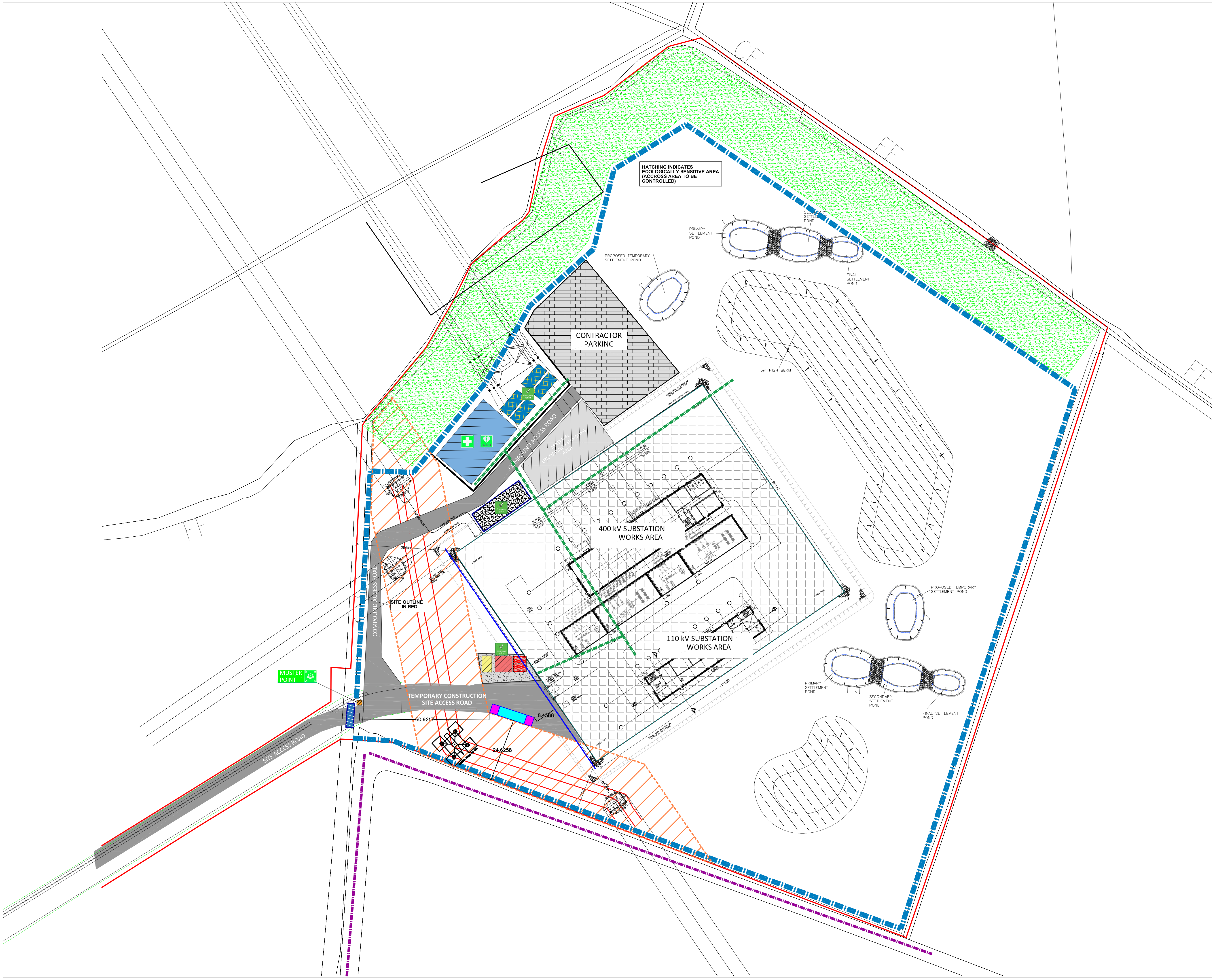
Title of Legislation	Regulation Relevance to Project
1996 Waste Management Act	All matters relating to waste management, licensing, permitting etc.
200/60/EC Water Framework Directive and Water Services Acts (2007-2012)	Protection and improvement of water quality in all waters to achieve good ecological status.
2006 Waste Framework Directive 2006 and Waste Management Acts (1996 – 2011)	All matters relating to waste management, licensing, permitting etc.
2011 European Communities (Birds and Natural Habitats) Regulations (as amended, 2015)	Protection of birds and habitats in member states and in Natura 2000 sites in particular.
Air Pollution Acts (1987 and 2011)	Protection of air quality
Environmental Protection Agency Act (1992)	Umbrella Act for protection of the Environment in Ireland
Environmental (Misc. Provisions) Act (2011)	Provisions under the EPA Act
EC (Control of Major Accident Hazards involving Dangerous Substances) Regulations (2000-2006)	Regulation of hazardous substances
EC (Environmental Liability) Regulations (2008-2011) (Environmental Liability Regulations)	Regulations on the liability of environmental issues
Wildlife Acts 1976-2012 as amended	Protection of wildlife
EU Regulation No. 1143/2014 on the Prevention and Management of the Introduction and Spread of Invasive Alien Species	Regulations to manage and reduce spread of invasive species.
Flora (Protection) Order 2022	To protect plants on site
Local Government (Water Pollution Acts (1977-1990)	Prevention of Water Pollution and discharge to sewer consents
National Monuments Act, 1930 as amended in 1954, 1987, 1994, 2004 and 2012 (S.I. 249 of 2012)	Protection of the Archaeological features



LEGEND:

SITE GATES	▨
OFFICE &WELFARE AREA	▨
SITE STORES	▦
ACCESS ROUTES FOR LANDOWNERS	-·-·-
FIRST AID	✚
HERAS SITE FENCING	▬▬ ▬
DEMARCATION FENCING (PEDESTRIAN BARRIER)	──
PEDESTRIAN ACCESS ROUTE TO SITE WORKS AREA	-·-·-
MUSTER POINT	🟩
EMERGENCY SPILL KIT	🟩
WHEEL WASHING AREA	▭
CONCRETE WASHOUT SKIP	▨
COSH (CHEMICAL) STORAGE	🟥
SECURITY HUT	▨
WASTE SKIPS AREA	▨
FUEL STORAGE AND REFUELLING ZONE	▩
EXCLUSION ZONE FOR 100kV O/H LINES	▨

NOTES:

OVERHEAD LINE PROTECTION MEASURES TO BE IMPLEMENTED IN ACCORDANCE WITH ESB SAFE CODE OF PRACTICE

FOUL WASTE FROM WELFARE TO BE DIRECTED TO HOLDING TANK FOR REMOVAL OFFSITE

SITE ACCESS ROAD IS SHARED WITH ADJACENT LANDOWNERS

SITE HOURS:
7AM - 7PM MONDAY TO FRIDAY
7AM - 1PM SATURDAY

KILWEX
CIVIL

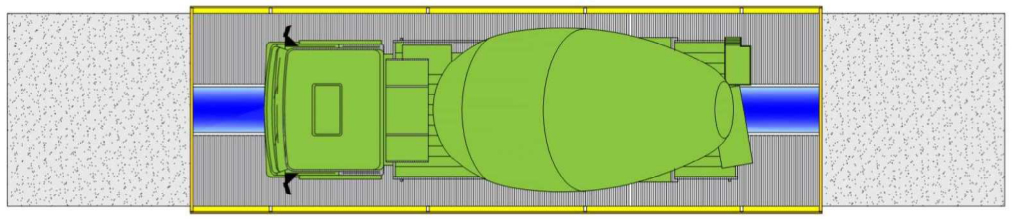
DRAWING TITLE:
SITE LOGISTIC PLAN

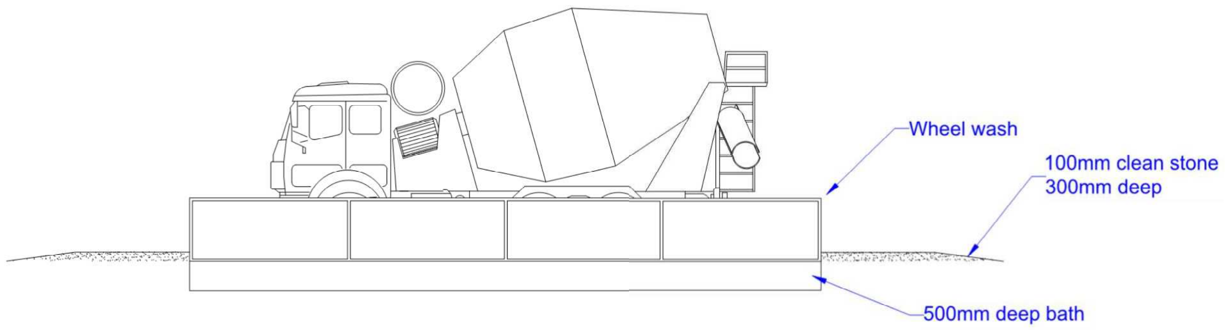
REVISION:
05

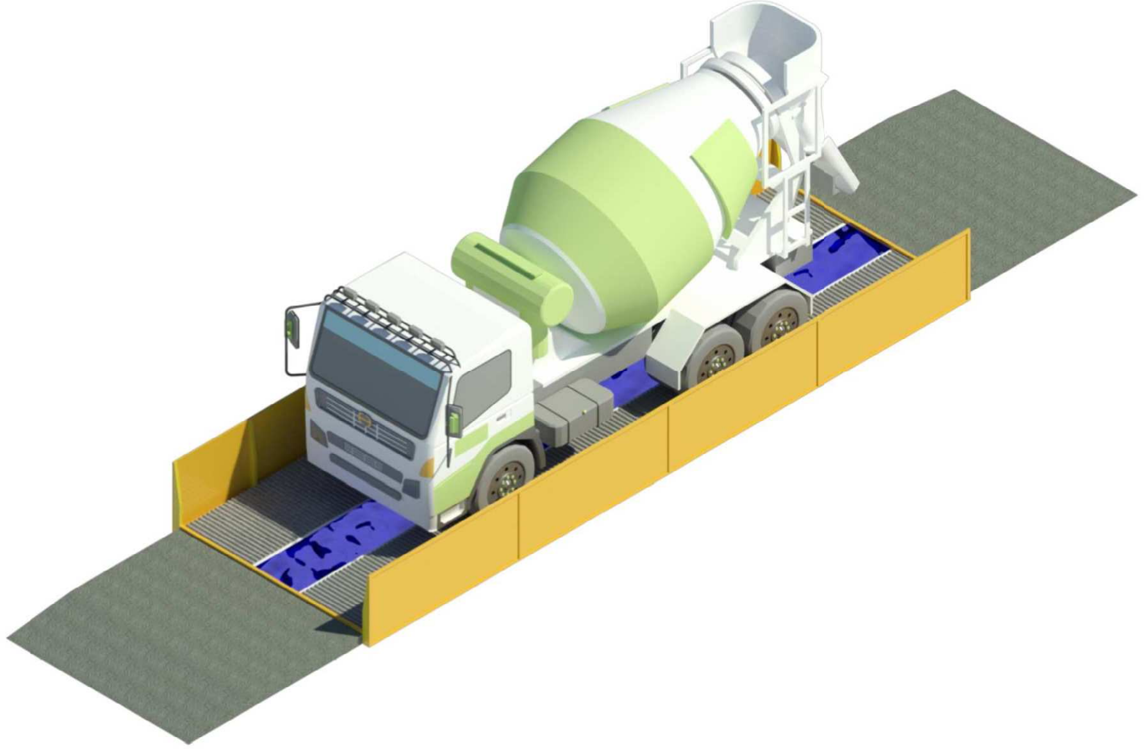
DATE:	DRAWN BY:
07/11/2023	**TU**

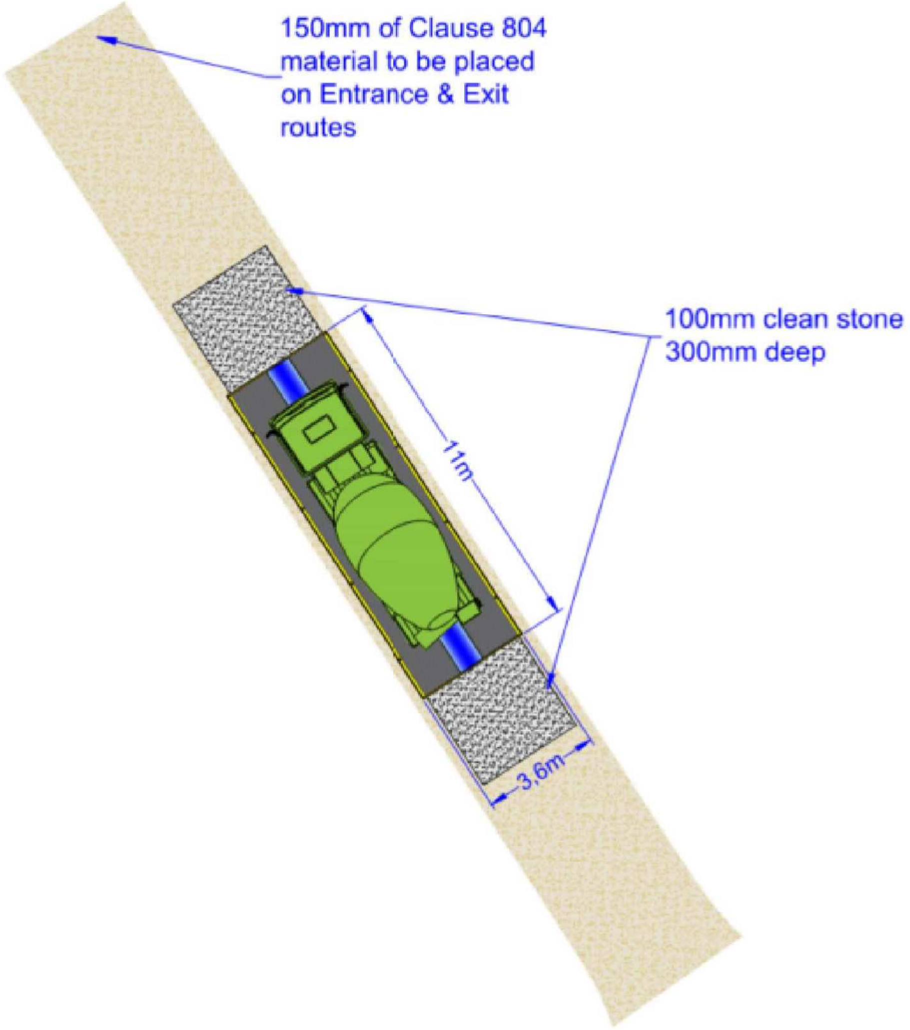
Energy for generations

Engineering and Major Projects,
One Dublin Airport Central, Dublin Airport,
Cloghran, Co. Dublin, K67 XF72, Ireland.
Tel: +353 (0)1 703 8000 Web: www.esb.ie
Engineering and Major Projects is a division of ESB.









LEGEND

NOTES:-

1.) Wheel wash will be established on site as follows (refer to Site Logistics Plan):-

- minimum 5m from all land drains
- minimum 5m from any watercourse

2.) Wheelwash to be used only as required i.e. main priority will be to provide clean routes into/out of site at all times

3.) Wheelwash to be monitored/inspected daily. Inspections to be documented/recorded & maintenance to be carried out as required. Inspection/maintenance checks to include:-

- Inspection of water levels (ensure no overflow)
- Build up of sediment/silt
- Functionality & operability
- Cleanliness

4.) Water/sediment to be removed from wheel wash (as required) by an approved licensed waste contractor

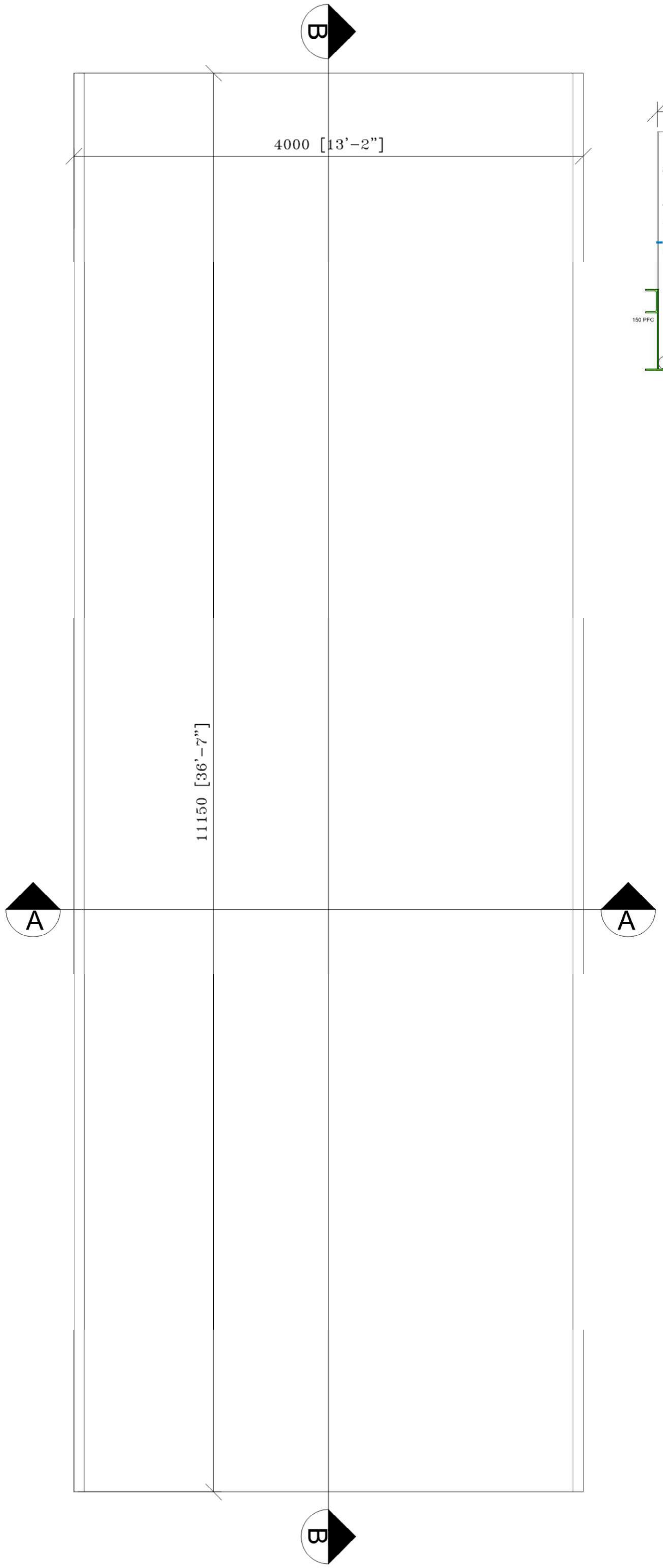
KILWEX
CIVIL

DRAWING TITLE:-
WHEEL WASH DETAILS

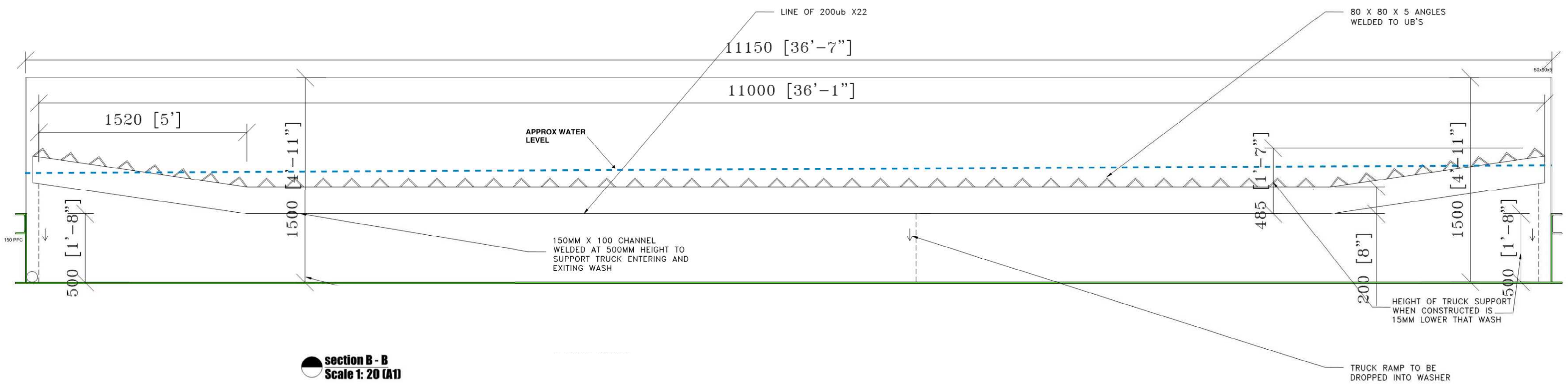
REVISION:-
01

DATE:- DRAWN BY:-
07/11/23 **FMK**

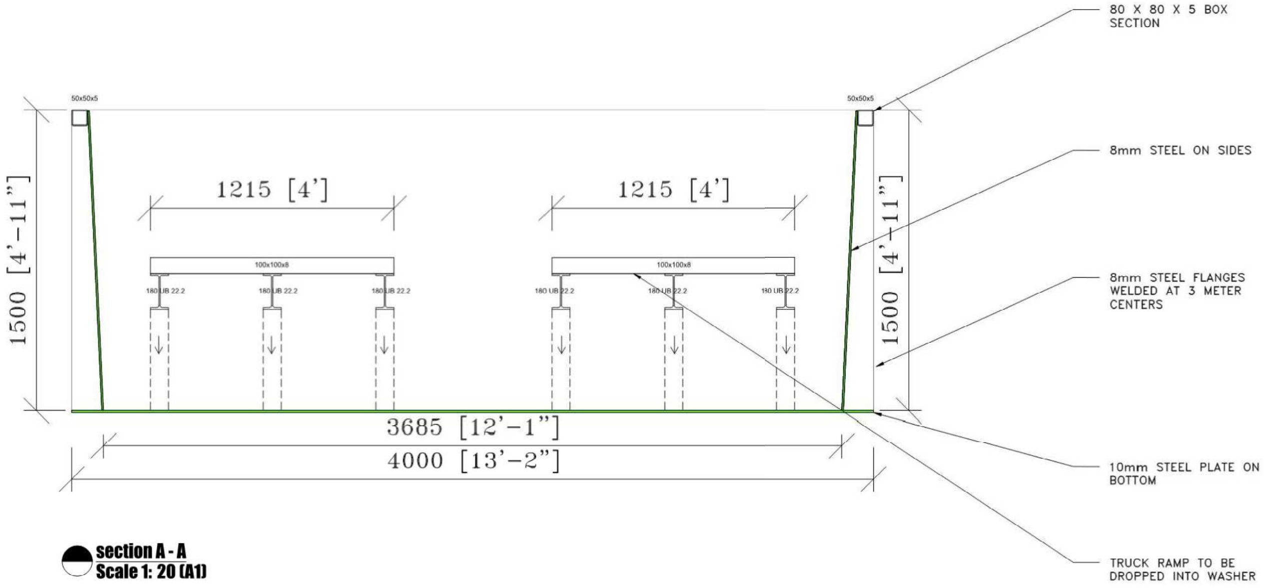
C. Wheel Wash Drawing



PLAN OF WASHER
Scale 1: 25 (A1)



section B - B
Scale 1: 20 (A1)



section A - A
Scale 1: 20 (A1)

ECOBATH STANDARD SPECIFICATIONS

- Capacity of EcoBath	Approx 29000 litres
- Dimensions	11m x 3.35m

- No power requirements
- Low maintenance
- No drainage connection required. Water can be removed via pump or suction methods, as required, during use on site.
- Removable rumble track sections
- Rumble tracks flexes tyre treads open
- Tyre treads submerged in water allowing for cleaning/removal of debris
- EcoBath allows 3.8 wheel revolutions when vehicle passes through
- Heavy duty lifting points (certified) provided

