry out any works on a protected structure and its environs, which will be reviewed within three months of application. Failure to do so may result in prosecution.

**Louth County Development Plan, 2021-2027**



It is a policy of the plan:

BHC 2 To protect the built heritage assets of the county and ensure they are managed and preserved in a manner that does not adversely impact on the intrinsic value of these assets whilst supporting economic renewal and sustainable development.

BHC 4 To promote awareness and knowledge of the archaeological resources of the County and support initiatives where appropriate that provide better access to the historic built environment.

BHC 8 To protect and preserve in situ all surviving elements of medieval town defences (both upstanding and buried) and associated features in accordance with the Conservation and Management Plans as applicable and with 'National Policy on Town Defences' (Department of Environment, Heritage and Local Government 2008).

BHC 20 To ensure that any development, modification, alteration, or extension affecting a protected structure and / or its setting is sensitively sited and designed, is compatible with the special character and is appropriate in terms of the proposed scale, mass, density, layout, and materials of the protected structure.

BHC 21 The form and structural integrity of the protected structure and its setting shall be retained and the relationship between the protected structure, its curtilage and any complex of adjoining buildings, designed landscape features, designed views or vistas from or to the structure shall be protected.

BHC 22 To prohibit inappropriate development within the curtilage and/or attendant grounds of a protected structure. Any proposed development within the curtilage and/or attendant grounds must demonstrate that it is part of an overall strategy for the future conservation of the entire complex including the structures, demesne and/or attendant grounds.

BHC 23 To require that all planning applications relating to protected structures contain the appropriate documentation as described in the Architectural Heritage Protection Guidelines for Planning Authorities (2011) or any subsequent guidelines, to enable a proper assessment of the proposed works and their impact on the structure or area.

BHC 24 To require the retention of original features such as windows, doors, renders, roof coverings, and other significant features which contribute to the character of protected structures and encourage the reinstatement of appropriately detailed features which have been lost, to restore the character of protected structures as part of development proposals.

BHC 25 To promote best conservation practice and the use of skilled specialist practitioners in the conservation of and for any works to protected structures.

BHC 26 To encourage the retention, sympathetic reuse and rehabilitation of protected structures and their settings where appropriate and where the proposal is compatible with their character and significance. In certain cases, development management guidelines may be relaxed in order to secure the conservation of the protected structure and architectural features of special interest.

BHC 27 To permit the demolition or significant modification of a protected structure, only in exceptional circumstances.



BHC 28 To ensure the protection of architectural features of special interest as part of any proposed re-development where there is conflict with other development plan requirements such as open space, car parking etc.

BHC 29 To review and update the Record of Protected Structures on an ongoing basis and to make additions and deletions as appropriate.

BHC 30 To seek funding streams for specific priority projects and to assist owners with the repair and conservation of protected structures and aim to make the structure climate resilient.

# Appendix 15.4 Impact Assessment and the Cultural Heritage Resource

May 2025

McCutcheon Halley
CHARTERED PLANNING CONSULTANTS

# Appendix 15.4 Impact Assessment and the Cultural Heritage Resource

Potential Impacts on Archaeological and Historical Remains

Impacts are defined as 'the degree of change in an environment resulting from a development' (Environmental Protection Agency 2022). They are described as profound, significant or slight impacts on archaeological remains. They may be negative, positive or neutral, direct, indirect or cumulative, temporary or permanent.

Impacts can be identified from detailed information about a project, the nature of the area affected and the range of archaeological and historical resources potentially affected. Development can affect the archaeological and historical resource of a given landscape in a number of ways.