KILWEX
C I V I L

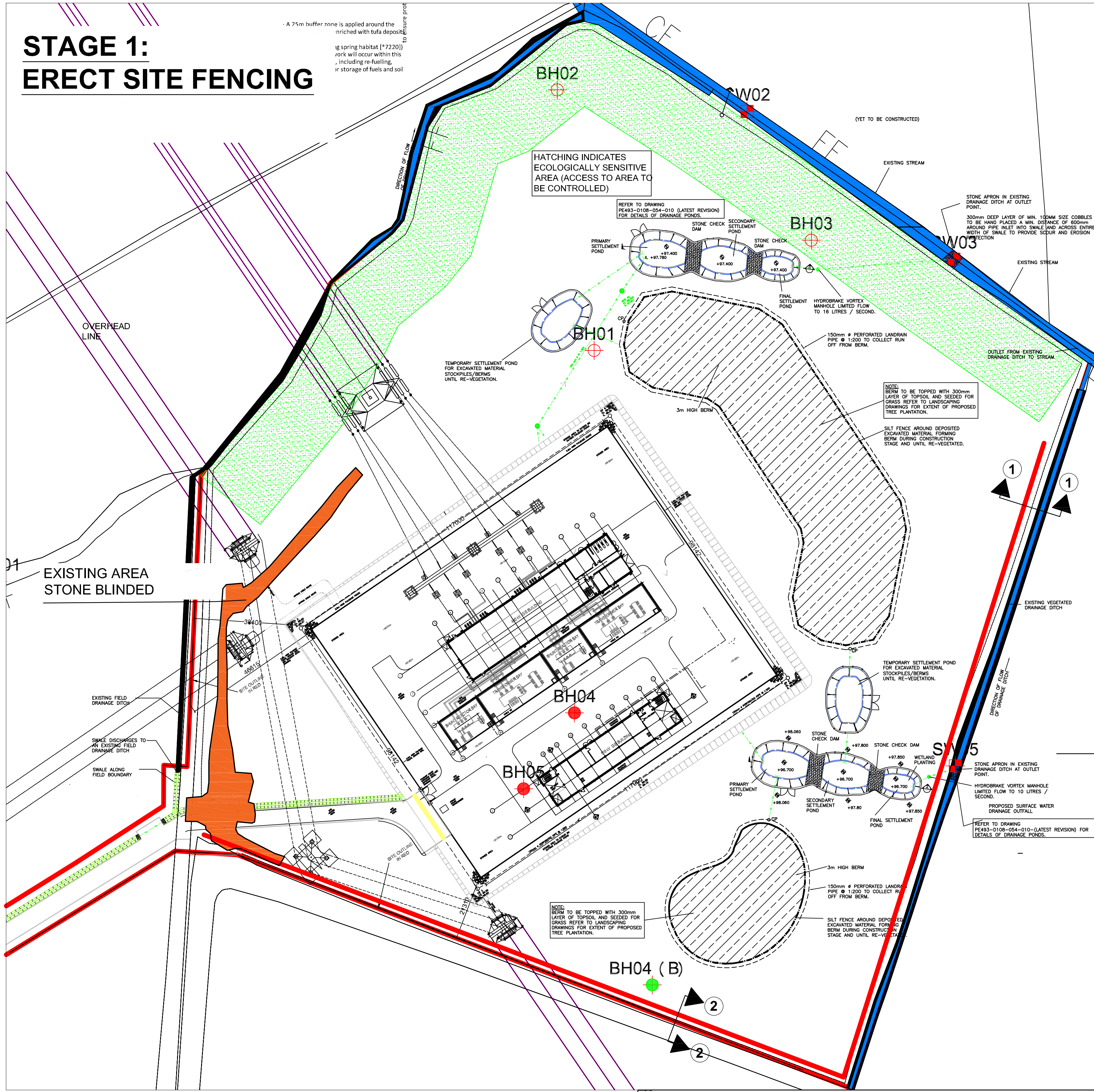
DRAWING TITLE:-
WHEEL WASH DETAILS

REVISION:-
01

DATE:-
07/11/23

DRAWN BY:-
FMK

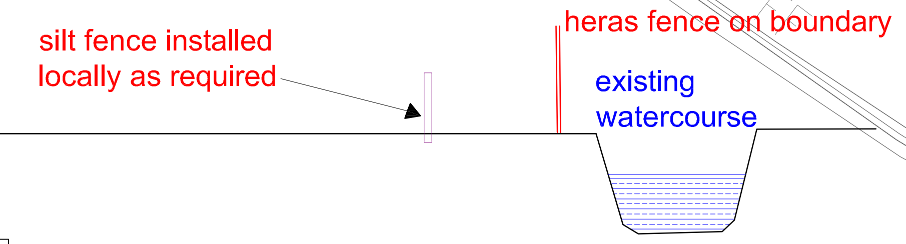
STAGE 1:
ERECT SITE FENCING



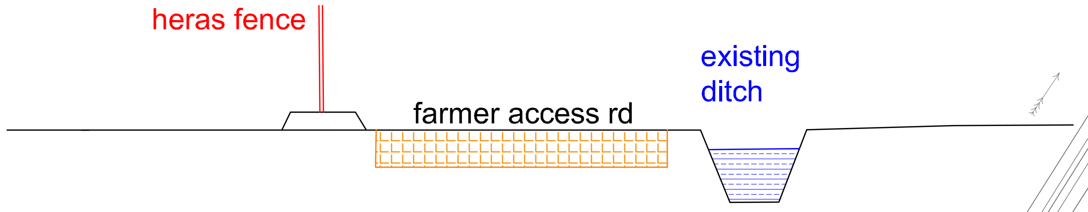
SEQUENCE OF WORKS

- Install heras fence along ecologically sensitive area and perimeter of site.
- Erect silt fencing locally as required.

SECTION 1 ALONG WATER COURSE



SECTION 2 ALONG FARMER ACCESS RD



KEY PLAN

EART MOVING PLAN

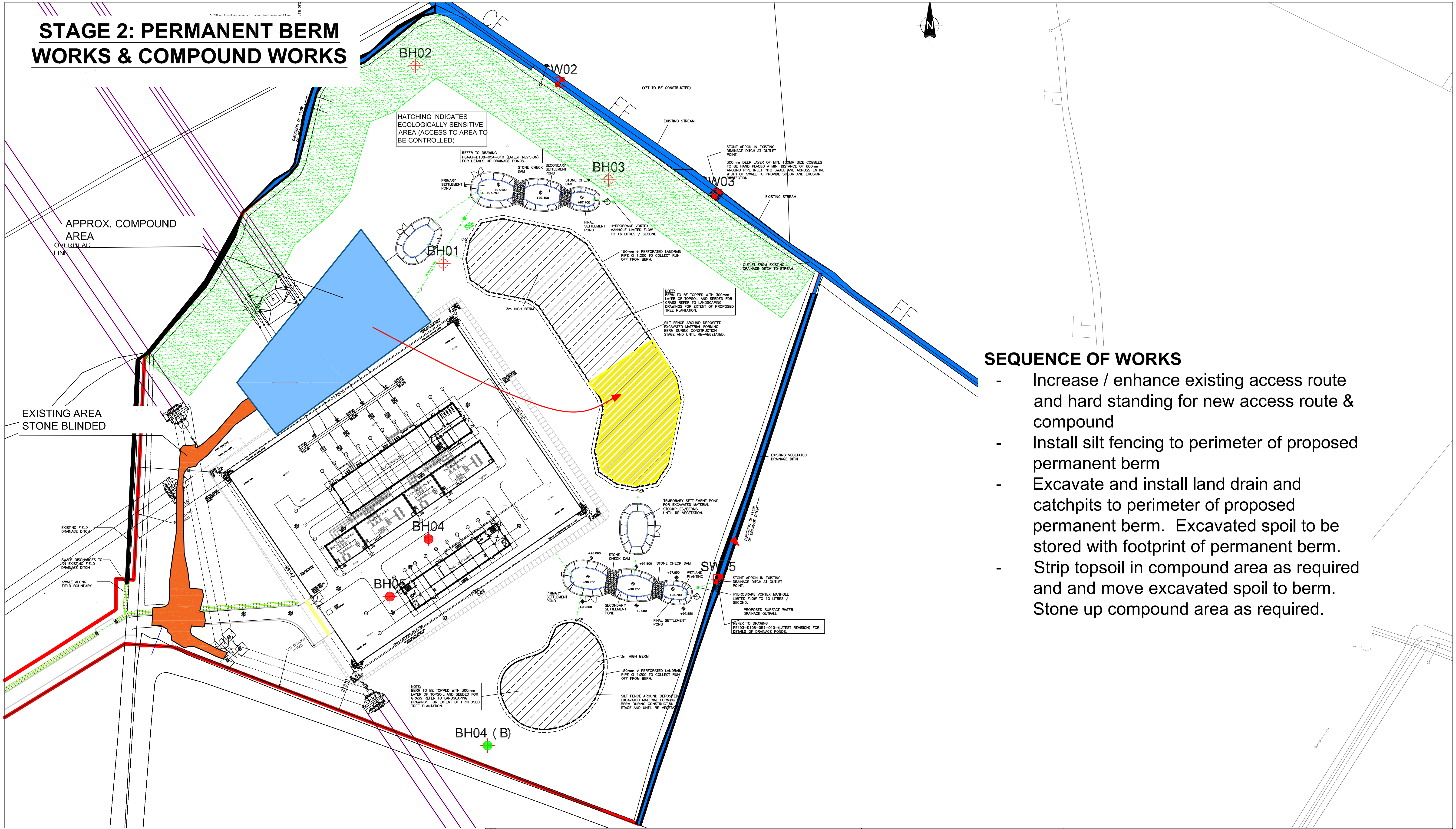
REVISIONS

NO.	BY	DATE	DESCRIPTION

PROJECT COOLNABACKY
CO.LAOIS

Drafted : TU
Date :
Email: tomasz.urbanski@kilwex.ie
Checked :
Date :

STAGE 2: PERMANENT BERM WORKS & COMPOUND WORKS



SEQUENCE OF WORKS

- Increase / enhance existing access route and hard standing for new access route & compound
- Install silt fencing to perimeter of proposed permanent berm
- Excavate and install land drain and catchpits to perimeter of proposed permanent berm. Excavated spoil to be stored with footprint of permanent berm.
- Strip topsoil in compound area as required and and move excavated spoil to berm. Stone up compound area as required.

KEY PLAN

EARTH MOVING PLAN

REVISIONS

NO.	BY	DATE	DESCRIPTION

PROJECT COOLNABACKY
CO.LAOIS

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Checked :
Date :

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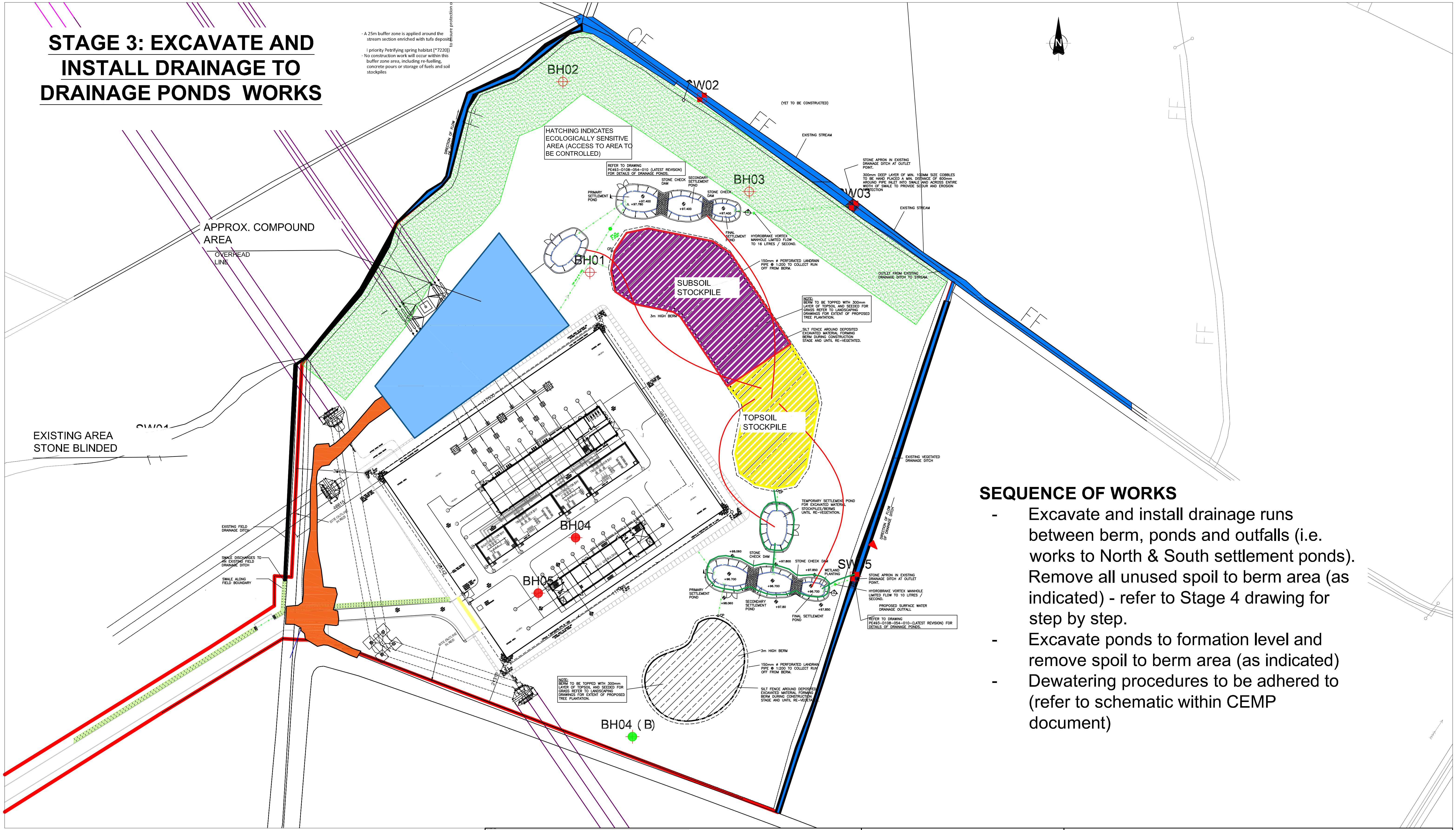
STAGE 3: EXCAVATE AND INSTALL DRAINAGE TO DRAINAGE PONDS WORKS



SEQUENCE OF WORKS

- Excavate and install drainage runs between berm, ponds and outfalls (i.e. works to North & South settlement ponds). Remove all unused spoil to berm area (as indicated) - refer to Stage 4 drawing for step by step.
- Excavate ponds to formation level and remove spoil to berm area (as indicated)
- Dewatering procedures to be adhered to (refer to schematic within CEMP document)

KEY PLAN

EARTH MOVING PLAN

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Date :

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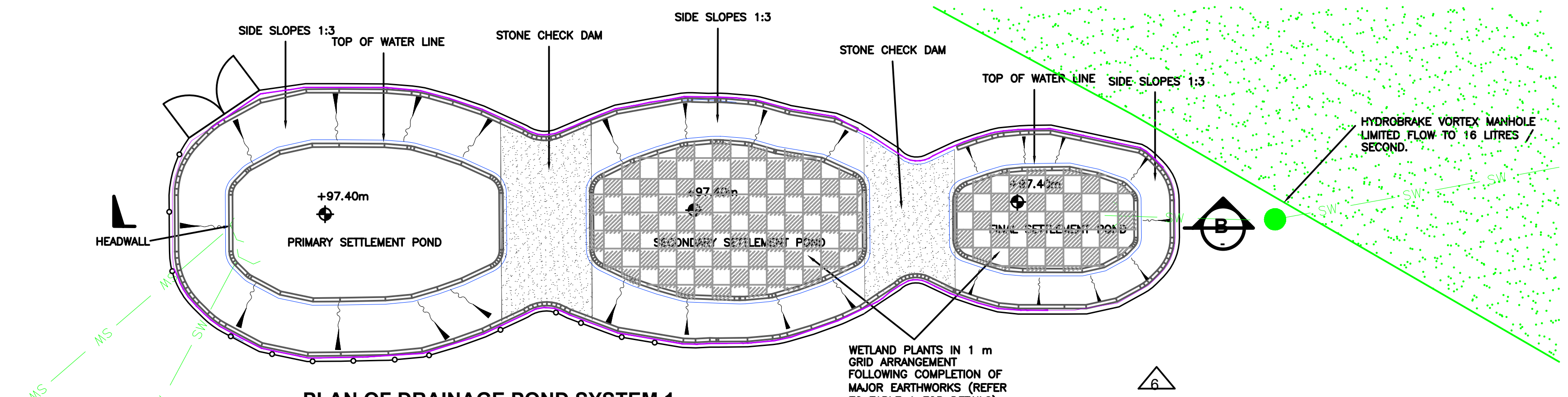
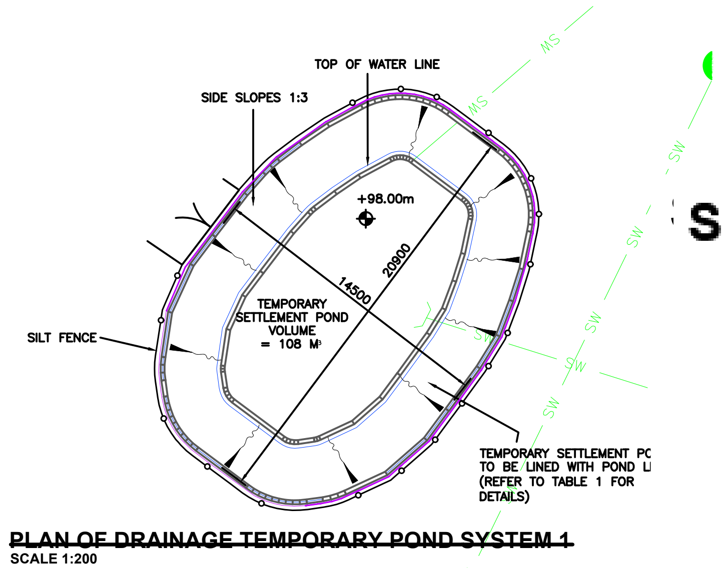
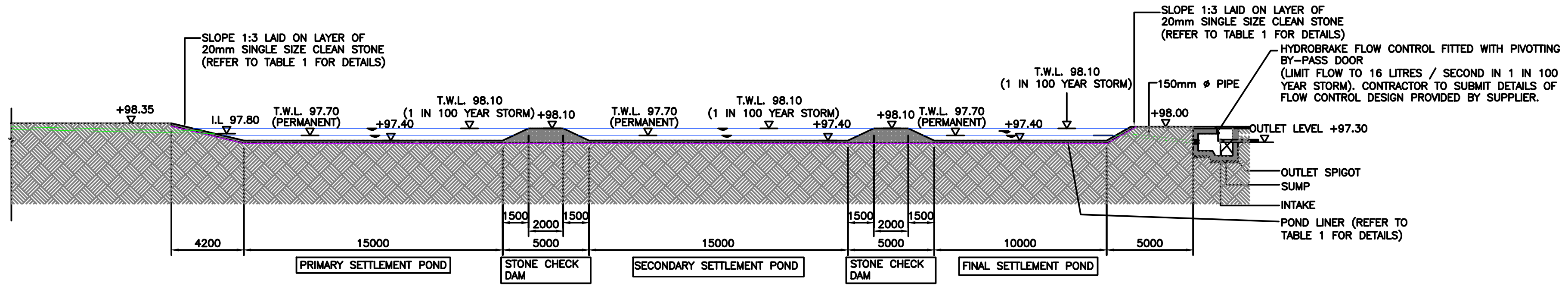
STAGE 4: DRAINAGE POND SYSTEM BECOMES OPERATIONAL



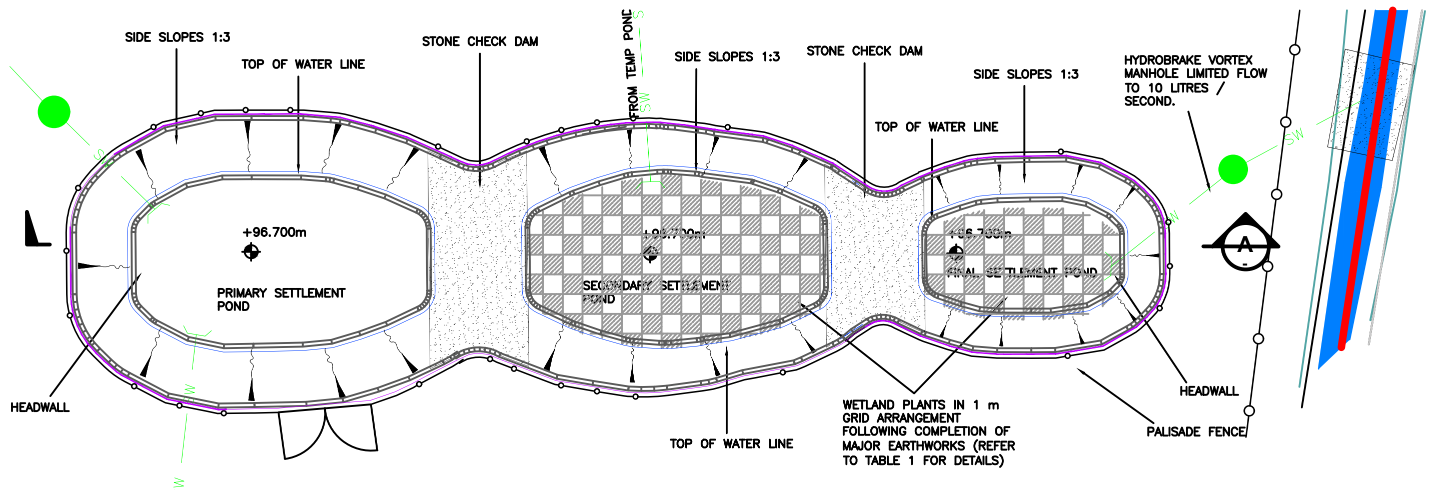
PLAN OF DRAINAGE POND SYSTEM 1
SCALE 1:200



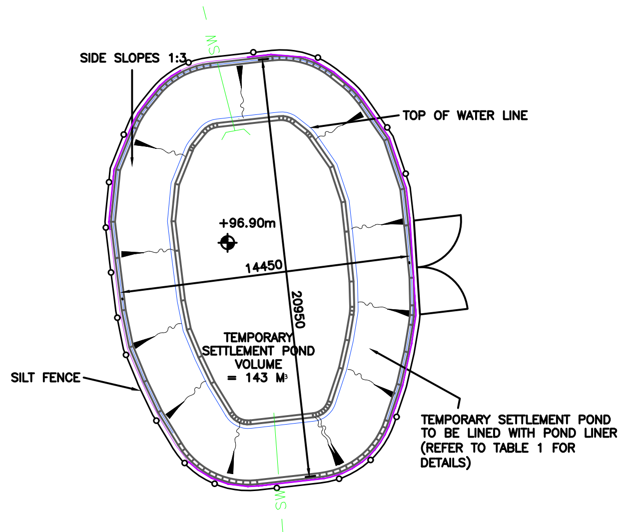
PLAN OF DRAINAGE TEMPORARY POND SYSTEM 1
SCALE 1:200



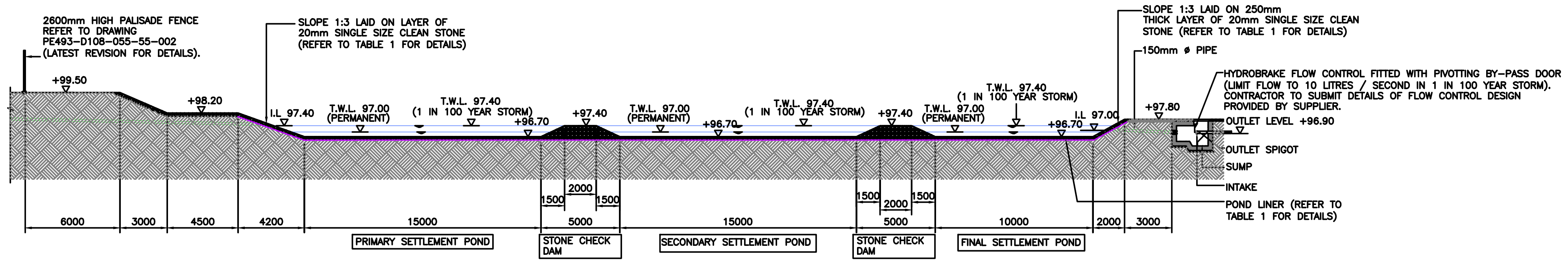
SECTION B
SCALE 1:200



PLAN OF DRAINAGE POND SYSTEM 2
SCALE 1:200



PLAN OF DRAINAGE TEMPORARY POND SYSTEM 2
SCALE 1:200



SECTION A
SCALE 1:200

SEQUENCE OF WORKS

- Excavate & install pipe work from watercourse to hydro brake MH
- Construct precast MH with hydro brake
- Excavate and install drainage run from hydro brake MH to final settlement pond
- Excavate to formation levels of drainage ponds and dispose of excavated material in berm area.
- Install impermeable HDPE liner & stone in accordance with drawing number PE493-D108-054-010-007
- Excavate and install pipe work to temporary pond
- Excavate to formation levels of temporary drainage pond and dispose of excavated material in berm area.
- Connect pond system to stone apron area in watercourse outlet PtSW03 as per drawing no.PE493-D108-054-010-007
- Dewatering procedures to be adhered to (refer to details and schematic within CEMP document)

KEY PLAN

1.All levels are in meters ralated to Ordonance datum Malin Head OSGM15
2.All co-ordinates are related to Irish Transverse Mercator Grid (ITM) and are in meters
3.Drawings are not to be scaled

REVISIONS

NO.	BY	DATE	DESCRIPTION

PROJECT COOLNABACKY
CO.LAOIS

Drafted : TU
Date : 30/08/23
Email: tomasz.urbanski@kilwex.ie
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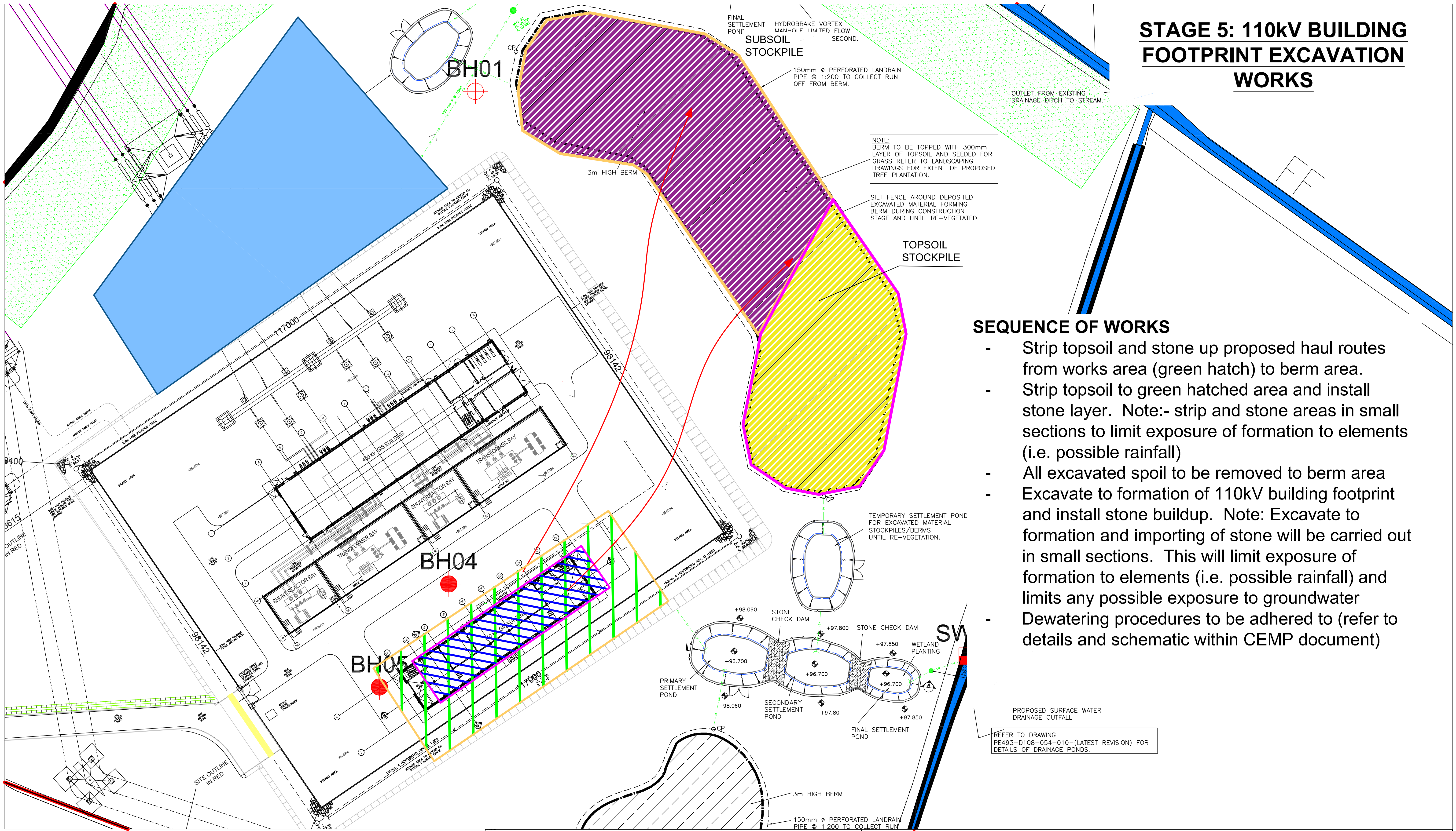
Date :

STAGE 5: 110kV BUILDING FOOTPRINT EXCAVATION WORKS



150mm ø PERFORATED LANDRAIN PIPE @ 1:200 TO COLLECT RUN OFF FROM BERM.

NOTE:
BERM TO BE TOPPED WITH 300mm LAYER OF TOPSOIL AND SEEDED FOR GRASS REFER TO LANDSCAPING DRAWINGS FOR EXTENT OF PROPOSED TREE PLANTATION.

SILT FENCE AROUND DEPOSITED EXCAVATED MATERIAL FORMING BERM DURING CONSTRUCTION STAGE AND UNTIL RE-VEGETATED.

TEMPORARY SETTLEMENT POND FOR EXCAVATED MATERIAL STOCKPILES/BERMS UNTIL RE-VEGETATION.

REFER TO DRAWING PE493-D108-054-010-(LATEST REVISION) FOR DETAILS OF DRAINAGE PONDS.

SEQUENCE OF WORKS

- Strip topsoil and stone up proposed haul routes from works area (green hatch) to berm area.
- Strip topsoil to green hatched area and install stone layer. Note:- strip and stone areas in small sections to limit exposure of formation to elements (i.e. possible rainfall)
- All excavated spoil to be removed to berm area
- Excavate to formation of 110kV building footprint and install stone buildup. Note: Excavate to formation and importing of stone will be carried out in small sections. This will limit exposure of formation to elements (i.e. possible rainfall) and limits any possible exposure to groundwater
- Dewatering procedures to be adhered to (refer to details and schematic within CEMP document)

KEY PLAN

1.All levels are in meters ralated to Ordonance datum Malin Head OSGM15
2.All co-ordinates are related to Irish Transverse Mercator Grid (ITM) and are in meters
3.Drawings are not to be scaled

EARTH MOVING PLAN

REVISIONS

NO.	BY	DATE	DESCRIPTION

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CO.LAOIS

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Checked :
Date :

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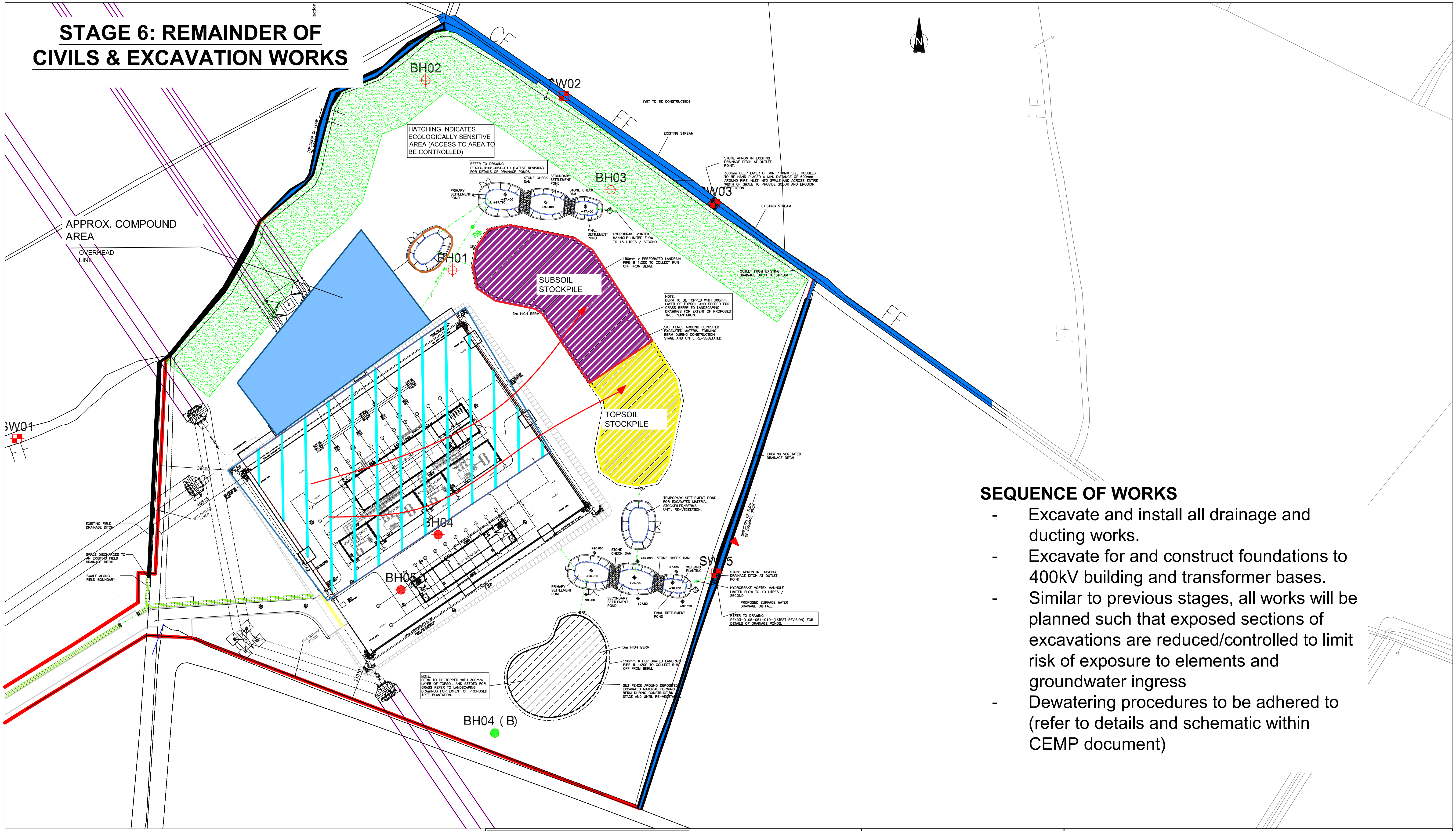
STAGE 6: REMAINDER OF CIVILS & EXCAVATION WORKS



SEQUENCE OF WORKS

- Excavate and install all drainage and ducting works.
- Excavate for and construct foundations to 400kV building and transformer bases.
- Similar to previous stages, all works will be planned such that exposed sections of excavations are reduced/controlled to limit risk of exposure to elements and groundwater ingress
- Dewatering procedures to be adhered to (refer to details and schematic within CEMP document)

KEY PLAN

EARTH MOVING PLAN

REVISIONS

NO.	BY	DATE	DESCRIPTION

PROJECT COOLNABACKY
CO.LAOIS

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Date : 30/08/23
Email: tomasz.urbanski@kilwex.ie
Checked :
Date :

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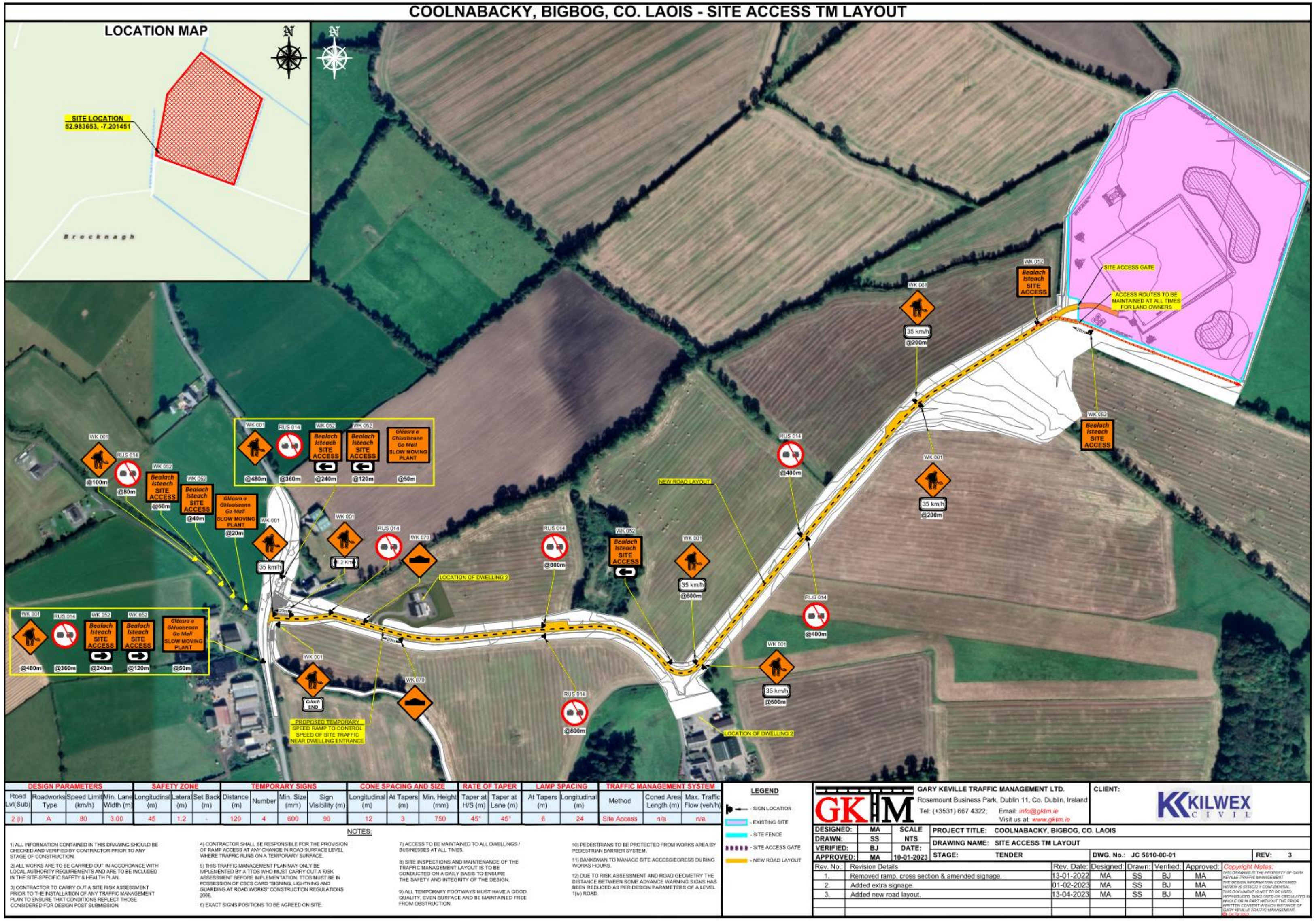
TRAFFIC MANAGEMENT PLAN AND DELIVERY INSTRUCTIONS

Project: Laois Kilkenny Electricity Reinforcement Project – Unit 1: A new 400kV/110kV Substation at Coolnabacky townland, Co. Laois.

Client: ESB Engineering and Major Projects



COOLNABACKY, BIGBOG, CO. LAOIS - SITE ACCESS TM LAYOUT

DESIGN PARAMETERS				SAFETY ZONE			TEMPORARY SIGNS				CONE SPACING AND SIZE			RATE OF TAPER		LAMP SPACING		TRAFFIC MANAGEMENT SYSTEM		
Road Lvl(Sub)	Roadworks Type	Speed Limit (km/h)	Min. Lane Width (m)	Longitudinal (m)	Lateral (m)	Set Back (m)	Distance (m)	Number	Min. Size (mm)	Sign Visibility (m)	Longitudinal (m)	At Tapers (m)	Min. Height (mm)	Taper at H/S (m)	Taper at Lane (m)	At Tapers (m)	Longitudinal (m)	Method	Coned Area Length (m)	Max. Traffic Flow (veh/h)
2 (i)	A	80	3.00	45	1.2	-	120	4	600	90	12	3	750	45°	45°	6	24	Site Access	n/a	n/a

NOTES:

1) ALL INFORMATION CONTAINED IN THIS DRAWING SHOULD BE CHECKED AND VERIFIED BY CONTRACTOR PRIOR TO ANY STAGE OF CONSTRUCTION.

2) ALL WORKS ARE TO BE CARRIED OUT IN ACCORDANCE WITH LOCAL AUTHORITY REQUIREMENTS AND ARE TO BE INCLUDED IN THE SITE-SPECIFIC SAFETY & HEALTH PLAN.

3) CONTRACTOR TO CARRY OUT A SITE RISK ASSESSMENT PRIOR TO THE INSTALLATION OF ANY TRAFFIC MANAGEMENT PLAN TO ENSURE THAT CONDITIONS REFLECT THOSE CONSIDERED FOR DESIGN POST SUBMISSION.

4) CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROVISION OF RAMP ACCESS AT ANY CHANGE IN ROAD SURFACE LEVEL WHERE TRAFFIC RUNS ON A TEMPORARY SURFACE.

5) THIS TRAFFIC MANAGEMENT PLAN MAY ONLY BE IMPLEMENTED BY A TTOS WHO MUST CARRY OUT A RISK ASSESSMENT BEFORE IMPLEMENTATION. TTOS MUST BE IN POSSESSION OF CSCS CARD "SIGNING, LIGHTNING AND GUARDING AT ROAD WORKS" CONSTRUCTION REGULATIONS 2006.

6) EXACT SIGNS POSITIONS TO BE AGREED ON SITE.

7) ACCESS TO BE MAINTAINED TO ALL DWELLINGS / BUSINESSES AT ALL TIMES.

8) SITE INSPECTIONS AND MAINTENANCE OF THE TRAFFIC MANAGEMENT LAYOUT IS TO BE CONDUCTED ON A DAILY BASIS TO ENSURE THE SAFETY AND INTEGRITY OF THE DESIGN.

9) ALL TEMPORARY FOOTWAYS MUST HAVE A GOOD QUALITY, EVEN SURFACE AND BE MAINTAINED FREE FROM OBSTRUCTION.

10) PEDESTRIANS TO BE PROTECTED FROM WORKS AREA BY PEDESTRIAN BARRIER SYSTEM.

11) BANKSMAN TO MANAGE SITE ACCESS/EGRESS DURING WORKS HOURS.

12) DUE TO RISK ASSESSMENT AND ROAD GEOMETRY THE DISTANCE BETWEEN SOME ADVANCE WARNING SIGNS HAS BEEN REDUCED AS PER DESIGN PARAMETERS OF A LEVEL 1(iv) ROAD.

LEGEND

- SIGN LOCATION
- EXISTING SITE
- SITE FENCE
- SITE ACCESS GATE
- NEW ROAD LAYOUT

GARY KEVILLE TRAFFIC MANAGEMENT LTD.
Rosemount Business Park, Dublin 11, Co. Dublin, Ireland
Tel: (+3531) 667 4322; Email: info@gktm.ie
Visit us at: www.gktm.ie

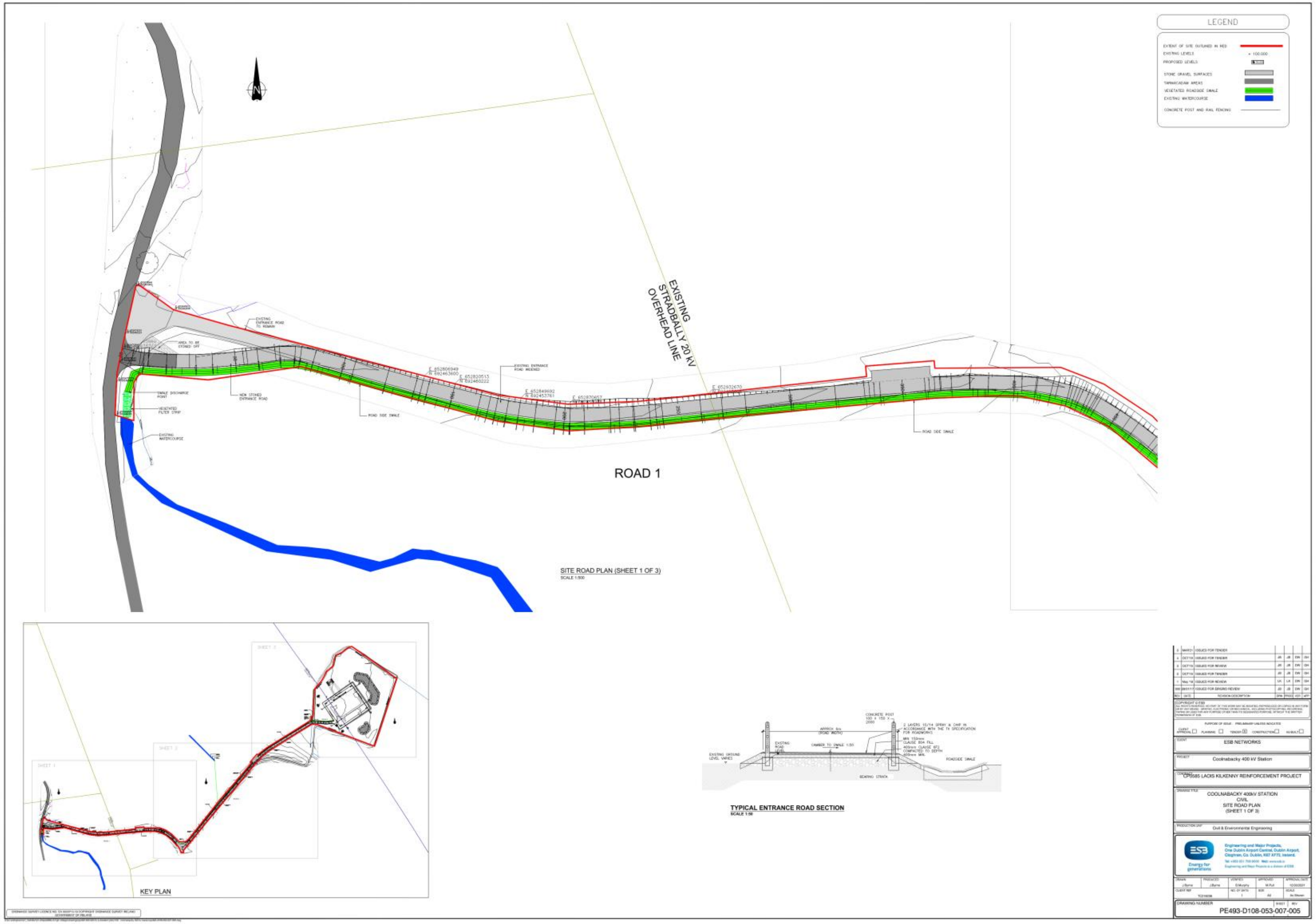
CLIENT: KILWEX CIVIL

DESIGNED:	MA	SCALE	
DRAWN:	SS	NTS	
VERIFIED:	BJ	DATE:	
APPROVED:	MA	10-01-2023	

PROJECT TITLE: COOLNABACKY, BIGBOG, CO. LAOIS
DRAWING NAME: SITE ACCESS TM LAYOUT
STAGE: TENDER
DWG. No.: JC 5610-00-01
REV: 3

Rev. No.:	Revision Details	Rev. Date:	Designed:	Drawn:	Verified:	Approved:
1.	Removed ramp, cross section & amended signage.	13-01-2022	MA	SS	BJ	MA
2.	Added extra signage.	01-02-2023	MA	SS	BJ	MA
3.	Added new road layout.	13-04-2023	MA	SS	BJ	MA

2


LEGEND
EXTENT OF SITE OUTLINED IN RED
EXISTING LEVELS
+ 100.000
PROPOSED LEVELS
STONE GRAVEL SURFACES
TARMACADAM AREAS
VEGETATED ROADSIDE SWALE
EXISTING WATERCOURSE
CONCRETE POST AND RAIL FENCING
N
EXISTING STRADBALLY 20 kV OVERHEAD LINE
EXISTING ENTRANCE ROAD TO REMAIN
AREA TO BE STONED OFF
EXISTING ENTRANCE ROAD WIDENED
E 652806949
N 692463600
E 652820513
N 692460222
E 652849692
N 692453761
E 652870657
E 652932670
SWALE DISCHARGE POINT
VEGETATED FILTER STRIP
NEW STONED ENTRANCE ROAD
ROAD SIDE SWALE
EXISTING WATERCOURSE
ROAD 1
SITE ROAD PLAN (SHEET 1 OF 3)
SCALE 1:500
SHEET 1
SHEET 2
SHEET 3
KEY PLAN
CONCRETE POST 100 X 150 X 2000
APPROX 6m (ROAD WIDTH)
2 LAYERS 10/14 SPRAY & CHIP IN ACCORDANCE WITH THE TII SPECIFICATION FOR ROADWORKS
EXISTING ROAD LEVEL
CAMBER TO SWALE 1:50
MIN 150mm CLAUSE 804 FILL
400mm CLAUSE 6F2 COMPACTED TO DEPTH 400mm MIN.
EXISTING GROUND LEVEL VARIES
ROADSIDE SWALE
BEARING STRATA
TYPICAL ENTRANCE ROAD SECTION
SCALE 1:50
5 MAR21 ISSUED FOR TENDER
4 OCT19 ISSUED FOR TENDER JR JB DW OH
3 OCT19 ISSUED FOR REVIEW JR JB DW OH
2 OCT19 ISSUED FOR TENDER JB JB DW OH
1 May 18 ISSUED FOR REVIEW LK LK DW OH
000 28/01/17 ISSUED FOR EIRGRID REVIEW JB JB DW OH
REV DATE REVISION DESCRIPTION DRW PROD VER APP
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PURPOSE OF ISSUE - PRELIMINARY UNLESS INDICATED
CLIENT APPROVAL ☐ PLANNING ☐ TENDER ☒ CONSTRUCTION ☐ AS BUILT ☐
CLIENT ESB NETWORKS
PROJECT Coolnabacky 400 kV Station
CONTRACT CP0585 LAOIS KILKENNY REINFORCEMENT PROJECT
DRAWING TITLE COOLNABACKY 400kV STATION
CIVIL
SITE ROAD PLAN
(SHEET 1 OF 3)
PRODUCTION UNIT Civil & Environmental Engineering
ESB
Energy for generations
Engineering and Major Projects,
One Dublin Airport Central, Dublin Airport,
Cloghran, Co. Dublin, K67 XF72, Ireland.
DRAWN J.Byrne
PRODUCED J.Byrne
VERIFIED D.Murphy
APPROVED
NO. OF SHTS 1
SIZE A0
DRAWING NUMBER PE493-D108-053-007-005