- Permanent and temporary land-take, associated structures, landscape mounding, and their construction may result in damage to or loss of archaeological remains and deposits, or physical loss to the setting of historic monuments and to the physical coherence of the landscape.
- Archaeological sites can be affected adversely in a number of ways: disturbance by excavation, topsoil stripping and the passage of heavy machinery; disturbance by vehicles working in unsuitable conditions; or burial of sites, limiting accessibility for future archaeological investigation.
- Hydrological changes in groundwater or surface water levels can result from construction activities such as de-watering and spoil disposal, or longer-term changes in drainage patterns. These may desiccate archaeological remains and associated deposits.
- Visual impacts on the historic landscape sometimes arise from construction traffic and facilities, built earthworks and structures, landscape mounding and planting, noise, fences and associated works. These features can impinge directly on historic monuments and historic landscape elements as well as their visual amenity value.
- Landscape measures such as tree planting can damage sub-surface archaeological features, due to topsoil stripping and through the root action of trees and shrubs as they grow.
- Ground consolidation by construction activities or the weight of permanent embankments can cause damage to buried archaeological remains, especially in colluviums or peat deposits.
- Disruption due to construction also offers in general the potential for adversely affecting archaeological remains. This can include machinery, site offices, and service trenches

Although not widely appreciated, positive impacts can accrue from developments. These can include positive resource management policies, improved maintenance and access to archaeological monuments, and the increased level of knowledge of a site or historic landscape as a result of archaeological assessment and fieldwork.

Predicted Impacts

The severity of a given level of land-take or visual intrusion varies with the type of monument, site or landscape features and its existing environment. Severity of impact can be judged taking the following into account:

- The proportion of the feature affected and how far physical characteristics fundamental to the understanding of the feature would be lost;
- Consideration of the type, date, survival/condition, fragility/vulnerability, rarity, potential and amenity value of the feature affected;
- Assessment of the levels of noise, visual and hydrological impacts, either in general or site-specific terms, as may be provided by other specialists.

# Appendix 15.5 Mitigation Measures and the Cultural Heritage Resource

May 2025

McCutcheon Halley
CHARTERED PLANNING CONSULTANTS

# Appendix 15.5 Mitigation Measures and the Cultural Heritage Resource

Potential Mitigation Strategies for Cultural Heritage Remains

Mitigation is defined as features of the design or other measures of the proposed development that can be adopted to avoid, prevent, reduce or offset negative effects.

The best opportunities for avoiding damage to archaeological remains or intrusion on their setting and amenity arise when the site options for the development are being considered. Damage to the archaeological resource immediately adjacent to developments may be prevented by the selection of appropriate construction methods. Reducing adverse effects can be achieved by good design, for example by screening historic buildings or upstanding archaeological monuments or by burying archaeological sites undisturbed rather than destroying them. Offsetting adverse effects is probably best illustrated by the full investigation and recording of archaeological sites that cannot be preserved in situ.

Definition Of Mitigation Strategies

Archaeological Resource

The ideal mitigation for all archaeological sites is preservation in situ. This is not always a practical solution, however. Therefore, a series of recommendations are offered to provide ameliorative measures where avoidance and preservation in situ are not possible.

Archaeological Test Trenching can be defined as 'a limited programme of intrusive fieldwork which determines the presence or absence of archaeological features, structures, deposits, artefacts or ecofacts within a specified area or site on land, inter-tidal zone or underwater. If such archaeological remains are present field evaluation defines their character, extent, quality and preservation, and enables an assessment of their worth in a local, regional, national or international context as appropriate' (CIfA 2020a).

Full Archaeological Excavation can be defined as 'a programme of controlled, intrusive fieldwork with defined research objectives which examines, records and interprets archaeological deposits, features and structures and, as appropriate, retrieves artefacts, ecofacts and other remains within a specified area or site on land, inter-tidal zone or underwater. The records made and objects gathered during fieldwork are studied and the results of that study published in detail appropriate to the project design' (CIfA 2020b).

Archaeological Monitoring can be defined as 'a formal programme of observation and investigation conducted during any operation carried out for non-archaeological reasons. This will be within a specified area or site on land, inter-tidal zone or underwater, where there is a possibility that archaeological deposits may be disturbed or destroyed. The programme will result in the preparation of a report and ordered archive (CIfA 2020c).

Underwater Archaeological Assessment consists of a programme of works carried out by a specialist underwater archaeologist, which can involve wade surveys, metal detection surveys and the

excavation of test pits within the sea or riverbed. These assessments are able to access and assess the potential of an underwater environment to a much higher degree than terrestrial based assessments.