SHEET 2
LEGEND
EXTENT OF SITE OUTLINED IN RED
EXISTING LEVELS
× 100.000
PROPOSED LEVELS
STONE GRAVEL SURFACES
TARMACADAM AREAS
VEGETATED ROADSIDE SWALE
EXISTING WATERCOURSE
CONCRETE POST AND RAIL FENCING
EXISTING FIELD DRAINAGE DITCH
TOW +122.550m
EXISTING WATERCOURSE
CONCRETE POST AND RAIL FENCING
ACCESS POINT TO FIELD (APPROX 8m WIDE)
CONCRETE POST AND RAIL FENCING
ROAD 2
ROAD SIDE SWALE
CONCRETE POST AND RAIL FENCING
EXISTING ENTRANCE ROAD WIDENED
ACCESS POINT TO FIELD
SITE ROAD PLAN (SHEET 2 OF 3)
SCALE 1:500
KEY PLAN
SHEET 1
SHEET 2
SHEET 3
4 | MAR21 | ISSUED FOR TENDER
3 | OCT19 | ISSUED FOR TENDER | JB | JB | DW | GH
2 | OCT19 | ISSUED FOR REVIEW | JB | JB | DW | GH
1 | May 19 | ISSUED FOR REVIEW | LK | LK | DW | GH
000 | 20/07/17 | ISSUED FOR ERGRID REVIEW | JB | JB | DW | GH
REV | DATE | REVISION DESCRIPTION | DRN | PROD | VER | APP
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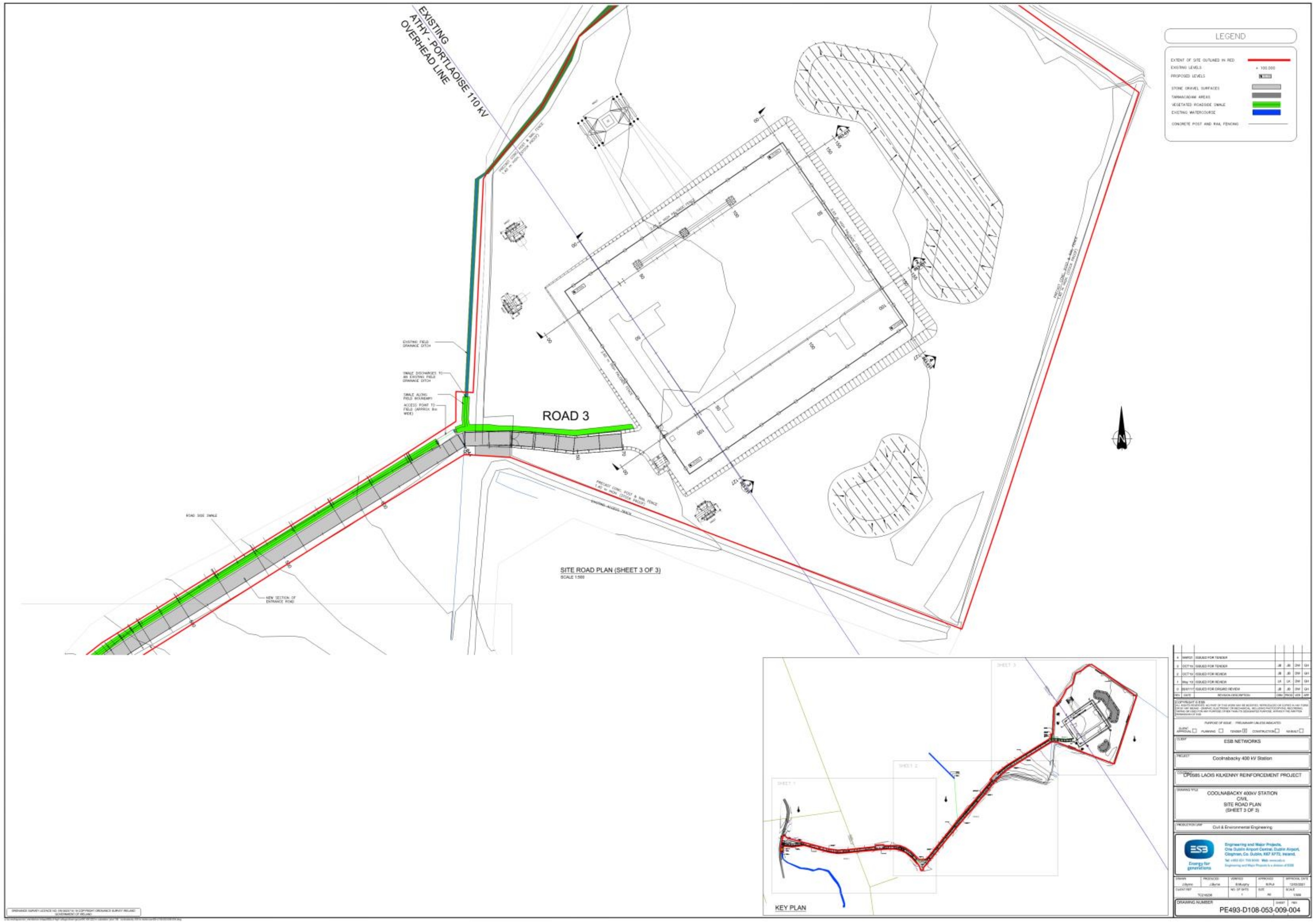
PURPOSE OF ISSUE - PRELIMINARY UNLESS INDICATED
CLIENT APPROVAL ☐ PLANNING ☐ TENDER ☒ CONSTRUCTION ☐ AS-BUILT ☐
CLIENT
ESB NETWORKS
PROJECT
Coolnabacky 400 kV Station
CP0585 LAOIS KILKENNY REINFORCEMENT PROJECT
DRAWING TITLE
COOLNABACKY 400kV STATION
CIVIL
SITE ROAD PLAN
(SHEET 2 OF 3)
PRODUCTION UNIT
Civil & Environmental Engineering
Energy for generations
Engineering and Major Projects,
One Dublin Airport Central, Dublin Airport,
Cloghran, Co. Dublin, K67 XF72, Ireland.
DRAWN J.Byrne
PRODUCED J.Byrne
VERIFIED S.Murphy
APPROVED M.Full
APPROVAL DATE 12/03/2021
CLIENT REF TC21/8296
NO. OF SHTS 1
SIZE A0
SCALE 1:500
DRAWING NUMBER
SHEET
REV
PE493-D108-053-008-004


EXISTING
ATHY - PORTLAOISE 110 kV
OVERHEAD LINE
LEGEND
EXTENT OF SITE OUTLINED IN RED
EXISTING LEVELS
+ 100.000
PROPOSED LEVELS
STONE GRAVEL SURFACES
TARMACADAM AREAS
VEGETATED ROADSIDE SWALE
EXISTING WATERCOURSE
CONCRETE POST AND RAIL FENCING
EXISTING FIELD DRAINAGE DITCH
SWALE DISCHARGES TO AN EXISTING FIELD DRAINAGE DITCH
SWALE ALONG FIELD BOUNDARY
ACCESS POINT TO FIELD (APPROX 8m WIDE)
ROAD 3
ROAD SIDE SWALE
NEW SECTION OF ENTRANCE ROAD
SITE ROAD PLAN (SHEET 3 OF 3)
SCALE 1:500
KEY PLAN
SHEET 1
SHEET 2
SHEET 3
ISSUED FOR TENDER
ISSUED FOR REVIEW
ISSUED FOR DRG/RD REVIEW
REVISION DESCRIPTION
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Delivery Framework

The following stipulations must be adhered to when delivering materials to site:

- Private Road Access is 1300m long with Road 2, 800m of roadway solely for the purpose of accessing the substations to be constructed.
- In the event of a congestion issue on site, traffic will be held on the final portion of access road, Road 2.
- This will prevent congestion on site and avoid HGVs parking in neighbouring entrances.
- Material suppliers will be instructed to ensure tachometer breaks do not occur on site or in any part of the private access road. In the event it does occur, again vehicles will be stopped in the final 800m section, on Road 2, on both page 4 and 5 above, ensuring 2 way traffic will be able to pass, thus avoiding congestion of site and unwanted parking in neighbouring roads and accessways.
- Deliveries scheduled in to be made known to Site Manager the day prior to entry to site and several hours prior to arriving on site.
- Upon reaching site, the delivery driver will make himself known to the gateman. The gateman will instruct him where to go on site to be offloaded. The gateman will record the entry and exit of the vehicle on the delivery log.
- Delivery vehicles while reversing on site will require the use of a spotter. Delivery drivers will require full PPE whilst on site outside of their vehicle. This will be communicated to the supplier when ordering materials
- Under no circumstances will any operative stand on rear of vehicle without edge protection.
- There is a 10km/h speed limit within the site.
- All delivery drivers must wear suitable PPE – hardhat, hi-vis vest, gloves, glasses and safety boots
- In the event of arrival to site prior to working hours, please ensure engine is switched off to prevent disturbance to the immediate homes on the access road.
- Please adhere to the designated traffic management plan within the private access road, follow any directions issued by The Site Manager and do not reverse at any time without a spotter/banksman in place.

RESOURCE & WASTE MANAGEMENT PLAN

ESB COOLNABACKY 400KV SUBSTATION CIVIL WORKS

Aaron McEvoy

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Appendix A - Definitions

Appendix B – Waste Licences

1.0 Introduction

1.1 Purpose and Objectives of the RWMP.

This document presents the Resource and Waste Management Plan (RWMP) for the for control, management and monitoring of resources and waste associated with the civil engineering and building works for Coolnabacky 400kV / 110kV Substation on behalf of ESB Engineering & Major Projects.

This Plan has been developed specifically for this project and outlines construction practices and waste management measures which will be implemented during the construction phase, to ensure that the project is constructed in accordance with best practice, minimising the impact on the surrounding environment. The purpose of the R&WMP is to determine how the construction phase will comply with the specified requirements including contractual, regulatory, statutory and planning conditions.

Kilwex are committed to comply with:

- All relevant EU, national and local waste policies and legislation. See Section 1.4 for list of relevant legislation.
- The Kilwex environmental policy and the requirements of our ISO14001 certified Environmental Management System.
- ESB environmental and waste policies.

1.2 Resource Targets

To outline the project-specific resource targets which should be set by the Client at the outset to the project. As per the EPA Guidance “the responsibility for setting any project target lies with the Client who may dictate the appropriate performance specification for the project”. A key target for this project shall be to have a waste diversion (from landfill) goal of 90% for the overall project waste removed from site.

1.3 Supporting Documentation

All works shall take place in accordance with the requirements this plan and additional relevant complementary documents such as:

- Construction & Environmental Management Plan (CEMP).
- Project Safety and Health Plan.
- ESB document: ‘*Employer’s Minimum Environmental Requirements for Construction and Demolition Projects and Related Works and Activities’*.
- EPAs ‘Best Practice Guidelines for the preparation of resource & waste management plans for construction & demolition projects’.
- Relevant Planning Conditions.

1.4 Relevant Legislation

List of relevant waste management legislation that shall be complied with at all times:

Title of Legislation:
Waste Management Act 1996 (No. 10 of 1996) as amended 2001 (No. 36 of 2001), 2003 (No 27 of 2003) and 2011 (No. 20 of 2011).
Waste Management (Collection Permit) Regulations 2007 as amended.
Environmental (Misc. Provisions) Act (2011)
EU Regulation No. 1143/2014 on the Prevention and Management of the Introduction and Spread of Invasive Alien Species
Department of Environment and Local Government (DoELG) Waste Management – Changing Our Ways, A Policy Statement (1998).
Department of Environment, Communities and Local Government (DoECLG), A Resource Opportunity - Waste Management Policy in Ireland (2012).
Department of Environment, Heritage and Local Government, Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and

Title of Legislation:
Demolition Projects (2006).
Environmental Protection Agency, 2021. Best practice guidelines for the preparation of resource & waste management plans for construction & demolition projects.
European Communities (Waste Directive) Regulations 2011 (SI 126 of 2011) as amended 2011 (S.I. No. 323 of 2011) and 2016 (S.I 315 of 2016).
Environmental Protection Agency, 2018. List of Waste & Determining if Waste is Hazardous or Non-hazardous. Waste Classification.
EU Council Decision 2003/33/EC establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 and Annex II of Directive 1999/31/EC (2002).
Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006.

Table 1 Relevant Legislation

1.5 R&WMP Review

The RWMP is a live document and will be reviewed on a monthly basis to ensure that it reflects the activities on site and will be updated when required. At project completion the RWMP will receive a final update with project waste levels compared to those predicted and lessons learnt noted.

Rev.	Date	Summary of amendments made:	Reviewed by:
01	18/01/23	Initial version.	Kilwex Ltd.
02	31/03/23	Format of Plan amended to align with EPA 'Best Practice Guidelines for the preparation of resource & waste management plans for construction & demolition projects'. Content updated to reflect feedback on initial plan, project information and content of the project CEMP.	Warren Donnelly / Aaron McEvoy
03	05/05/23	Further general revisions following project team review.	Kilwex Ltd.

Table 2 Review Table

2.0 Project Description

2.1 **Project Name**

ESB Coolnabacky 400kV Substation Civil Works.

2.2 Site Location

The substation will be constructed in a 6.7-hectare field in the townland of Coolnabacky near the village of Timahoe, Co. Laois. It is approximately 2km from the town of Timahoe and 15km from Portlaoise. It is set the middle of a rural area adjacent to overhead ESB powerlines:

2.3 Site Description

The site comprises mainly grassland and is enclosed by watercourses and hedgerows. A gravel track is present along the southern boundary as well and from the southwest corner of the site up along the western boundary. The wider area is dominated by agricultural land (mainly improved grassland). Tufa formations within the watercourse along the western boundaries of the site have been identified. This watercourse eventually discharges to the river Barrow and river Nore cSAC / pNHA some 4.7 km northeast. Figure 1 shows site location.

Figure 1 Map of Coolnabacky Site

2.4 Proposed Development

The permitted development consists of the following:

- 110kV GIS building
- 400kV GIS building
- 2 no. transformers positioned in bund enclosures.
- Associated compound and all other infrastructure contained within.

The 400kV substation build is a 64m x 15.3m x 12m building equipped with 8 bays consisting of 2No. Lines, 1No. from Moneypoint and 1No. Dunstown, 2No. transformers and 4No. spare bays for future proofing the build.

Some of the following are features included in the build:

- Building will house the 400kV switchgear (electrical equipment)
- The build will be carried out off of a waterproofed cast in-situ raft foundation.
- Cast in situ walls will be formed above first floor level, with the remainder cladded in an insulated panel. Steel frame will be built off of top of wall forming remainder of structure.
- Cavity wall formed with rubble stone exterior, cavity and insulation.
- Precast first floor and roof slabs will be utilised in conjunction with screed on top.
- Roof will be insulated and formed in a tapered insulation.
- Gantry cranes will be provided by a specialist engineering supplier.

The 110kV substation build is a 50m x 11.5m x 12m with 8 bays consisting of 3 no. lines Athy, Portlaoise and Ballyragget, 2 no. transformers and 3 spare bays for future development.

Some of the following are features included in the build:

- Building will house the 110kV switchgear (electrical equipment).
- The build will be carried out off of a waterproofed cast in-situ raft foundation.
- Steel frame structure build off subfloor, used to hold precast and insulated panels in place.
- Composite first floor with additional reinforced structural screed on top.
- Precast insulated concrete sandwich panels extending above first floor with an insulated cladding panel above.
- Precast insulated sandwich panel will be faced with a stone slip system.
- Insulated panel for roof with preformed gutter attached.
- Gantry cranes will be provided by a specialist engineering supplier.

2.5 Details of project programme and phasing.

Anticipated Start Date:	TBC 2023
Completion Date:	TBC 2024

2.6 Site history

The initial use of the site was for agricultural purposes, mainly for the grazing of livestock. Adjacent properties are currently being used for both livestock and arable farming. The site is drained by an existing river on 3 sides. Bund 1 to be formed during 110kV build is partially formed from pre-existing works.

Some construction has occurred on site. Remains of haul roads can be seen, silt fencing around existing stockpiles and minor berms where material has been gathered can be found. The condition of the site is extremely overgrown and so pathways will need to be stripped to safely navigate the site. Existing materials can be seen in various places around the site such as stakes and ESB pylon steel.

For the most part, existing stockpiles have returned to nature with grass material preventing them from being eroded by run off except 1No. stockpile. Adjacent properties have suffered extensive erosion from hills on lands as they have been reclaimed and regraded. The soil is very sandy in condition causing this.

2.7 Details of any site clearance

The following are examples of vegetation removal:

- Topsoil stripping or other excavations to enable works.
- Excavation for raft foundations both builds.
- Excavation for settlement ponds.
- Drainage and duct install.

All excavated spoil is to remain on site and stored in berms, which form part of the permanent works. This, then will be silt fenced, with a French drain placed around each stockpile, draining water from stockpiles to the settlement ponds being discharged into the perimeter river. Construction wastes will be segregated and collected by a licenced waste contractor. See section 7.2 for further information.

2.8 Description of construction elements

The following is a description of the building works to ensue in Coolnabacky:

- The 400kV indoor substation building with dimensions of 64m x 15.3m x 12m will be equipped with 8 bays ,2 no. lines from Moneypoint and Dunstown, 2 no. transformers, 4 spare bays.
- The foundation consists of an 800mm raft foundation with insulated screed poured on top.
- Cast in situ walls are built off the foundation slab to carry the steel frame. It is erected on top of the walls.
- Façade finishes include precast sandwich panels approximately 60% up the side of the building, insulated Kingspan panels, rubble stone walls and face fixed stone slips. Precast stair walls and flights are to be utilised within. Internal walls are to be of a fair-faced blockwork. Stairs are to be capped with precast to prevent migration of fire and maintain safe egress from the building.
- The roof consists of precast material with an insulation laid to falls placed on top of a 75mm topping on the roof.
- The 110kV indoor station with building dimensions 50m x 11.5m x 12m will also be equipped with 8 bays ,3 no. lines Athy, Portlaoise, Ballyragget, 2 no. transformers and 3 spare bays. This build again has an 800mm thick raft foundation built on layers of stone. Ground floor is insulated. The steel is built coming off of the raft foundation. Façade in this case is an insulated concrete sandwich panel around the perimeter with a Kingspan insulated sheet around the perimeter.
- The roof consists of an insulated Kingspan panel. Stair flights and stair walls are to be precast with internal walls being of a fair-faced blockwork.
- For both builds, storm water is managed by sediment ponds being installed to take storm water discharge from the roof. This in turn will be discharged to the local river once free from suspended solids. The main entrance road is to be surfaced with limited landscape and shaping to be undertaken on the side embankments.
- Ducting is to be installed from pylons to substation buildings and from transformers to substations. 1 No. foul tank is to be placed to take foul water from building with an adjacent water tank to be maintained to hold water in the event of fire. The entire ESB compound site is also to be fenced, ensuring security within the facility. A firefighting storage tank is to be installed also.
- The compound will be stoned up in the fenced area. There will be an existing stone road making access to site to be extended and tarred to access buildings also.

2.9 Material balance for the site indicating the cut/fill requirements for development and estimates for all other material imports

All excavated spoil is to remain on site and stored in berms, which form part of the permanent works.

2.10 Asbestos-Containing material (ACM)

No ACM anticipated on this project. In the unlikely event of ACM being suspected on site, works will cease, the area in question cordoned off and a specialist contractor will be employed to complete testing of the material.

2.11 Details of any other hazardous materials known on site.

There are no known contaminants within the confines of the project.

2.12 Planning permission conditions

This Resource & Waste and Management Plan has been prepared in accordance with Planning Condition 11 of the grant of permission dated 23rd April 2014 for the Laois - Kilkenny Reinforcement Project (Reference 11.VA0015).

Planning Condition 11 includes the following requirements for waste management:

(a) location of any site and materials compound(s) including area(s) identified for the storage of construction refuse

- All materials delivered to site will, on the most part, be on an as required basis and will be stored adjacent to the 100kV or 400kV footprints. As part of the permanent scope of works, all excavated material is to be kept on site in 2no. berms – these berms will be shaped and seeded as part of the permanent works.
- There will be a designated waste holding area where any waste arising from site works will be segregated and put into designated skips.
- The waste holding area will be positioned on a hardstanding well away from any watercourse. (Refer to Site Logistics Plan for current proposed location).
- All waste skips will be monitored daily and once full will be removed from site by a licenced waste contractor. Daily site inspection records will be maintained, kept on site and made available for inspection as required.
- All foul waste from the welfare facilities will drain to a proprietary holding tank. The waste from the tank will be emptied and disposed of by a licensed waste contractor, as required. The tank will be checked daily as part of the daily site inspections.
- Records of inspections will be kept on site and made available for inspection as required. A copy of all Waste Collection Permits and Waste Facilities Licences will also be kept on site.

(g) measures to prevent the spillage or deposit of clay, rubble or other debris on the public road network

The following points will apply when negating the risk of clay/debris/rubble/ etc. on the public road network:

- Kilwex have a cleaning policy in relation to equipment. Prior to entry to site and prior to leaving site, cleaning for all vehicles leaving site. All site haul roads will be constructed and maintained such that vehicles will not collect any excess debris or spoil on the wheels, axles and chassis of the vehicles.
- A wheel wash facility will be provided on site for use as required.
- All excavated spoil is to remain on site, therefore the risk of debris spilling onto the road network from vehicles leaving site is vastly reduced.
- Waste removal contractor will be required to cover any skips prior to leaving site.
- All vehicles leaving site will be inspected by Kilwex gateman for cleanliness and to ensure they are suitably and safely loaded. Any vehicles deemed non-compliant will not be allowed to leave site.
- When issuing orders and purchase orders to contractors/suppliers/hauliers/couriers and the like, Kilwex will include memos outlining the requirement that all vehicles are to be safely loaded and suitably cleaned prior to commencing their journey to the Coolnabacky site.
- When deemed necessary Kilwex will have a road sweeper on site.

- All nearby by roads shall be inspected by Kilwex daily or more frequently if deemed necessary due to construction works, weather and the like. Records of inspections shall be kept on site and made available for inspection as required.

(k) containment of all construction-related fuel and oil within specially constructed bunds to ensure that fuel spillages are fully contained; such bunds shall be roofed to exclude rainwater.

Below are some measures which will be implemented onsite regarding fuel storage and management:

- All plant will be refuelled on site e.g., excavators, dumpers etc., Refuelling will take place at a designated distance away from watercourses (>25m) in accordance with the buffer zone guidelines highlighted in Section 10 of the EIS (Environmental Impact Assessment)
- Fuel will be transported to the site vehicles using a bunded fuel bowser. This bowser will be filled weekly by a fuelling lorry.
- Drip trays will be used while refuelling, and spill kits will be located onsite to be deployed if required.
- Rigid and articulated vehicles will be fuelled off site as would all site vehicles (jeeps, cars and vans).
- Only designated trained operators will be authorized to refuel plant on site.
- Mobile bowsers, tanks and drums will be stored in a secure, impermeable storage area, away from drains and open water.
- Fuel containers will be stored within a secondary containment system e.g., bund for static tanks or a drip tray for mobile stores.
- Ancillary equipment such as hoses, pipes will be contained within the bund.
- Taps, nozzles or valves will be fitted with a lock system.
- Fuel and oil stores, including tanks and drums, will be regularly inspected for leaks and signs of damage.
- Procedures and contingency plans will be set up to deal with an emergency accidents or spills; including availability of specialist 24/7 spill contractor in case of major incident.

(l) off-site disposal of construction/demolition waste and details of how it is proposed to manage excavated soil.

- There are no demolitions works in this Project. All excavated spoil is to remain on site and stored in berms, which form part of the permanent works.
- Any other wastes will be segregated, stored accordingly and collected by a licenced waste contractor. The waste area will be checked as part of Kilwex's daily site inspections and records of same will be kept on site and made available for inspection as required. Waste transfer licences will be available for inspection.

2.13 Ground contamination

During geotechnical site investigation, no contamination was found and so no material is to be removed from site.

2.14 Design Changes

This section shall be updated during the construction phase to reflect changes in design that may have an impact on resource and waste management.

3.0 Roles & Responsibilities

This section outlines the responsibilities for the key project stakeholders to ensure the development of an effective RWMP through the lifecycle of the project. Typical responsibilities are detailed in the EPA Best Practice Guidelines for R&WMP:

3.1 Contractor (Kilwex)

The Main Contractor procured by the Client to undertake the construction operations is responsible for the following:

- Preparing, implementing and reviewing the RWMP through construction (including the management of all suppliers and sub-contractors) as per the requirements of these guidelines.
- Identifying a designated and suitably qualified Resource & Waste Manager (RWM) who will be responsible for implementing the RWMP.
- Identifying all hauliers to be engaged to transport each of the resources / wastes off-site. Note that any resource that is legally a ‘waste’ must only be transported by a haulier with a valid Waste Collection Permit.
- Identifying all destinations for resources taken off-site. As above, any resource that is legally a ‘waste’ must only be transported to an authorised waste facility.
- End-of-waste and by-product notifications addressed with EPA where required.
- Clarification of any other statutory waste management obligations, which could include on-site processing.
- Full records of all resources (both wastes and other resources) should be maintained for the duration of the project.
- Preparing a RWMP Implementation Review Report at project handover.

4.0 Design approach

4.1 Design initiatives adopted for Reuse and Recycling

The Circular Economy

Ireland's national waste policy is '*A Waste Action Plan for A Circular Economy – Ireland's National Waste Policy 2020 – 2025*'. The policy is intended to move Ireland toward a circular economy in which focus is shifted away from waste disposal, favouring circularity and sustainability by identifying and maximising the value of material through improved design, durability, repair and recycling. By extending the time resources are kept within the local economy, both environmental and economic benefits are foreseen.

This project will implement the above policy as follows:

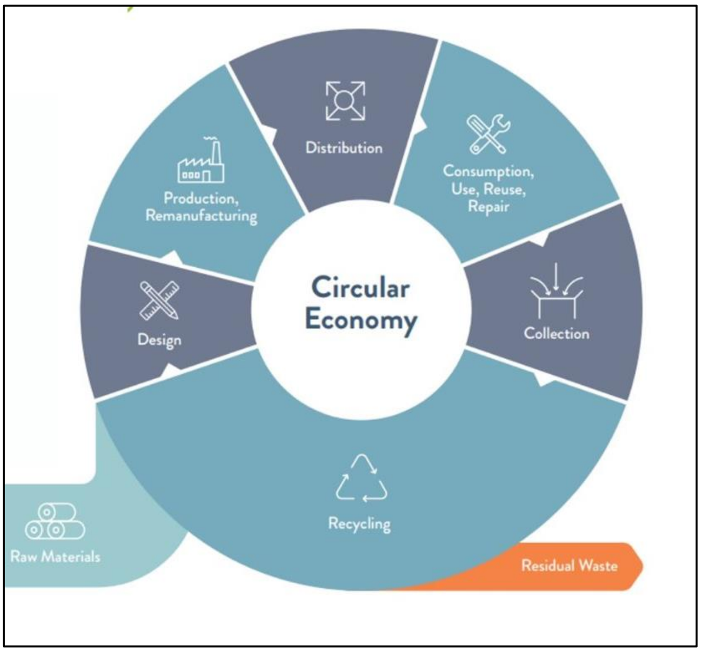


Figure 2 Waste Action Plan for a Circular Economy

- Reuse on-site of all excavated soils and stones on site as part of the permanent works.
- The purchase of construction materials as needed to prevent over-supply and potential for damage whilst in storage.
- The segregation of construction waste streams into separate storage containers to maximise the potential for the re-use of the materials.
- Minimising the volume of waste through design.
- Take back schemes adopted where possible, e.g., pallets, packaging.
- Insisting on reusable formwork shuttering systems.

4.2 Document design initiatives adopted for Green Procurement

- Supply chain competency shall be assessed prior to appointment via a pre-qualification questionnaire which cover key environmental matters.
- Procurement selection will minimise unnecessary packaging. Options for packaging reduction discussed with subcontractors and suppliers using measures such as 'delivery when required' delivery.
- A specialist environmental consultant with expert knowledge in waste prevention and minimisation has been employed to support Kilwex during this project.
- Methods of waste prevention and minimisation shall be discussed with potential subcontractors and suppliers at an early stage (pre-procurement). Proposed design solutions to be agreed, with innovation encouraged to recognise sustainable approaches.
- Material specifications for the project shall be flexible enough to allow for the variations in reclaimed materials. Specifications shall outline the essential performance properties required of a material but not over define the details.
- Use ordering procedures that avoid waste, i.e., no over-ordering, take-back schemes for both material surplus and offcuts.

- Contractual agreements secured to implement the initiatives outlined in our policies and the RWMP as part of the contract.

4.3 Document design initiatives adopted for Off-Site Construction

Precast material in the forms of concrete stairs, walls and exterior sandwich panels are incorporated into this project. This increases performance of the project in the following ways:

- Precast construction is seen to be a quicker method. This is evident in the quick turnaround of precast panels and walls, whereby entire levels of buildings can be formed in relatively short period of time. Also, with regard to precast panels for façade, massive areas are closed in, in a short space of time, meaning internal works can commence much earlier.
- Accuracy of product is seen to be superior as it is fabricated in a factory environment, negating weather and general site conditions.
- Less waste is produced. On site construction is said to be waste laden contributing to the amount of materials to be disposed of after completion of the project.
- It eliminates over ordering of materials, as materials are produced in a factory environment.
- Unusable or odd sized off cuts of materials do not occur. This is due to again materials being measured and procured by the specialist fabricator.
- Precast materials are often seen as being better quality. Using precast concrete as an example, concrete used in a controlled environment, outside of delay or weather factors can be utilised within optimum parameters.
- Use of precast items results in the reduction of concrete materials being used and waste on site. Reasons for such a belief is that there are less spillages associated within factory setting.

4.4 Document design initiatives adopted for Materials Optimisation

- Composite flooring is utilised in the 110kV building. This reduces the depth of concrete required in the first floor to carry significant loadings. In turn, this reduces the sizes of steel required to carry the first floor, in the steel frame and as such requires less steel and concrete.
- The shell of both the 110kV and 400kV builds are steel frame with an associated amount of cast in situ whether it is the raft foundation or concrete walls. The frame of the build is of relatively simple design. All columns placed on concrete formation either wall or foundation raft with either a cladding panel or a precast sandwich panel fixed to it.
- 3D modelling is undertaken in this project in relation to the steel frame. This aids in understanding the building layout in designing several elements of the build such as the gantry crane, insulated panel install, precast sandwich panels and roof gutter design. It ensures the required fixings cleat, spacing for the precast panel install is available and also indicates a certain amount of tolerance available within the panel, all whilst ensuring, insulated panels have a drip at junction where panel and precast meet. In turn, it ensures gantry crane can freely move about length of build.
- Coordination of design is an integral part of the project to reduce rework and waste as much as possible, ensuring product installed on site meets client requirements.
- It is important to physically compare external levels of a build to landscape design. Careful comparison can indicate issues with levels such as external levels being higher than DPC in blockwork causing damp, or simply ground levels do not meet DAC requirements.

4.5 Document design initiatives adopted for Flexibility and Deconstruction

In regard to this project, the 110kV build has both a precast sandwich panel and insulated cladding panel. The cladding panels can be removed relatively easy and sent to specialist waste disposal for recycling purposes, as can the roof also. The precast panels can be broken down and disposed of and reused for filling on another construction project as can the foundation.

The steel frame is made of 100% recyclable steel. Dismantling of frame and sending it to waste metal recycle centre only takes days. Indeed, in the event of structural engineering sign off, structural steel frame can be re-used again, once members are straight and free from metal fatigue. Steel in the composite flooring can be separated from the concrete, with both by-products to be reused, steel to go to specialist waste disposal for recycling purposes and the concrete also as fill.

In regard to the 400kV build, again cast in situ walls can be removed, broken for fill along with other concrete elements of the build such as the cast in situ walls and raft foundation. The steel frame again can be either scrapped and sent to a metal waste recycler or simple re-erection in another location once sign off from structural engineer is achieved subject to metal fatigue and rust.

5.0 Key Materials Quantities & Costs

5.1 Resource and waste inventory

Description	LoW Code	Volume Generated (tonnes)	Prevention (tonnes) (non-waste)	Reused (tonnes) (non-waste)	Recycled (tonnes) (non-waste)	Recovered (tonnes) (non-waste)	Disposed (tonnes) (non-waste)	Unit Cost Rate (€/tonne)	Total Cost (€)
Concrete	17 01 01								
Bricks	17 01 02								
Tiles & Ceramics	17 01 03								
Mixtures of, or separate fractions of concrete, bricks, tiles and ceramics containing hazardous substances.	17 01 06								
Wood / Timber	17 02 01								
Glass	17 02 02								
Plastic	17 02 03								
Glass, plastic and wood containing or contaminated with hazardous substances	17 02 04								
Bituminous mixtures containing coal tar	17 03 01								
Bituminous mixtures containing other than those mentioned in 17 03 01	17 03 02								
Copper, bronze, brass	17 04 01								
Aluminium	17 04 02								
Lead	17 04 03								
Zinc	17 04 04								
Iron and Steel	17 04 05								
Tin	17 04 06								

Mixed Metals	17 04 07								
Metal waste contaminated with hazardous substances	17 04 09								
Cables other than those in 17 04 10	17 04 11								
Soil and stones containing hazardous substances	17 05 03								
Soil and stones other than those in 17 05 03	17 05 04								
Insulation materials other than those mentioned in 17 06 01 and 17 06 03	17 06 04								
Construction materials containing asbestos	17 06 05								
Gypsum-based construction materials other than those mentioned in 17 08 01	17 08 02								
Mixed C&D waste other than those mentioned in 17 09 01, 17 09 02 and 17 09 03	17 09 04								
Other resources (nonwasted materials) (specify as needed)									
Other wastes (specify as needed)									

Table 3 Waste Materials table

5.2 Contractors Removing Waste

Any resource that is legally a 'waste' shall only be transported by a haulier with a valid Waste Collection Permit to an authorised facility with a valid waste management licence. Kilwex will ensure that waste collectors/hauliers and waste facilities shall be assigned prior to works commencing. Waste facilities shall issue a letter of acceptance prior to works commencing to ensure that the facility is suitable and there is sufficient capacity.

Name and Address of company removing waste materials	**Waste Collection Permit Number**	**Expiry Date:**	**Waste Management Licence Number (for facility receiving the waste)**	**Licence Expiry Date:**	**Copies held on site (Y/N)**
Bord Na Mona Main Street, Newbridge, Co.Kildare W12 XR59 Ireland	NECPO-08-10601-07	14/12/2025	Various Facilities used. Please See Appendix Waste Facility Permit Numbers	See previous Statement	Yes
AQS Castletown Galmoy Co. Kilkenny E41 CH93 Ireland	NWCPO-12-02583-03	21/07/2027	Various Facilities used. Please See Appendix Waste Facility Permit Numbers	See previous Statement	Yes

Table 4 Waste Carriers List

6.0 Site Management

6.1 Resource and Waste Manager (RWM) of the RWMP

The Resource Manager for this project shall be the Kilwex Project Manager. The RM responsibilities shall include:

- Update the plan as required to reflect new resource streams, work practices, suppliers or resource management options as required.
- Delivery of training in relation to resource management, e.g. induction and toolbox talks.
- Ensuring site infrastructure is supplied and maintained as fit for purpose.
- Conducting internal site audits including audits of subcontractor operations. Participating as required for any Local Authority or other audits undertaken.

Kilwex Contacts

Position Title:	Name:	Phone:	Email:
PSCS / Main Contractor	Kilwex Civil	045 889 479	civileng@kilwex.ie
Managing Director	Darragh O'Connell	087 2542557	Darragh.oconnnell@kilwex.ie
Contracts Manager	Fintan McKeon	086-1081029	Fintan.mckeon@kilwex.ie
Project Manager / Resource Manager (RM)	Aaron McEvoy	086 103 4052	aaron.mcevoy@kilwex.ie
Site Manager	Philip Holmes	086 0842195	philip.holmes@kilwex.ie
Environmental Manager	Daniella O'Neill	086 8427748	daniella@coyleenv.ie
SHEQ Manager	Warren Donnelly	086 8587795	Warren.donnelly@kilwex.ie
EHS Advisor	Antonio Panadero	086 035 5194	antonio.panadero@kilwex.ie
Site Emergency Number	Aaron McEvoy	086 103 4052	aaron.mcevoy@kilwex.ie
Project Archaeologist	Martin Byrne	087 262 4954	martinbyrne1063@gmail.com
Overall Project PSDP	Patrick Graham	087 418 5317	patrick.graham@esb.ie

Table 5 Kilwex Contacts

Employer (ESB) Contacts

Position:	Name:	Phone:	Email:
ESB EMP Project Manager	Aoife Heneghan	0879822952	aoife.heneghan@esb.ie
ESB EMP Environmental Specialist	Lorna Conway	0879202428	lorna.conway@esb.ie

Table 6 ESB EMP Contacts

Third Party Contacts

Organisation:	Position:	Name:	Phone:	Email Address:
Inland Fisheries Ireland	Eastern River Basin District	Dublin Regional Office	(01) 2787022	blackrock@fisheriesireland.ie
National Parks and Wildlife Service	North - Eastern Region	District Conservation Officer	(076) 1002594	nature.conservation@chg.gov.ie
Environmental Protection Agency (EPA)	EPA	EPA Headquarters	(053) 9160600	info@epa.ie
Local Authority	Laois County Council	Laois County Council Headquarters	(057) 866 4000	corpaffairs@laoiscoco.ie
Department of Culture, Heritage and the Gaeltacht	National Monuments Service	Custom House, Dublin	(01) 8882000	nationalmonuments@chg.gov.ie
Health and Safety Authority	Health and Safety Authority	Head Office, Dublin	(01) 6147000	wcu@hsa.ie
Emergency Services	An Garda Síochána	Stradbally Garda	(057) 8625222	-
Emergency Services	Ambulance and Fire Service	Ambulance and Fire Service	999 or 112	-
Bord na Mona	Waste Disposal	Skips Off site	045 439 000	info@bnmrecycling.ie
AQS	Waste Disposal	Specialist Waste Removal	1800 500 020	info@aqssolutions.ie

Table 7 Third Party Contacts

6.2 Site induction and toolbox talk training

- The project induction shall include a briefing for all operatives on the site-specific environmental requirements of this project. This shall include key details from the R&WMP and environmental impacts and controls detailing in the project CEMP.
- Environmental/waste topics shall be included once a month into site toolbox talks. These weekly talks provided to all site operatives shall cover such matters as disposal of waste within correct waste bins and skips to avoid cross contamination and to ensure recycling is completed correctly.

6.3 Procedures for identifying suitably authorised waste collection operators and waste destination sites

- Waste collectors and waste facilities shall be assigned by Kilwex prior to works commencing. All licences and WCP will be stored on site by Kilwex at all times for reference.
- Waste facilities are required to issue a letter of acceptance to the contractor (Kilwex) prior to works commencing to ensure that the facility is suitable and there is sufficient capacity.
- Waste Collection: all waste moved off site.
- A list of currently authorised waste collectors can be accessed here: https://www.nwcpo.ie/permitsearch.aspx

- Waste Disposal / Recovery: all waste shall be sent to a suitably authorised waste facility. Waste Facility Permits or Certificate of Registrations can be accessed here: http://facilityregister.nwcpo.ie
- A list of sites currently licensed by the EPA (Industrial Emissions or Waste Licence) is available on the following website: https://epawebapp.epa.ie/terminalfour/waste/index.jsp?disclaimer=yes&Submit=Continue https://epawebapp.epa.ie/terminalfour/ippc/index.jsp?disclaimer=yes&Submit=Continue

6.4 Requirements for resource-efficient supply chains

Kilwex will ensure that supply chain appointed for this project are adhering to best practices with regard to resources and waste management. This will require:

- Supply chain competence assessed via pre-qualification questionnaires to confirm that contractors have sufficient resources, e.g. access to competent advice, supervision, environmental policies and procedures.
- Early engagement and collaboration with the supply chain to implement ordering procedures that avoid waste, e.g. no over-ordering, use of take-back schemes for packaging, material surplus and offcuts. Formal prestart meetings to review and agree controls and best practice to be followed.
- On-going consultation with contractors during the project to adopt a ‘continual improvement’ policy of reviewing lessons learned.

6.5 Procedures for record keeping and reporting

- The RM shall ensure that all waste records shall be stored on the Kilwex project SharePoint and via the Project Management System (PMS) on site for hard copies of waste records.
- All records will be retrievable at site level upon request from interested parties. This includes documents such as haulier dockets, facility dockets and final waste transfer forms.
- In advance of proposed soil and waste transfer, Kilwex will request letters of acceptance from the proposed waste facility/landfill/transfer station that will accept the waste.

A Waste Register (also may be known as a waste despatch log) will be held on site where a record will be kept of each waste consignment taken from the site. The details recorded for each consignment will, at a minimum, include:

- Date of removal of waste
- Waste stream description
- Waste LoW (EWC) code.
- Quantity of waste (in tonnes or litres as appropriate)
- Waste haulage contractor name and address.
- Waste haulage collection permit no.
- Waste haulage vehicle registration.
- Waste disposal contractor name and address.
- Waste treatment (Reuse/Recycling/Disposal) contractor certificate of registration, permit no. or waste licence no. including appropriate disposal/recovery code.
- Confirmation that waste was received/accepted by designated facility.

- Final destination of the waste (including waste licence number)

See Section 5.1 for sample Waste Register.

- Following the transfer of the waste, Site management shall obtain confirmation of the tonnage of waste transferred to the facility. This tonnage must be noted on all waste records.
- A monthly waste report summarising all waste types leaving site shall be prepared by Kilwex.

6.6 Requirements for communications with the local authority and other stakeholders

The Kilwex RM shall communicate through the construction phase with all stakeholders as required. This may include:

- Internal reporting of resource statistics to the Client and the wider Kilwex management team. This may include performance relative to agreed targets and objectives.
- Engaging with relevant local authority on any site inspection or enforcement audits undertaken at the site. All follow-up actions and corrective actions should be logged and reported to the local authority.
- Engaging with other stakeholders (EPA, public, etc.) as appropriate in relation to the resource management on site.
- Upon completion of construction, the RM will prepare a final report (post-project RWMP) summarising the outcomes of resource management processes adopted, the total reuse and recovery figures and the final destinations of all resources taken off-site.

6.7 Procedures for audits and inspections of resource management practices

Kilwex Civil has an integrated environmental, quality and health and safety management system in place. This system is certified to ISO 9001, ISO 14001 and Safe-T-Cert and is designed to maintain and continually improve the effectiveness and efficiency of the organisation’s performance.

To monitor the company’s resource management practices the following inspections and audits shall take place:

- Daily checks shall be carried out daily by Kilwex Site Management team, which will include checks that all works are in compliance with this RWMP. This will include monitoring of the Waste Storage Area (WSA), ensuring correct waste segregation, storage of waste, signage, subcontractor compliance, reviewing waste documentation, etc.
- No vehicle shall be permitted to leave site until the Site Management have countersigned the waste transfer note. The Site Management shall ensure that the waste carrier is authorised by Kilwex and that the transfer note is completed correctly.
- Regular checks shall be carried out with a documented call to the waste license facility to check corresponding delivery to transfer note at hand.
- Periodically site team members shall follow vehicles removing waste from site to ensure that the waste is being disposed of at the agreed waste facility. Records of same shall be recorded.
- Formal EHS audits shall be carried out on site by Kilwex H&S Department. These inspections shall be completed on a weekly basis.
- The site management team shall also complete a formal weekly SHEQ checklist.
- Kilwex will participate in any additional audits shall be carried out by ESB or other parties during the project.
- Findings from audits and inspections to be summarised on a monthly environmental report.

6.8 Requirements for a final report

Upon completion of the project a RWMP Implementation Review Report shall be produced.

7.0 Site Infrastructure

7.1 Minimum requirements for site signage on resource management

In order to ensure that waste materials are correctly segregated, it is the responsibility of the project RM to ensure all staff are informed by means of clear signage and verbal instruction and made responsible for ensuring site housekeeping and the proper segregation of construction waste materials.

7.2 Minimum requirements for resource storage (dedicated skips, hazardous materials storage, stockpile management, etc.)

Figure 3 Segregation of Waste

The Waste Storage Area (WSA) shall be established in the designated Kilwex site compound on a hard standing. The WSA will have adequate space for storage and handling, suitable signage posted, Where required, skips will be covered.

Non-hazardous waste

The designated WSA will have dedicated waste containers for segregation of wastes including but not limited to:

- Mixed / General waste
- Bulky waste

- Metal
- Mixed dry waste

All excavated material is to be kept on site for reuse or to form part of site berms. In the event of waste soils being exported off-site, the soil shall be classified as inert, non-hazardous or hazardous in accordance with the EPA's Waste Classification Guidance – List of Waste & Determining if Waste is Hazardous or Non-Hazardous document to ensure that the waste material is transferred by an appropriately permitted waste collection permit holder and brought to an appropriately permitted or licensed waste facility. Burning or burial of waste shall not be allowed at any time.

Hazardous waste

There is a low-risk of contaminated soil on this project. During the project there will be relatively minor amount of hazardous substances in use on the project. These may include:

- Fuel
- Oil
- WEEE
- Construction chemicals, e.g. additives, cement, sealants, paints.
- Sewage (use of chemical toilets at mobilisation).
- Contaminated soil. Any fuel or oil spills shall be managed as per the project Emergency Response Plan.

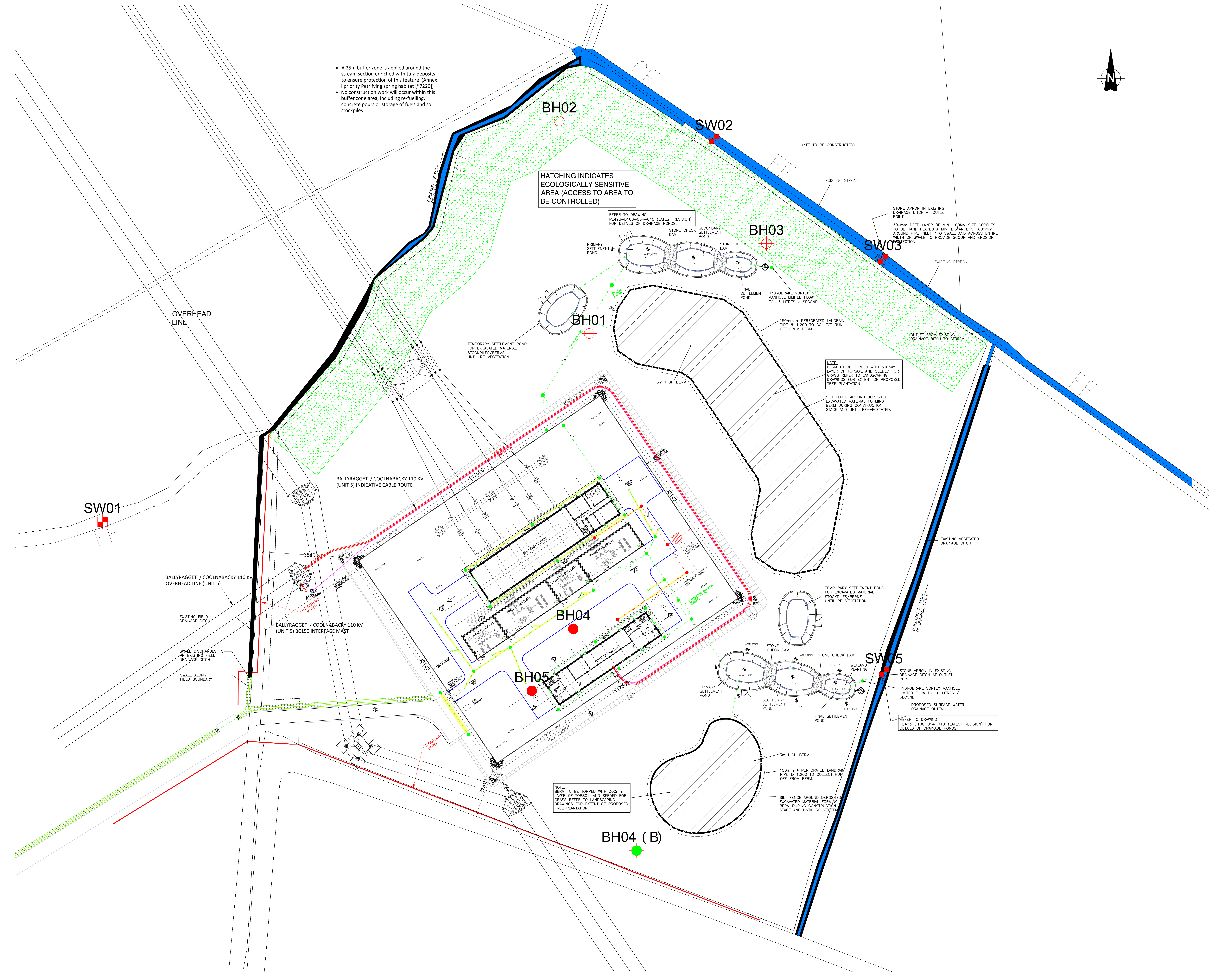
A bunded chemical stores shall be in place for safe storage of chemicals on site (expected to be very low quantities). Any hazardous waste shall be responsibly disposed of by a licensed contractor with the site team monitoring compliance with legal requirements under the Waste Management Act as outlined in Sections 6.3 and 6.5.

All foul water from offices/welfare will be stored in a holding tank for removal from site by a specialist contractor. Foul tank will be inspected daily. Foul tank will be emptied when full, most likely several times a week subject to the number of personnel on site.

Appendix A - Definitions

Term	Definition
Backfilling	Means any recovery operation where suitable non-hazardous waste is used for purposes of reclamation in excavated areas or for engineering purposes in landscaping. Waste used for backfilling must substitute non-waste materials, be suitable for the aforementioned purposes, and be limited to the amount strictly necessary to achieve those purposes.
By-product	A substance or object resulting from a production process the primary aim of which is not the production of that substance or object is considered not to be waste, but to be a by-product if the following conditions are met: ● further use of the substance or object is certain. ● the substance or object can be used directly without any further processing other than normal industrial practice. ● the substance or object is produced as an integral part of a production process; and ● further use is lawful in that the substance or object fulfils all relevant product, environmental and health protection requirements for the specific use and will not lead to overall adverse environmental or human health impacts.
Brownfield Land	Land previously developed e.g. used for industrial, commercial or residential uses, where such land may be contaminated with hazardous substances or anthropogenic or man-made substances that are not natural to the environment
C & D	Construction & Demolition
C&D waste	Waste generated by construction and demolition activities.
Disposal	Means any operation which is not recovery even where the operation has as a secondary consequence the reclamation of substances or energy. Annex I sets out a non-exhaustive list of disposal operations.
End of Waste	Waste which has undergone a recycling or other recovery operation is considered to have ceased to be waste if it complies with the following conditions: ● the substance or object is to be used for specific purposes; ● a market or demand exists for such a substance or object; ● the substance or object fulfils the technical requirements for the specific purposes and meets the existing legislation and standards applicable to products ● the use of the substance or object will not lead to overall adverse environmental or human health impacts.
Hazardous Waste	Waste which displays one or more of the hazardous properties listed in Annex III of Directive 2008/98/EC.
Inert Waste	Waste that does not undergo any significant physical, chemical or biological transformations (e.g. concrete, bricks, masonry, tiles). Inert waste will not dissolve, burn or otherwise react physically or chemically, biodegrade or adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm human health.
LoW	List of waste

Term	Definition
Non-hazardous waste	Waste which is not covered by the definition of hazardous waste.
Pre-demolition Audit	A preparatory activity with the purpose of: ● collecting information about the qualities and quantities of the C&D waste materials that will be released during the demolition or renovation works; and ● giving general and site-specific recommendations regarding the demolition process.
Prevention	Means measures taken before a substance, material or product has become waste, that reduce: ● the quantity of waste, including through the re-use of products or the extension of the life span of products. ● the adverse impacts of the generated waste on the environment and human health; or ● the content of hazardous substances in materials and products.
Product	All material that is deliberately created in a production process. In many cases it is possible to identify one (or more) ‘primary’ products, this or these being the principal material(s) produced.
Production Residue	A material that is not deliberately produced in a production process but may or may not be waste.
Re-use	Any operation by which products or components that are not waste are used again for the same purpose for which they were conceived.
Recycling	Any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations.
Recovery	Any operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy.
TFS Regulation	Regulation (EC) No. 1013/2006 of the European Parliament and of the Council of 14 June 2006 on shipments of waste.
Treatment	Means recovery or disposal operations, including preparation prior to recovery or disposal.
Uncontaminated soil	Essentially relates to virgin soil or soil that is equivalent to virgin soil.
Waste	Any substance or object which the holder discards or intends or is required to discard.
Waste Holder	Waste producer or the natural or legal person who is in possession of the waste.
Waste Treatment	Recovery or disposal operations, including preparation prior to recovery or disposal.
WCP	Waste Collection Permit
WSA	Waste Storage Area



- A 25m buffer zone is applied around the stream section enriched with tufa deposits to ensure protection of this feature (Annex I priority Petrifying spring habitat [*7220])
- No construction work will occur within this buffer zone area, including re-fuelling, concrete pours or storage of fuels and soil stockpiles

HATCHING INDICATES ECOLOGICALLY SENSITIVE AREA (ACCESS TO AREA TO BE CONTROLLED)

REFER TO DRAWING PE493–D108–054–010 (LATEST REVISION) FOR DETAILS OF DRAINAGE PONDS.

HYDROBRAKE VORTEX MANHOLE LIMITED FLOW TO 16 LITRES / SECOND.

STONE APRON IN EXISTING DRAINAGE DITCH AT OUTLET POINT.

300mm DEEP LAYER OF MIN. 100MM SIZE COBBLES TO BE HAND PLACED A MIN. DISTANCE OF 600mm AROUND PIPE INLET INTO SWALE AND ACROSS ENTIRE WIDTH OF SWALE TO PROVIDE SCOUR AND EROSION PROTECTION

TEMPORARY SETTLEMENT POND FOR EXCAVATED MATERIAL STOCKPILES/BERMS UNTIL RE–VEGETATION.

150mm ø PERFORATED LANDRAIN PIPE @ 1:200 TO COLLECT RUN OFF FROM BERM.

OUTLET FROM EXISTING DRAINAGE DITCH TO STREAM.

NOTE:
BERM TO BE TOPPED WITH 300mm LAYER OF TOPSOIL AND SEEDED FOR GRASS REFER TO LANDSCAPING DRAWINGS FOR EXTENT OF PROPOSED TREE PLANTATION.

SILT FENCE AROUND DEPOSITED EXCAVATED MATERIAL FORMING BERM DURING CONSTRUCTION STAGE AND UNTIL RE–VEGETATED.

BALLYRAGGET / COOLNABACKY 110 KV (UNIT 5) INDICATIVE CABLE ROUTE

BALLYRAGGET / COOLNABACKY 110 KV OVERHEAD LINE (UNIT 5)

EXISTING FIELD DRAINAGE DITCH

BALLYRAGGET / COOLNABACKY 110 KV (UNIT 5) BC150 INTERFACE MAST

SWALE DISCHARGES TO AN EXISTING FIELD DRAINAGE DITCH

SWALE ALONG FIELD BOUNDARY

EXISTING VEGETATED DRAINAGE DITCH

TEMPORARY SETTLEMENT POND FOR EXCAVATED MATERIAL STOCKPILES/BERMS UNTIL RE–VEGETATION.

STONE APRON IN EXISTING DRAINAGE DITCH AT OUTLET POINT.

HYDROBRAKE VORTEX MANHOLE LIMITED FLOW TO 10 LITRES / SECOND.

REFER TO DRAWING PE493–D108–054–010–(LATEST REVISION) FOR DETAILS OF DRAINAGE PONDS.

3m HIGH BERM

150mm ø PERFORATED LANDRAIN PIPE @ 1:200 TO COLLECT RUN OFF FROM BERM.

SILT FENCE AROUND DEPOSITED EXCAVATED MATERIAL FORMING BERM DURING CONSTRUCTION STAGE AND UNTIL RE–VEGETATED.

NOTE:
BERM TO BE TOPPED WITH 300mm LAYER OF TOPSOIL AND SEEDED FOR GRASS REFER TO LANDSCAPING DRAWINGS FOR EXTENT OF PROPOSED TREE PLANTATION.

LEGEND

PROPOSED SURFACE WATER	SW SW
CONCRETE ENCASED SURFACE WATER	SW SW
SURFACE WATER MANHOLE	● SW 1 C.L. = 0.000 I.L. = 0.000
GULLY	GY–A
ACCESS JUNCTION (SURFACE)	AJ
PROPOSED OIL SEPERATOR	
LAND DRAIN	
CATCH PIT	CP
PROPOSED FOUL WATER	FOUL FOUL
CONCRETE ENCASED FOUL WATER	FOUL FOUL
FOUL WATER MANHOLE	● FW 1 C.L. = 0.000 I.L. = 0.000
OIL SENSITIVE PUMP	
RISING MAIN	— > — > — > —
PROPOSED LEVELS	+ 100.000
FOUL HOLDING TANK	▨
COMMS DUCTS	
POWER DUCTS	
SOIL & VENT PIPE	SVP
ROAD SIDE KERB	
INDICATIVE SURFACE FLOW DIRECTION	←

NOTE:

FOR DRAINAGE POND DETAILS REFER TO DRAWING PE493–D108–054–010 (LATEST REVISION)

FOR COMPOUND DRAINAGE LAYOUT REFER TO DRAWING PE493–D108–125–002 (LATEST REVISION)

MONITORING POINTS LEGEND

EXISTING BOREHOLE TO BE DECOMMISSIONED	BH00
EXISTING BOREHOLE TO BE RETAINED	BH00
PROPOSED BOREHOLE	BH04 (B)
SURFACE WATER MONITORING POINTS	SW 00

REV	DATE	REVISION DESCRIPTION	DRN	PROD	VER	VER2	APP
4	09.01.24	EXTEND SW NETWORK, ADD KERBING,					
3	16.11.23	MINOR REVISIONS	JB	JB	SM	N/A	BM
2	10.11.23	UNIT 5 CABLE ADDED	JB	JB	SM	N/A	BM
1	29.08.23	GENERAL REVISIONS	JB	HG	RMcG	N/A	BM
0	29.08.23	ISSUED FOR INFORMATION	JB	HG	RMcG	VC	BM

PURPOSE OF ISSUE - PRELIMINARY UNLESS INDICATED

CLIENT APPROVAL ☐ PLANNING ☐ TENDER ☐ CONSTRUCTION ☐ AS-BUILT ☐

CLIENT
ESB NETWORKS

PROJECT
Coolnabacky 400 kV Station

CONTRACT
CP0585 LAOIS KILKENNY REINFORCEMENT PROJECT

DRAWING TITLE
COOLNABACKY 400 kV STATION
CIVIL

PLANNING SITE DRAINAGE PLAN

PRODUCTION UNIT
Transmission and Distribution Delivery

Energy for generations
Engineering and Major Projects,
One Dublin Airport Central, Dublin Airport,
Cloghran, Co. Dublin, K67 XF72, Ireland.
Tel: +353 (0)1 703 8000 Web: www.esb.ie
Engineering and Major Projects is a division of ESB.

DRAWN	PRODUCED	VERIFIED 1	VERIFIED 2	APPROVED	APPROVAL DATE
J.Byrne	S.Maxwell	M.Vaughan		B.Murphy	10/01/2024

CLIENT REF	NO. OF SHTS	SIZE	SCALE
TC229651	1	A0	1:500

DRAWING NUMBER
PE493-D108-125-001-004

SHEET REV

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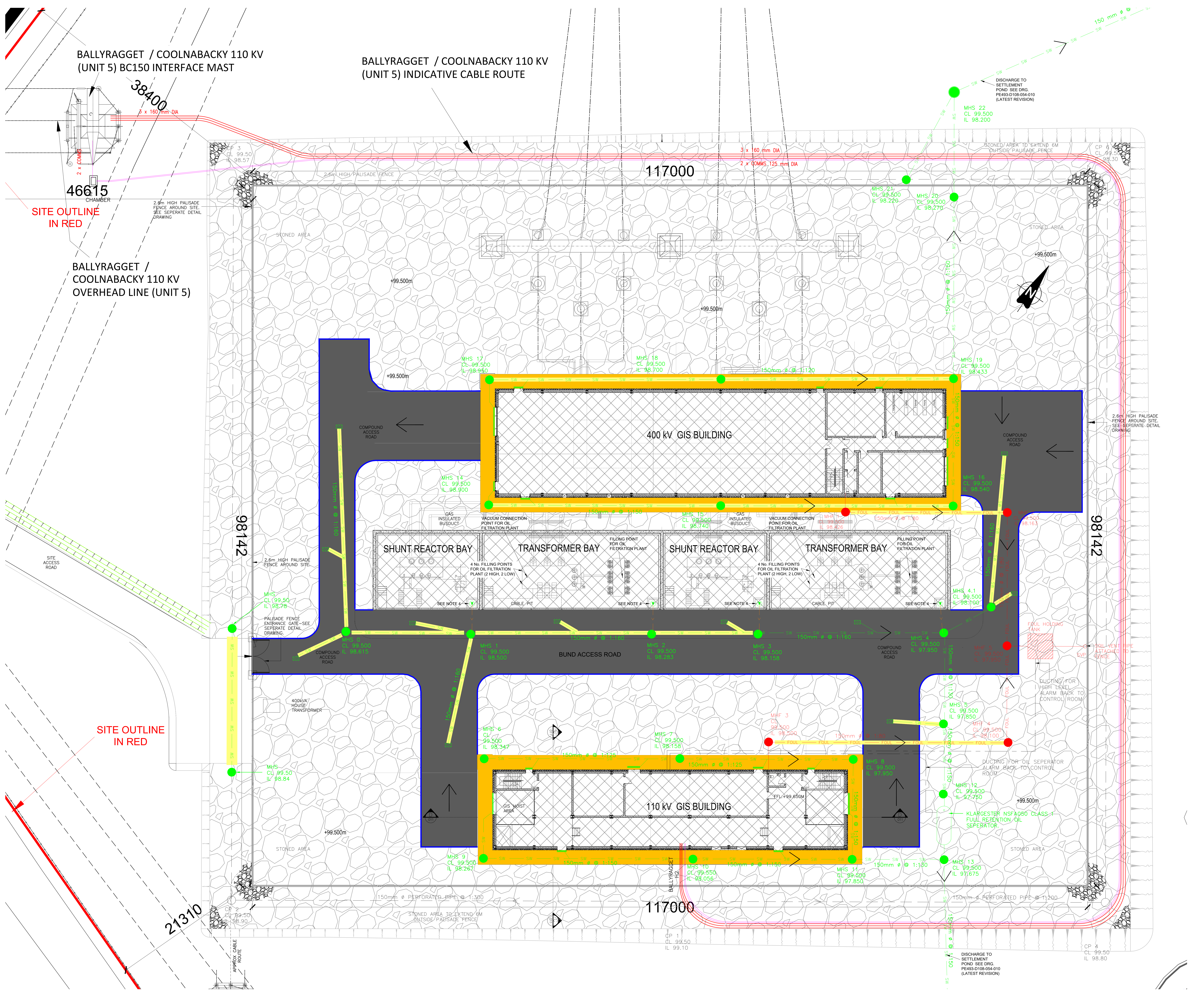


NOTE:

FOR DRAINAGE POND DETAILS REFER TO DRAWING PE493-D108-054-010 (LATEST REVISION)

FOR SITE DRAINAGE LAYOUT REFER TO DRAWING PE493-D108-125-001 (LATEST REVISION)

LEGEND

PROPOSED SURFACE WATER	— SW — SW —
CONCRETE ENCASED SURFACE WATER	— SW — SW —
SURFACE WATER MANHOLE	● SW 1 C.L. = 0.000 I.L. = 0.000
GULLY	▨ GY–A
ACCESS JUNCTION (SURFACE)	◇ AJ
PROPOSED OIL SEPERATOR	○
LAND DRAIN	— — — — —
CATCH PIT	○ CP
PROPOSED FOUL WATER	— FOUL — FOUL —
CONCRETE ENCASED FOUL WATER	— FOUL — FOUL —
FOUL WATER MANHOLE	● FW 1 C.L. = 0.000 I.L. = 0.000
OIL SENSITIVE PUMP	▲
RISING MAIN	— > — > — > — > — > — > —
PROPOSED LEVELS	+ 100.000
FOUL HOLDING TANK	▨
COMMS DUCTS	———
POWER DUCTS	———
SOIL & VENT PIPE	○ SVP
50 mm SINGLE SIZE LIMESTONE AS PER MATERIALS AND WORKMANSHIP SPECIFICATION	▨
BRUSH FINISHED CONCRETE	■
ASPHALT	■
ROAD SIDE KERB	———
INDICATIVE SURFACE FLOW DIRECTION	←

GENERAL NOTES:

1. ALL DRAWINGS TO BE READ IN CONJUNCTION WITH THE SPECIFICATION AND ALL ENGINEER'S AND ARCHITECT'S DRAWINGS. ANY DISCREPANCIES ARE TO BE NOTED IN WRITING TO THIS OFFICE IMMEDIATELY PRIOR TO COMMENCING THE WORK.
2. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE NOTED. NO DIMENSIONS SHALL BE SCALED FROM THE DRAWINGS. ALL DIMENSIONS SHALL BE CHECKED ON SITE.
3. ALL LEVELS TO OSI DATUM MALIN HEAD.
4. BUNDS FITTED WITH AN OIL SENSITIVE BUND DEWATERING SYSTEM WITH A 1 L/S LOW SHEAR VORTEX PUMP WITH OIL SEPARATION DETECTION AND A BUND-INTEGRATED CLASS 1 FULL RETENTION OIL SEPARATOR WITH INDEPENDENT CERTIFICATION OF COMPLIANCE WITH EN 858
5. SEPARATOR DRAINAGE NETWORK HAS BEEN EXTENDED TO ALL INTERNAL COMPOUND ACCESS ROADS TO SATISFY LAOIS COUNTY COUNCIL INDEPENDENT RISK ASSESSMENT PROCESS. THIS IS NON-STANDARD AND UNIQUE TO THE COOLNABACKY SITE.
6. ALL COMPOUND ROADS TO INCLUDE APPROPRIATE CAMBERING TO DIRECT STORMWATER TOWARD ROAD GULLIES. KERBING WILL ADDITIONALLY ENSURE CONTAINMENT OF ALL STORMWATER LANDING ON THESE AREAS.

REV	DATE	REVISION DESCRIPTION	DRN	PROD	VER	VER2	APP
5	05.01.24	EXTEND SW NETWORK, ADD KERBING, REVISE LEGEND COLOUR					
4	14.12.23	AREAS HATCHED	JB	HG	MV	N/A	BM
3	16.11.23	MINOR REVISIONS	JB	JB	SM	N/A	BM
2	10.11.23	UNIT 5 CABLE ADDED	JB	JB	SM	N/A	BM
1	29.08.23	GENERAL REVISIONS	JB	HG	RMcG	N/A	BM
0	31.08.23	ISSUED FOR INFORMATION	JB	HG	RMcG		BM

PURPOSE OF ISSUE - PRELIMINARY UNLESS INDICATED

CLIENT APPROVAL ☐ PLANNING ☐ TENDER ☐ CONSTRUCTION ☐ AS-BUILT ☐

CLIENT
ESB NETWORKS

PROJECT
Coolnabacky 400 kV Station

CONTRACT
CP0585 LAOIS KILKENNY REINFORCEMENT PROJECT

DRAWING TITLE
COOLNABACKY 400 kV STATION
CIVIL

PLANNING COMPOUND DRAINAGE PLAN

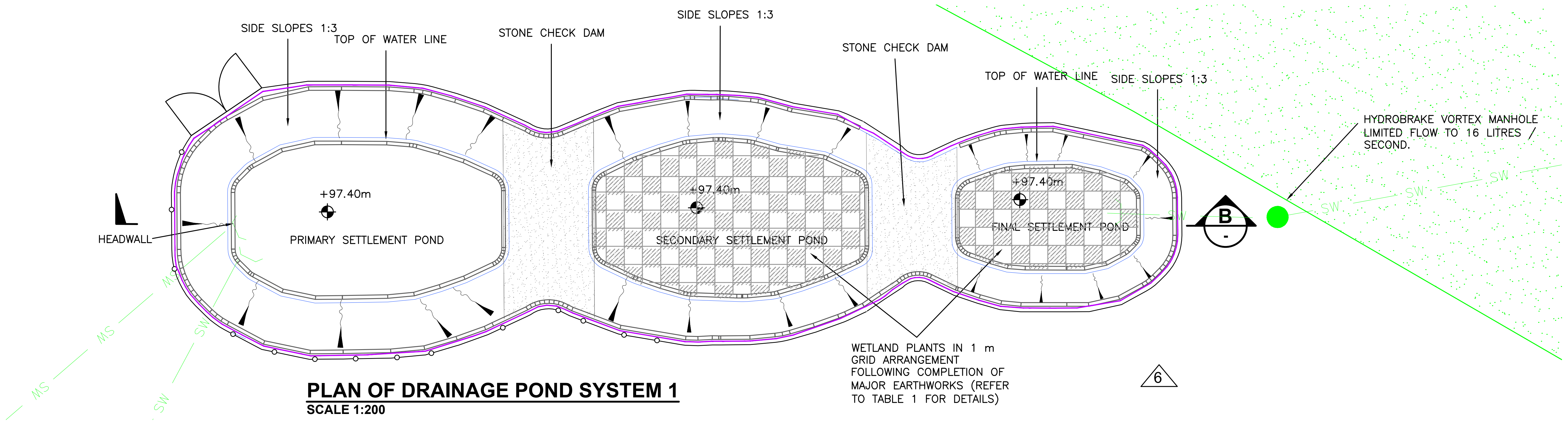
PRODUCTION UNIT
Transmission and Distribution Delivery

Engineering and Major Projects,
One Dublin Airport Central, Dublin Airport,
Cloghran, Co. Dublin, K67 XF72, Ireland.
Tel: +353 (0)1 703 8000 Web: www.esb.ie
Engineering and Major Projects is a division of ESB.

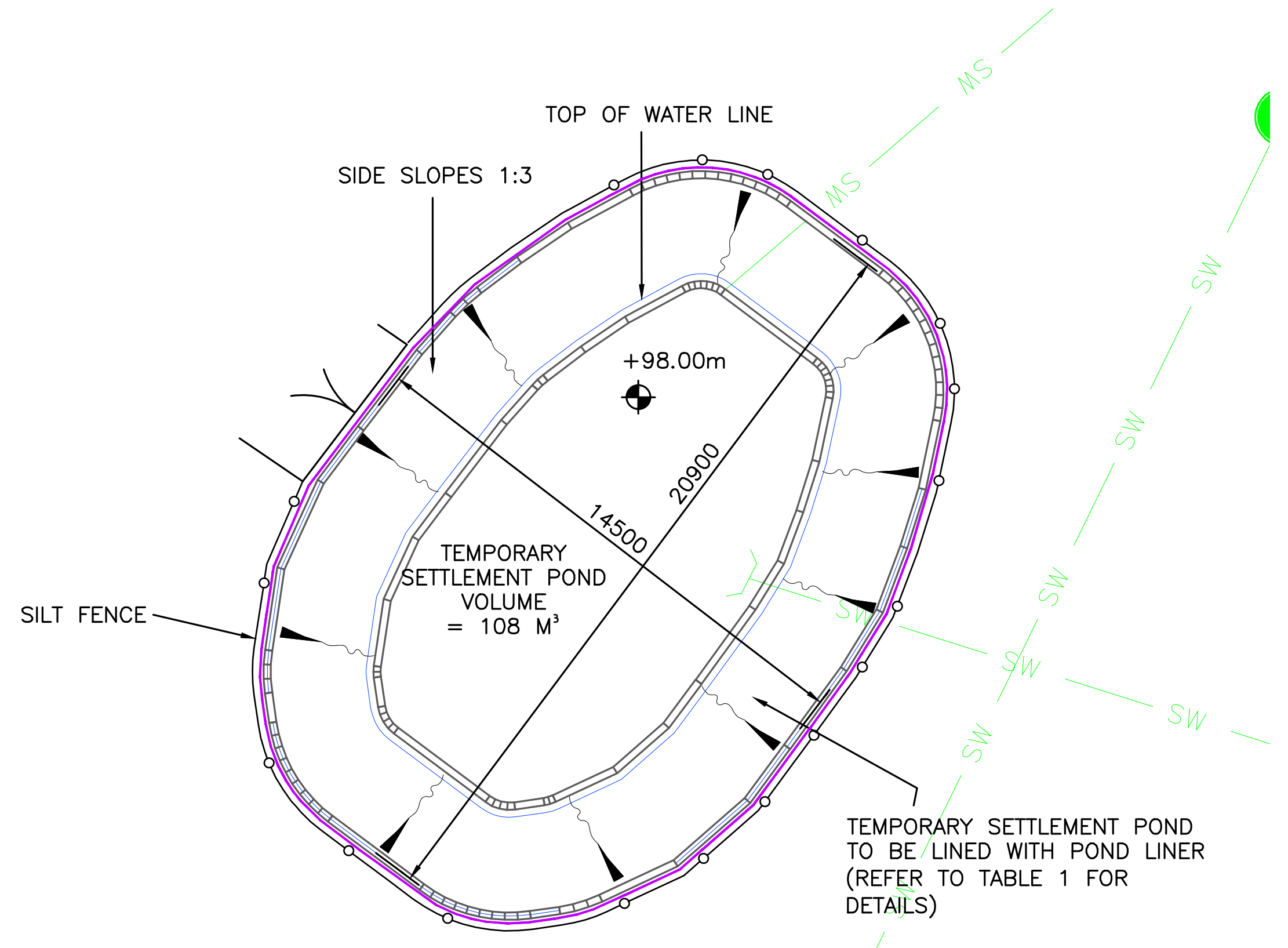
DRAWN	PRODUCED	VERIFIED 1	VERIFIED 2	APPROVED	APPROVAL DATE
J.Byrne	H.Griffin	M.Vaughan		B.Murphy	05/01/2024

CLIENT REF	NO. OF SHTS	SIZE	SCALE
TC229651	1	A0	1:200

DRAWING NUMBER	SHEET	REV
PE493-D108-125-002-005		



PLAN OF DRAINAGE POND SYSTEM 1
SCALE 1:200



PLAN OF DRAINAGE TEMPORARY POND SYSTEM 1
SCALE 1:200

LEGEND	
EXISTING SURFACE WATER	— EXS —
PROPOSED SURFACE WATER	— SW —
CONCRETE ENCASED SURFACE WATER	— SW —
SURFACE WATER MANHOLE	● SW 1 C.L. = 0.000 I.L. = 0.000
LAND DRAIN	—— ——
CATCH PIT	—○— CP
POND/LAKE/SURFACE WATER RETENTION	⬭
POND LINER	——
EXISTING LEVELS	+ 100.000
PROPOSED LEVELS	100.000
TOP OF WATER LEVELS	TOW 100.00
SILT FENCE	▬
BERM AREA	▨
WETLAND PLANTING	▦

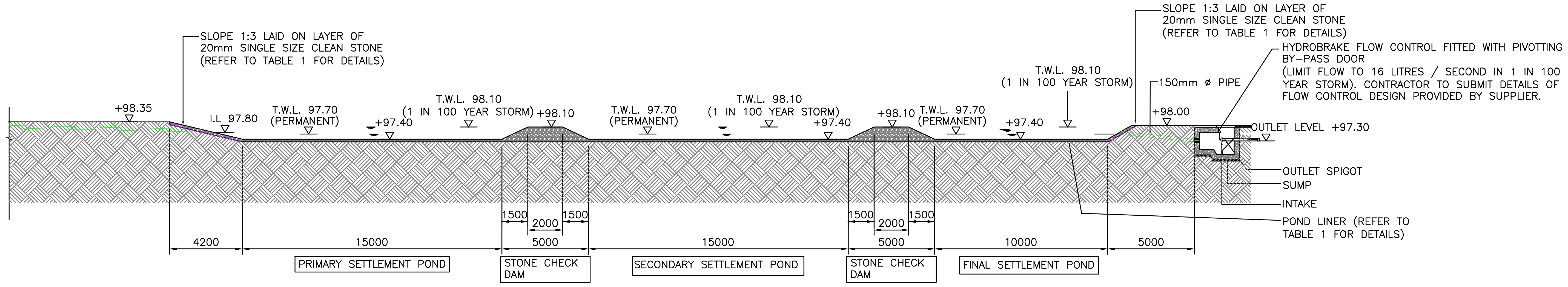
TABLE 1

SEQUENCE OF DRAINAGE POND WORKS TO BE COMPLETED PRIOR TO ANY OTHER EXCAVATION

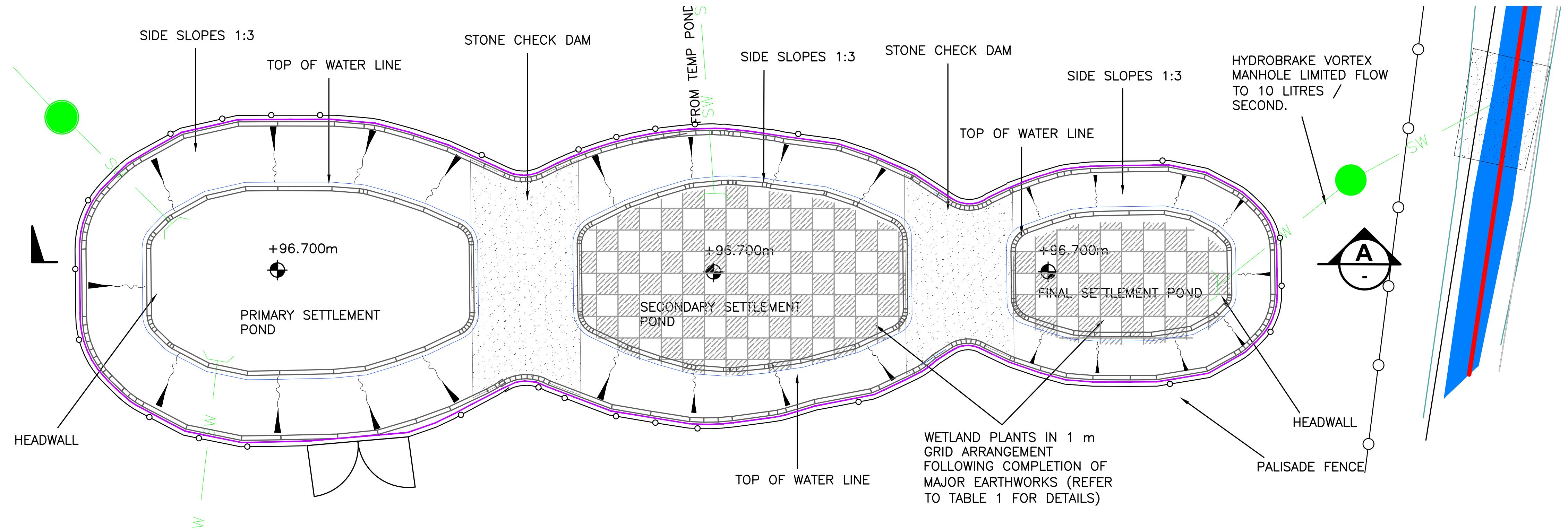
1. EXTENTS OF 3 NO. PONDS SHALL BE EXCAVATED AS ONE DIG. THE SIDES OF THE EXCAVATION SHALL BE MAXIMUM 1:3 SLOPE.
2. 2 MM HDPE IMPERMEABLE LINER WITH WELDED JOINTS WRAPPED IN A GEOTEXTILE FLEECE SHALL BE LAID ACROSS EXCAVATION, WITH A MINIMUM LAP LENGTH OF 300 MM.
3. 50 MM DEEP LAYER OF 20 MM SINGLE SIZED CLEAN STONE SHALL BE PLACED ACROSS BASE OF EXCAVATION.
4. STONE CHECK DAMS SHALL BE CONSTRUCTED WITH 20 MM SINGLE SIZED CLEAN STONE.

FOLLOWING COMPLETION OF MAJOR EARTHWORKS

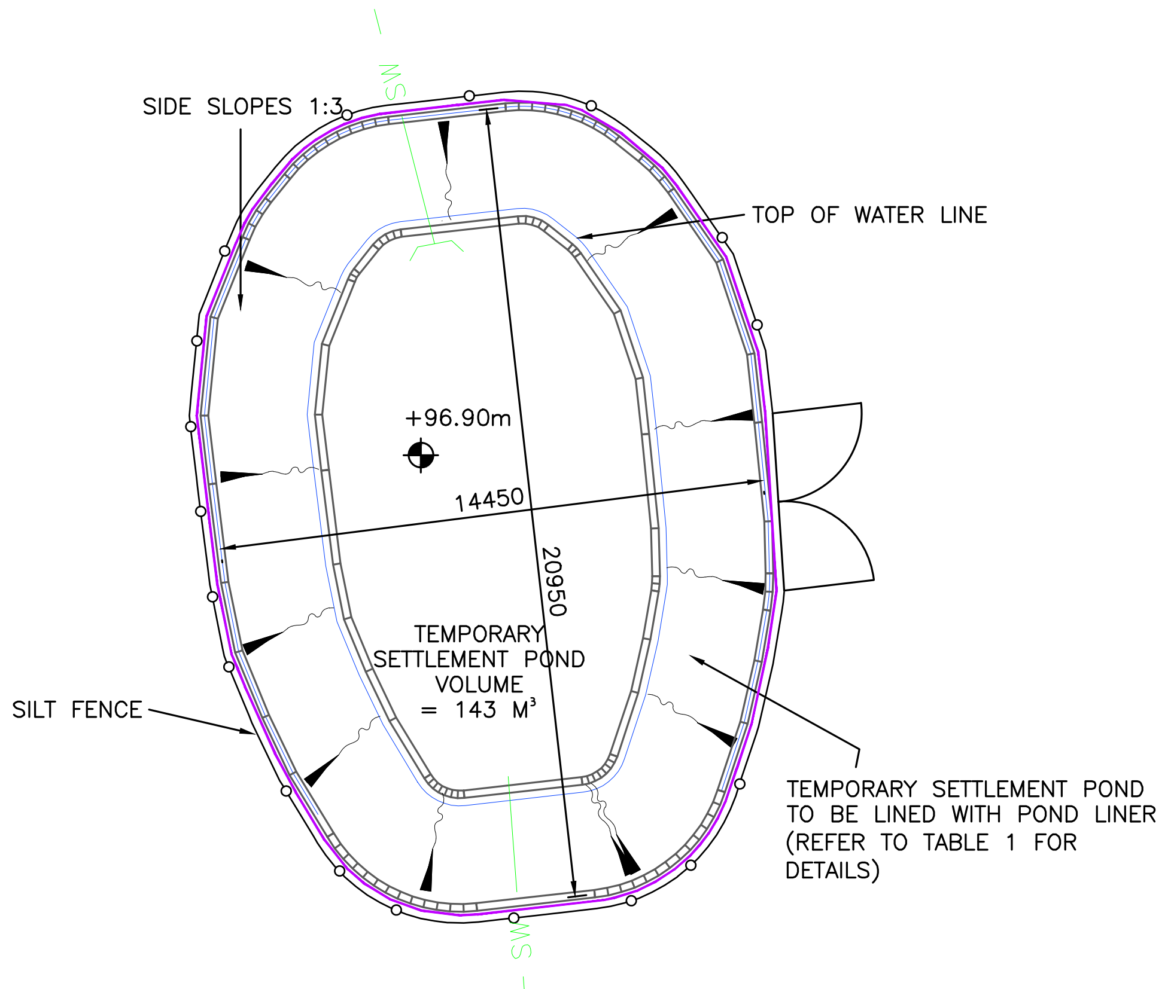
1. POND INLET SHALL BE TEMPORARILY BUNGED AND PONDS DRAINED TO PERMIT POND WORKS. ANY PUMPED WATER TO DISCHARGE VIA A SILT BAG - NO DISCHARGE DIRECT TO WATERCOURSE PERMITTED.
2. SEDIMENT, SILT, STONE CHECK DAMS, STONE BEDDING AND LINER SHALL BE REMOVED AND DISPOSED OF IN A LICENCED WASTE FACILITY.
3. NEW 2 MM HDPE IMPERMEABLE LINER WITH WELDED JOINTS WRAPPED IN A GEOTEXTILE FLEECE SHALL BE LAID ACROSS EXCAVATION, WITH A MINIMUM LAP LENGTH OF 300 MM.
4. NEW 250 MM DEEP LAYER OF 20 MM SINGLE SIZED CLEAN STONE SHALL BE PLACED ACROSS BASE AND SIDES OF THE EXCAVATION.
5. NEW STONE CHECK DAMS SHALL BE CONSTRUCTED WITH 20 MM SINGLE SIZED CLEAN STONE.
6. WETLAND PLANTING TO BE TO BE PLANTED IN 1 M GRID ARRANGEMENT IN SECONDARY SETTLEMENT POND, CONSISTING OF: YELLOW IRIS (40%), RED CANARY GRASS (40%), PURPLE LOOSESTRIFE (10%), MARSH THISTLE (5%) AND WATERMINT (5%), UNLESS OTHERWISE AGREED DURING CONSTRUCTION.
7. WETLAND PLANTING TO BE TO BE PLANTED IN 1 M GRID WETLAND PLANTING TO BE TO BE PLANTED IN 1 M GRID ARRANGEMENT IN FINAL SETTLEMENT POND, CONSISTING OF: GREAT POND SEDGE (40%), BOTTLE SEDGE (30%), MARSH MARIGOLD (10%), COMMON WATER PLAINSTAIN (10%) AND WATER-ME-NOT (10%), UNLESS OTHERWISE AGREED DURING CONSTRUCTION.



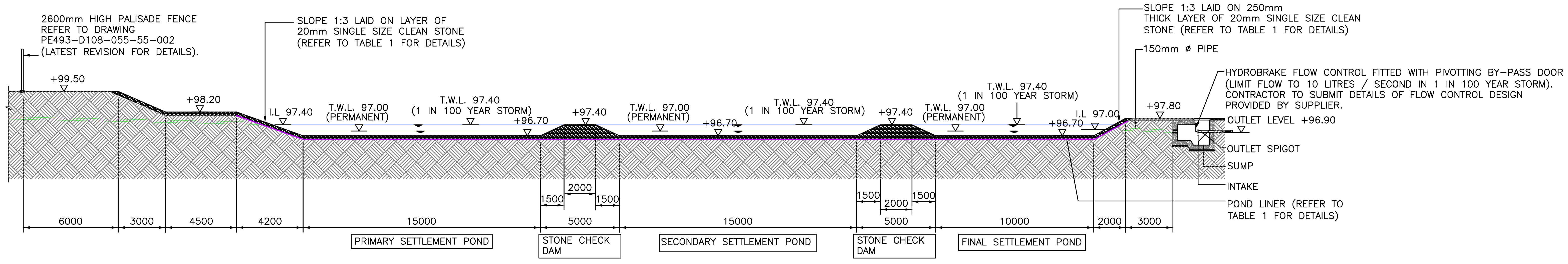
SECTION B
SCALE 1:200



PLAN OF DRAINAGE POND SYSTEM 2
SCALE 1:200



PLAN OF DRAINAGE TEMPORARY POND SYSTEM 2
SCALE 1:200



SECTION A
SCALE 1:200

NOTE:

FOR DRAINAGE LAYOUT AND NOTES REFER TO DRAWING PE493-D108-053-002 (LATEST REVISION)

REV	DATE	REVISION DESCRIPTION	DRN	PROD	VER	APP
7	AUG. '23	NOTES REVISED				
6	APR. '23	DRAINAGE POND SYSTEM 1 MOVED	JB	JB	RMcG	BM
5	FEB. '23	TEMPORARY POND DETAILS ADDED	JB	JB	RMcG	BM
4	FEB. '23	POND DRAINAGE SYSTEM 1 REVISED	JB	JB	RMcG	BM
3	JAN. '23	ISSUED FOR CONSTRUCTION	JB	JB	DOM	BM
2	FEB. '22	ISSUED FOR TENDER	JB	JB	DOM	BM
1	OCT 19	ISSUED FOR TENDER	LK	RC	DW	GH
0	JULY'17	ISSUED FOR CLIENT APPROVAL	LK	LK	DW	DS

PURPOSE OF ISSUE - PRELIMINARY UNLESS INDICATED

CLIENT APPROVAL ☐ PLANNING ☐ TENDER ☐ CONSTRUCTION ☒ AS-BUILT ☐

CLIENT
ESB NETWORKS

PROJECT
Coolnabacky 400 kV Station

CONTRACT

DRAWING TITLE
COOLNABACKY 400 kV STATION
CIVIL
DRAINAGE PONDS DETAILS

PRODUCTION UNIT
Civil & Environmental Engineering

Energy for generations

Engineering and Major Projects,
One Dublin Airport Central, Dublin Airport,
Cloghran, Co. Dublin, K67 XF72, Ireland.
Tel: +353 (0)1 703 8000 Web: www.esb.ie
Engineering and Major Projects is a division of ESB.

DRAWN	PRODUCED	VERIFIED	APPROVED	APPROVAL DATE
J.Byrne	H.Griffin	R. McGowan	B.Murphy	29/08/2023

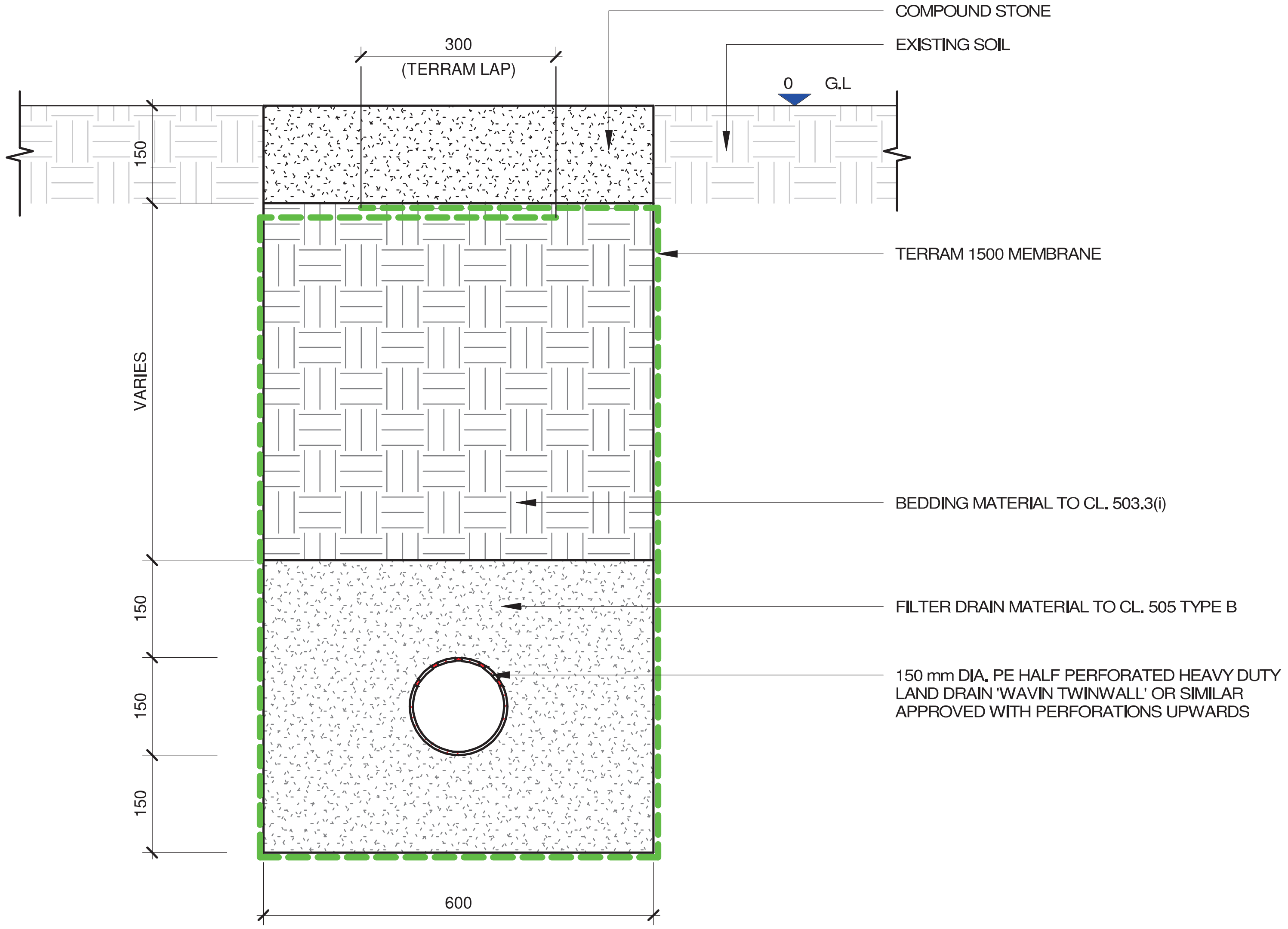
CLIENT REF	NO. OF SHTS	SIZE	SCALE
TC218248	1	A1	1:25

DRAWING NUMBER | SHEET | REV
PE493-D108-054-010-007

NOTE:

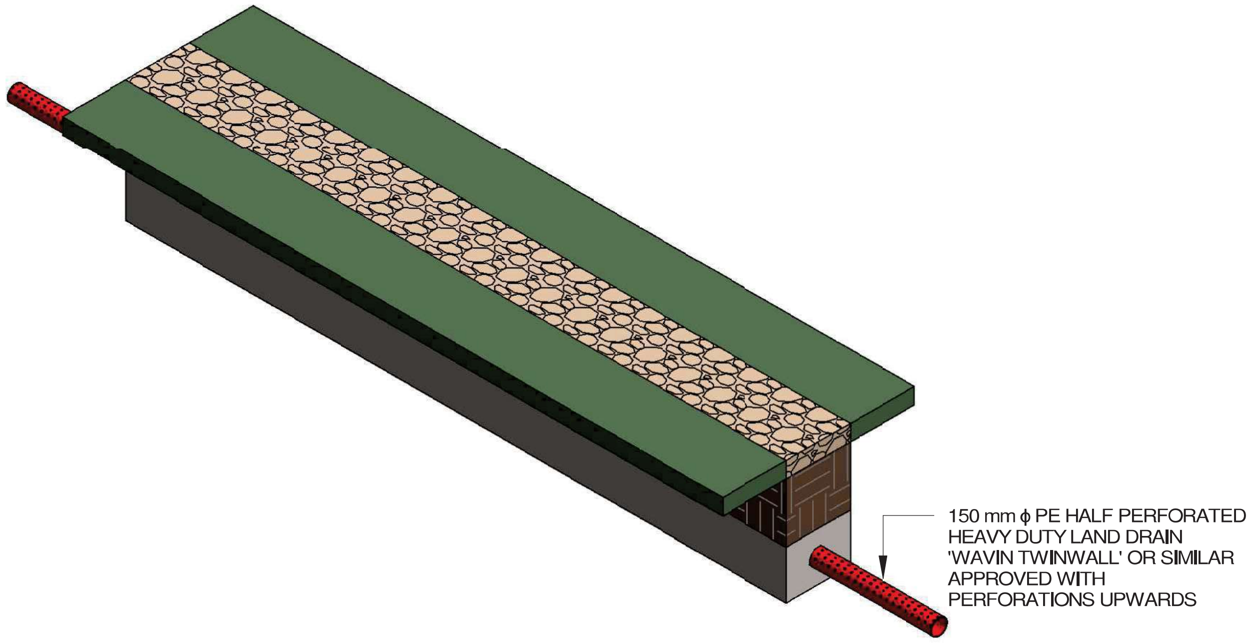
1. FOR DRAINAGE LAYOUT AND NOTES, REFER TO DRAWING PE493-D108-053-002-(LATEST REVISION) AND PE493-D108-053-003-(LATEST REVISION)
2. A RISK ASSESSMENT, CARRIED OUT BY AN APPROPRIATELY QUALIFIED ENGINEER, IS TO BE CARRIED OUT ON EACH EXCAVATION PRIOR TO ANY CIVIL WORKS COMMENCING.
3. MATERIAL SPECIFICATION IN ACCORDANCE WITH TII SPECIFICATION FOR ROAD WORKS.

<u>ACRONYMS</u>
G.L = GROUND LEVEL



TYPICAL SECTION THROUGH LAND DRAIN

SCALE: 1 : 10



ISOMETRIC VIEW

REV.	DATE	REVISION DESCRIPTION	Dm	Prod	Ver1	Ver2	App
3	JAN. '23	ISSUED FOR CONSTRUCTION					
2	FEB. '22	ISSUED FOR TENDER	JB	JB	DOM	N/A	BM
1	OCT 19	ISSUED FOR TENDER	RC	RC	DW	N/A	GH
0	04/08/17	ISSUED FORTENDER	LK	LK	DC	N/A	DW

Purpose of Issue - Preliminary unless indicated

Client Approval ☐ Planning ☐ Tender ☐ Construction [x] As-Built ☐

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Energy for generations

Client
ESB NETWORKS

Project
COOLNABACKY 400 kV STATION

Contract
CP0585 LAOIS KILKENNY REINFORCEMENT PROJECT

Drawing Title
COOLNABACKY 400 kV STATION
CIVIL
LAND DRAIN

Production Unit
Civil & Environmental Engineering

DRAWN	PRODUCED	VERIFIED 1	VERIFIED 2	APPROVED	APPD DATE
J.Byrne	J.Byrne	R.McGowan	N/A	B.Murphy	JAN. 2023

Client Ref	No. of Sheets	Size	Scale
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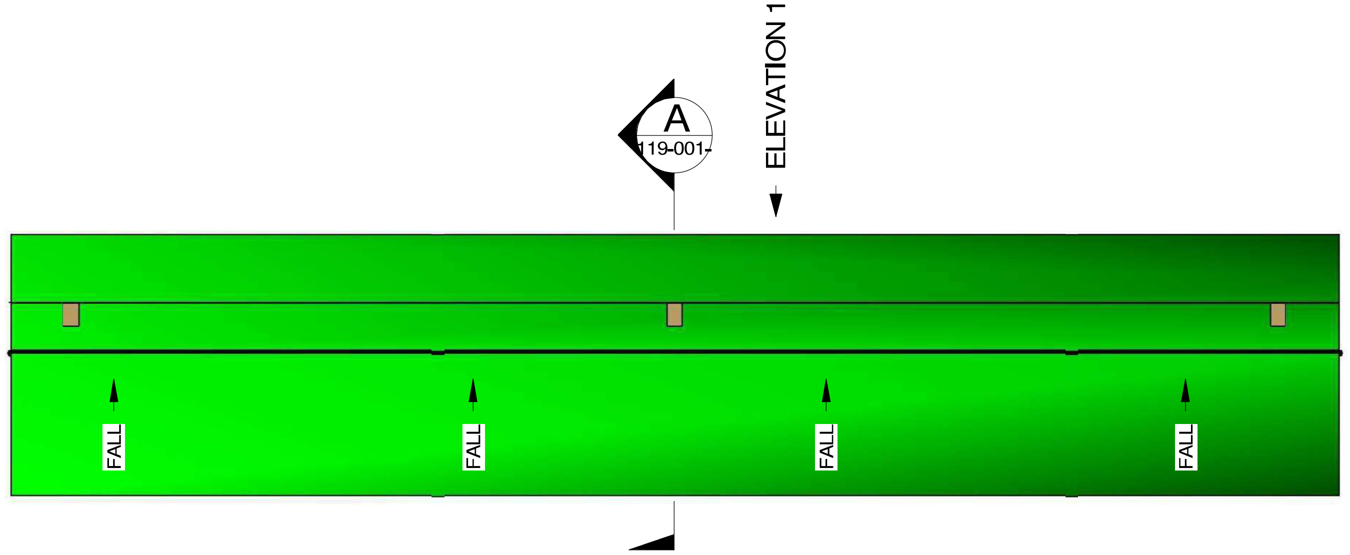
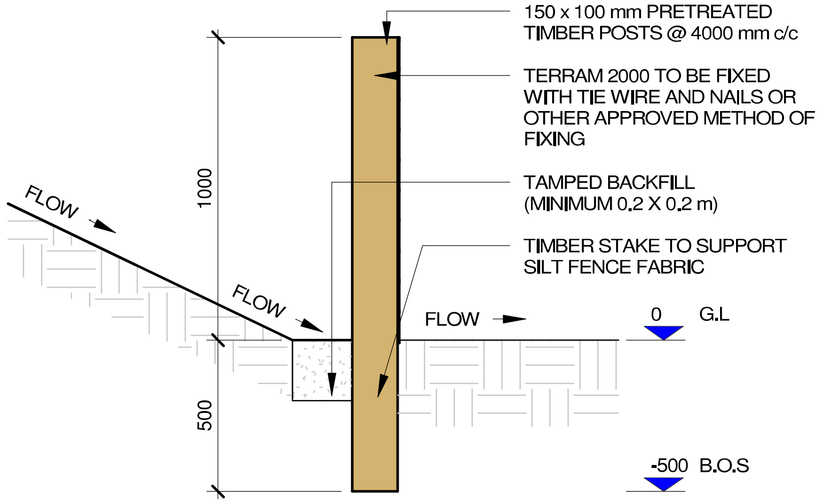
Drawing Number: PE493-D108-054-012-003 (Sheet: 012, Rev: 003)



PLAN - SILT FENCE

SCALE: 1 : 50



SECTION A-A

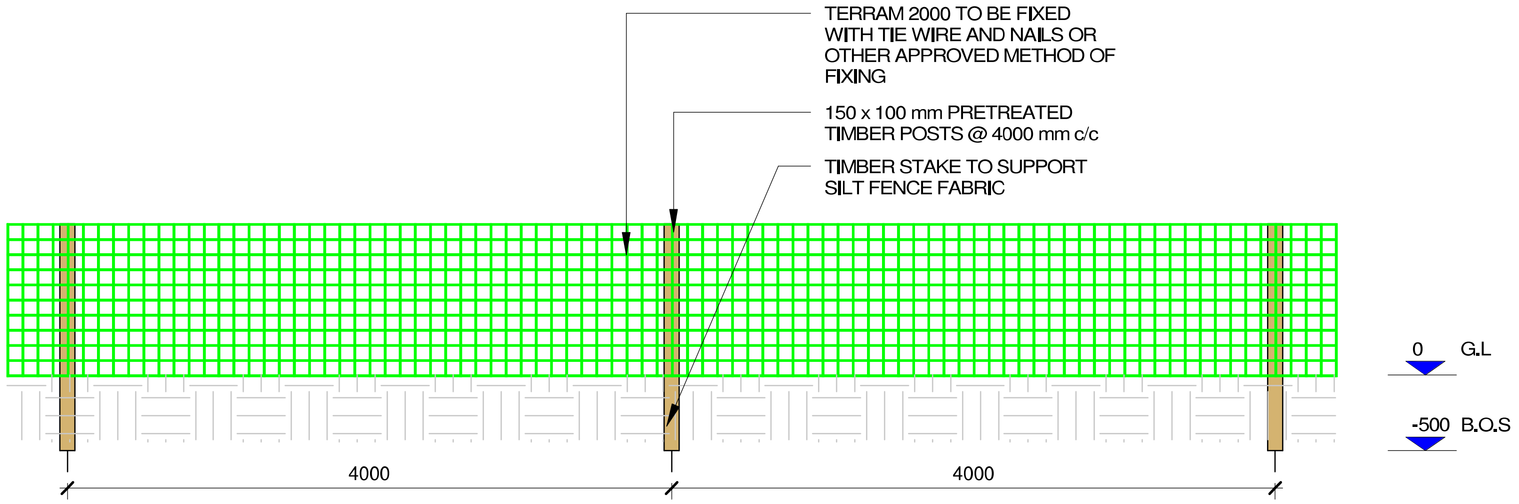
SCALE: 1 : 25

NOTE:

1. CHECK DAMS TO BE INSTALLED USING HAND TOOLS ONLY TO AVOID GROUND DISTURBANCE BY MACHINERY.
2. CHECK DAMS TO BE INSPECTED AT LEAST DAILY (MORE FREQUENTLY DURING RAINFALL PERIODS) AND BUILD UP OF SILT TO BE REMOVED BY HAND AND DISPOSED OF APPROPRIATELY.
3. REFER TO DRAWING PG406-D100-001-002 (LATEST REVISION) FOR GENERAL CONSTRUCTION NOTES.
4. A RISK ASSESSMENT, CARRIED OUT BY AN APPROPRIATELY QUALIFIED ENGINEER, IS TO BE CARRIED OUT ON EACH EXCAVATION PRIOR TO ANY CIVIL WORKS COMMENCING.

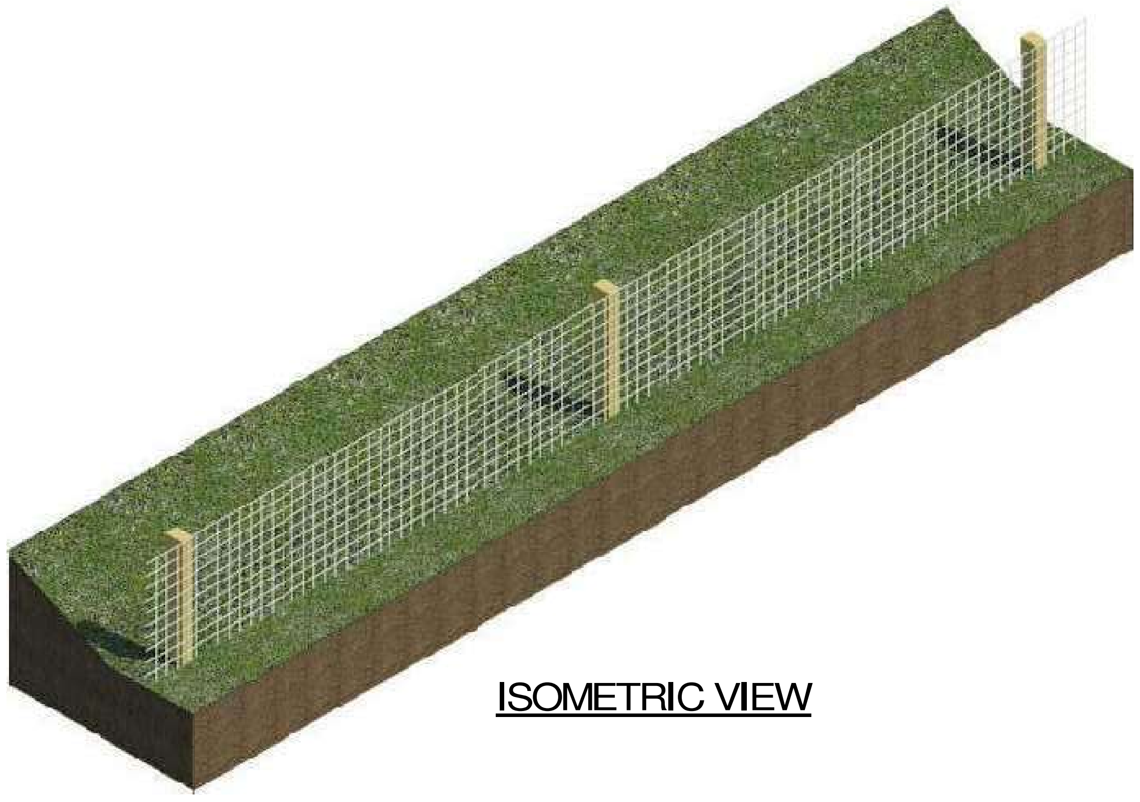
ACRONYMS

G.L	=	GROUND LEVEL
B.O.S	=	BOTTOM OF TIMBER STAKE



ELEVATION 1

SCALE: 1 : 50



ISOMETRIC VIEW

REV.	DATE	REVISION DESCRIPTION	Dm	Prod	Ver1	Ver2	App
0	FEB. '23	ISSUED FOR CONSTRUCTION					

Purpose of Issue - Preliminary unless indicated

Client Approval ☐ Planning ☐ Tender ☐ Construction ☒ As-Built ☐

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Dublin Airport, Cloghran,
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Energy for generations

Client
ESB NETWORKS

Project
GENERAL CIVIL DRAWINGS & NOTES

Contract

Drawing Title
COOLNABACKY 400 kV SUBSTATION
CIVIL
SILT FENCE DETAIL

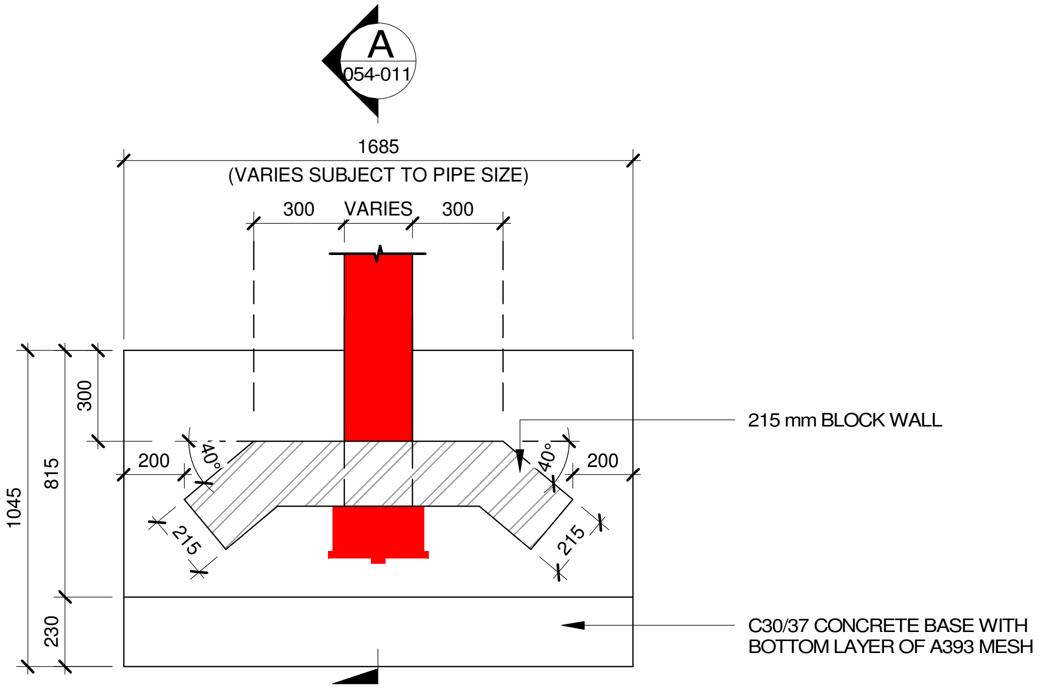
Production Unit
Transmission and Distribution Delivery

DRAWN	PRODUCED	VERIFIED 1	VERIFIED 2	APPROVED	APPD DATE
J.Byrne	J.Byrne	R.McGowan	N/A	B.Murphy	Feb. 2023

Client Ref	No. of Sheets	Size	Scale
	1	A3	As indicated

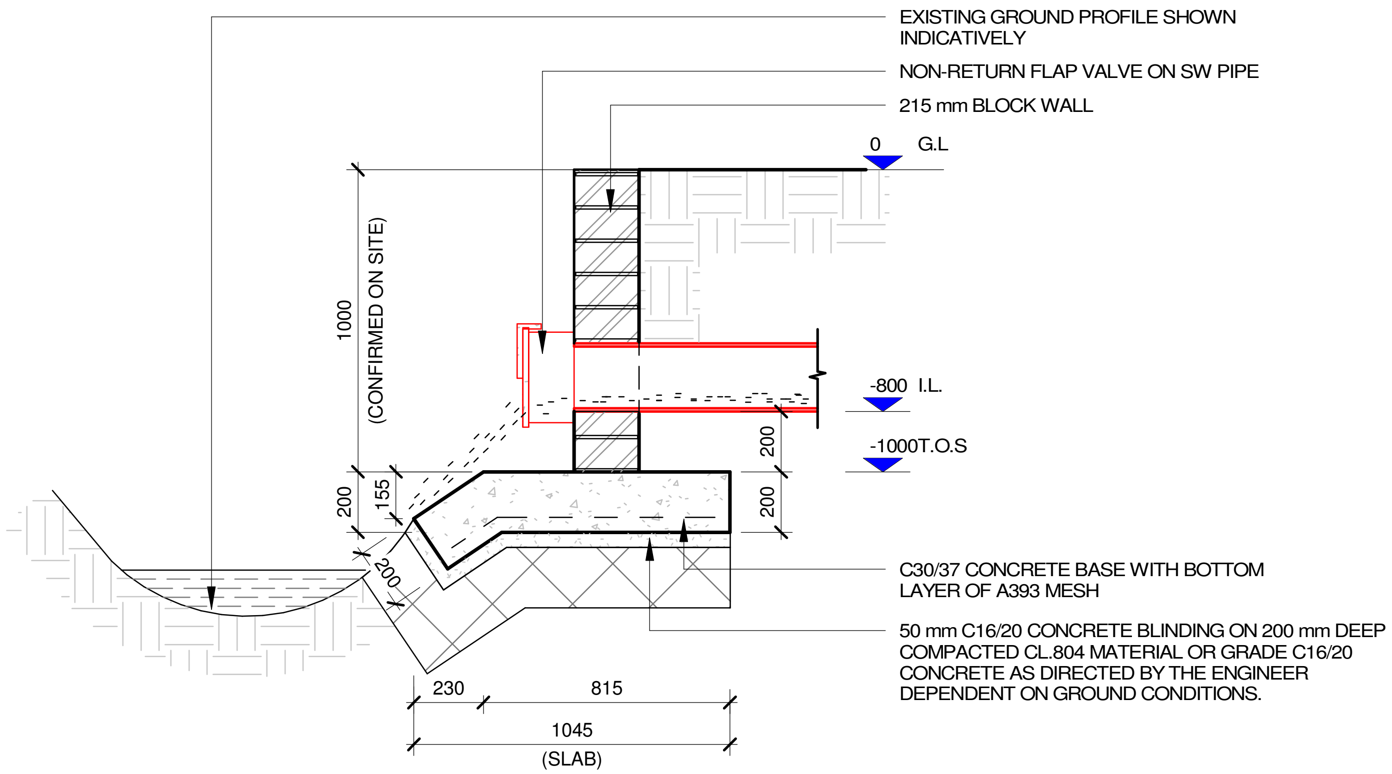
Drawing Number
PE493-D108-119-001-000
Sheet
Rev

A:\01 Projects\PE493-220 kV Substations\108 - Coolnabacky 400kV Station\Revit Standard Details\PE493-D108-119-001-000 SILT FENCE DETAILS.rvt



PLAN - TYPICAL HEADWALL DETAIL

SCALE: 1 : 25



SECTION A

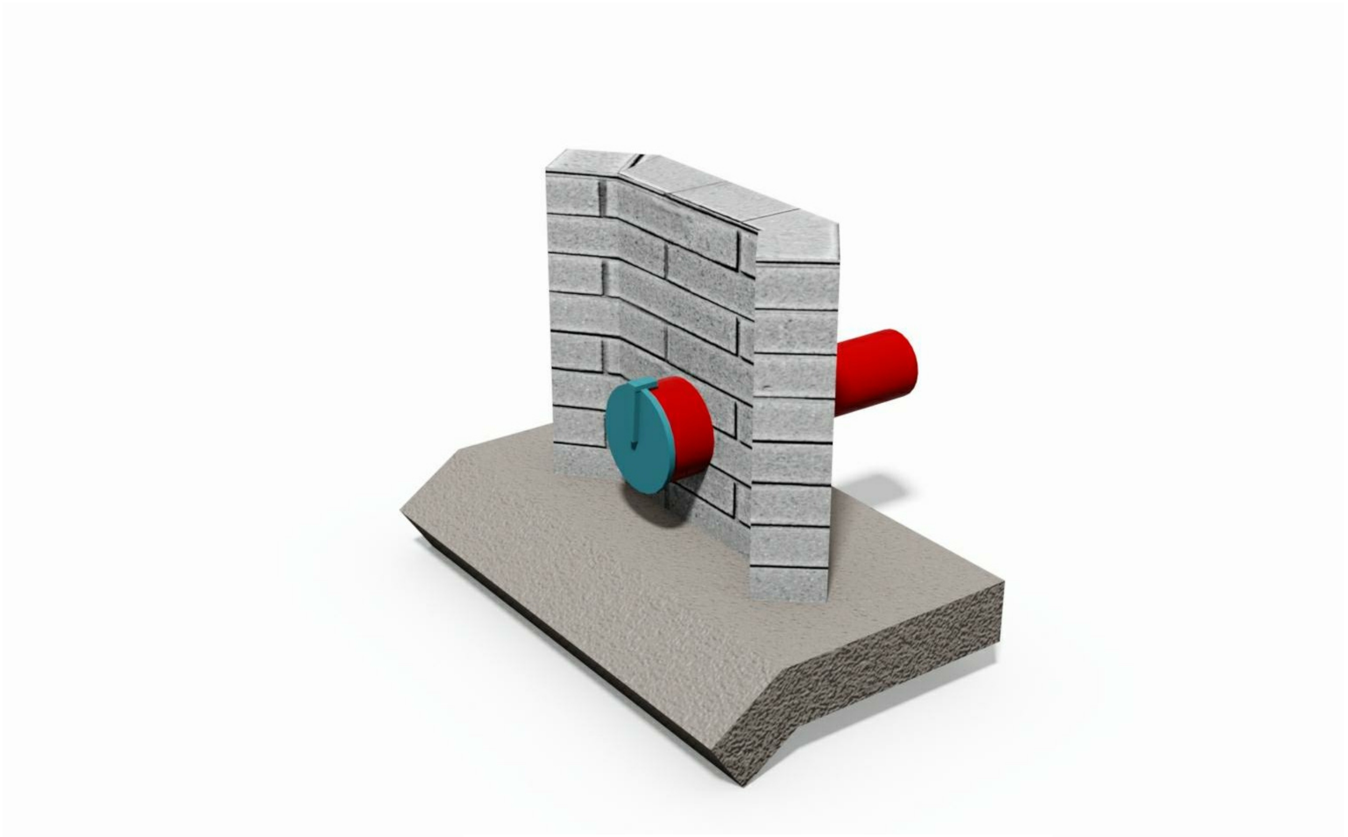
SCALE: 1 : 25

NOTE:

1. FOR DRAINAGE LAYOUT AND NOTES, REFER TO DRAWING PE493-D108-053-002-(LATEST REVISION) AND PE493-D108-053-003-(LATEST REVISION)
2. PRIOR TO CONSTRUCTION, CONTRACTOR TO INFORM ESB INTERNATIONAL IF TOPOGRAPHICAL SURVEY DATA OF ADJACENT STREAM INDICATES THAT IT MAY AFFECT THE FEASABILITY OF PROPOSED DESIGN
3. A RISK ASSESSMENT, CARRIED OUT BY AN APPROPRIATELY QUALIFIED ENGINEER, IS TO BE CARRIED OUT ON EACH EXCAVATION PRIOR TO ANY CIVIL WORKS COMMENCING.
4. MATERIAL SPECIFICATION IN ACCORDANCE WITH TII SPECIFICATION FOR ROAD WORKS.

ACRONYMS

G.L = GROUND LEVEL
T.O.S = TOP OF SLAB
I.L = INVERT LEVEL



RETAINING HEADWALL 3D VIEW

REV.	DATE	REVISION DESCRIPTION	Dm	Prod	Ver1	Ver2	App
3	JAN. '23	ISSUED FOR CONSTRUCTION					
2	FEB. '22	ISSUED FOR TENDER	JB	JB	DOM	N/A	BM
1	OCT 19	ISSUED FOR TENDER	RC	RC	DW	N/A	GH
0	04/08/17	ISSUED FOR TENDER	LK	LK	DC	N/A	DW

Purpose of Issue - Preliminary unless indicated

Client Approval ☐ Planning ☐ Tender ☐ Construction ☒ As-Built ☐

**Engineering and Major Projects,
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Energy for generations

Client
ESB NETWORKS

Project
COOLNABACKY 400 kV STATION

Contract
CP0585 LAOIS KILKENNY REINFORCEMENT PROJECT

Drawing Title
**COOLNABACKY 400 kV STATION
CIVIL
HEADWALL DETAIL**

Production Unit
Civil & Environmental Engineering

DRAWN	PRODUCED	VERIFIED 1	VERIFIED 2	APPROVED	APPD DATE
J.Byrne	J.Byrne	R.McGowan	N/A	B.Murphy	JAN. 2023

Client Ref	No. of Sheets	Size	Scale
TC218031		A3	**As indicated**

Drawing Number Sheet Rev
PE493-D108-054-011-003

A:\01 Projects\PE493-220 kV Substations\108 - Coolnabacky 400kV Station\Revit Standard Details\PE493-D108-054-011-003 HEADWALL DETAIL.rvt

Phase (Planning Permission)	Parts	Project Phase	Activities/Tasks	Construction Sub Phase/ Stage		Contractor	CEMP Section Reference
Prior to Commencement of Development		Pre Commencement	Discharge of Pre-Commencement Conditions and delivery of previous commitments.	Pre Civil Construction: Ecology walkover suverys, basesline surface water & groundwater monitoring, noise, dust & vibration			
Construction of Unit 1 Development at Coolnabacky	**Part 1**	Pre Civil Construction	Borehole Decommissioning & Installation.	Modification and installation of boreholes to accommodate groundwater monitoring programme as required.		IE Consulting	Section 3
				EARTHMOVING PLAN	**CONSTRUCTION**		
		Main Civil Construction **Phase 1**	Enabling works & site Establishment, Drainage & Surface Water Management, Main Construction of 110 kV Building	**Stage 1: Site Preparation** - Mobilise to site - Fencing & Security of Site - Ecological Buffer Zone - Overhead Cable Avoidance - Fencing & Protection of Boreholes		Kilwex Construction	Section 4.1
				Stage 2: Site Establishment - Site Acccess Route & hardstanding - Site Compound and Laydown Area - Permanent Berm Drainage (land drain & catchpits)			
				Stage 3: Excavate Ponds and associated Drainage - Excavate & Install Drainage connections between berm and ponds - Move spoil to berm - Excavate Ponds to formation level - remove spoil to berm area			
				Stage 4: Construct Drainage Ponds & Associated Infrastucture - Excavations for remaining drainage works - Install hydro brake, manhole at pond outlets, stone apron at stream - Install impermeable HDPE liner, Geotextile fleece & stone			
				Stage 5: **110 kV Building Footprint Excavation Works** - Strip topsoil and install stone on haul route - All excavated spoil to be moved to berm - Excavate to formation 110 kV building footprint and install stone - Dewatering Procedure to be applied			
				Stage 6: **Remainder of Civils & Excavation Works** - Excavate and install drainage - Excavate trenches and install cable ducting - Excavate & Install tanks, oil separator etc - Dewatering Procedure to be applied	**110 kV Building Construction:** - Pour Foundations - Structural Steel Frame -Composite Cladding -First Floor -Internal Finishes, Building Services		
		Main Civil Construction **Phase 2**	Construction of 400 kV Building and Transformer bunds within site compound.	**400kV Excavations** - Excavate Building Footprint (Refer to Earthmoving Plan Stage 6) - 400 kV Cable Ducts Excavation - Excavate 400 kV Transformer Bund Footprint (Refer to Earthmoving Plan (Stage 6) - Dewatering Procedure to be applied	**400kV Foundation & Ducting** - Pour Foundations - 400 kV Cable Ducts Installation - Pour Transformer Bund Foundations	Kilwex Construction	Section 4.2
					400 kV Building Construction: -Structural Steel Frame -Composite Cladding -First Floor -Internal Finishes, Building Services		
					400 kV Transformer Bund: - Bund Walls - Bund Testing - Blast Walls installation - Blockwork Sumps & Covers, Drainage stone		
					Landscaping - Berm Planting with native Irish trees - Wetland Planting in ponds - Revegetation planting - Landscape in accordance with permitted design		
	Part 2	Electrical Installation **Phase 1**	Installation of 110 kV Switchgear in completed 110 kV Building	(indicative) **Stage 1:** Install Switchgear & Testing **Stage 2:** Commission Switchgear, Underground Cable installation & Terminations **Stage 3:** Energise 110 kV Substation		To be Awarded	
		Electrical Installation **Phase 2**	Installation of 400 kV Switchgear in completed 400 kV Building.	(indicative) **Stage 1:** Install Switchgear & Testing **Stage 2:** Commission Switchgear, Underground Cable installation & terminations **Stage 3:** Energise 400 kV Substation		To be Awarded	
		Transformer Delivery & Installation	Delivery and installation of 400 kV Transformers	(indicative) Stage 1:Delivery & Offload Stage 2: Assemble & Fill Stage 3: Commission Stage 4: Energisation of 400 kV Transformer		To be Awarded	
Operation of Unit 1 Coolnabacky Substation		Interfacing & Tying in of Other Units on Laois Kilkenny Project. (Construction phases of Units 2 & 8 to overlap with unit 1)	Overhead Line Diversions from Athy Portlaoise 110 kV OHL (Unit 8)			To be Awarded	
			Overhead Line Diversions from Dunstown Moneypoint 400 kV (Unit 2)			To be Awarded	
		Substation Operation & Maintenance				ESB Networks	N/A

Coolnabacky Unit 1- Indicative Development Programme

ID	Task Name	Duration	Start - Month	Finish - Month
1	**Coolnabacky - Stages of Development**	**29 mons?**	**Month 1**	**Month 29**
2	Unit 1: Borehole Decommissioning & Installation	1 mon	Month 1	Month 2
3	**Civil Construction *Outline Programme- timing and durations subject to change during construction.**	**19 mons**	**Month 1**	**Month 17**
4	**Main Civil Construction Phase 1**	**12 mons**	**Month 1**	**Month 7**
5	Earthmoving Stage 1: Site Preparation	1 mon	Month 1	Month 1
6	Earthmoving Stage 2: Site Establishment	2 mons	Month 1	Month 2
7	Earthmoving Stage 3: Excavate Ponds and Associated Drainage	2 mons	Month 2	Month 5
8	Earthmoving Stage 4: Construct Drainage ponds & Associated Infrastructure	3 mons	Month 3	Month 6
9	Earthmoving Stage 5: 110 kV Building Footprint Excavation Works	2 mons	Month 5	Month 7
10	Earthmoving Stage 6: Remainder of Civils & Excavation works	5 mons	Month 7	Month 11
11	110kV Building Construction	6 mons	Month 7	Month 12
12	**Main Civil Construction Phase 2**	**10 mons**	**Month 8**	**Month 18**
13	400 kV Excavations	2 mons	Month 8	Month 10
14	400kV Foundation and Ducting	2 mons	Month 10	Month 12
15	400 kV Building Construction	8 mons	Month 11	Month 18
16	400 kV Transformer Bund	10 mons	Month 8	Month 18
17	Landscaping	2 mons	Month 17	Month 18
18	**Electrical Construction *Programme Subject to Contract award**	**18 mons**	**Month 11**	**Month 29**
19	**Electrical Construction Phase 1**	**12 mons**	**Month 11**	**Month 23**
20	Stage 1: Install 110kV Switchgear & Testing	9 mons	Month 11	Month 20
21	Stage 2: Commission 110kV Switchgear, Install Underground Cables & Terminations	3 mons	Month 20	Month 23
22	Stage 3: Energise 110 kV Substation	0 mons	Month 23	Month 23
23	**Electrical Construction Phase 2**	**12 mons**	**Month 17**	**Month 29**
24	Stage 1: Install 400kV Switchgear & Testing	9 mons	Month 17	Month 25
25	Stage 2: Commission 400kV Switchgear, Install Underground Cables & Terminations	3 mons	Month 25	Month 28
26	Stage 3: Energise 400 kV Substation	0 mons	Month 28	Month 28
27	**Transformer Delivery & Installation *Programme Subject to Contract award**	**4 mons**	**Month 25**	**Month 29**
28	Stage 1:Delivery & Offload	1 mon	Month 25	Month 26
29	Stage 2: Assemble & Fill	2.5 mons	Month 25	Month 28
30	Stage 3: Commission	1 mon	Month 28	Month 29
31	Stage 4: Energisation of 400 kV Transformer	0 mons	Month 29	Month 29
32	**Operation of Unit 1 Coolnabacky Substation**	**13.05 mons?**	**Month 17**	**Month 28**
33	Interfacing & Tying in of Other Units on Laois Kilkenny Project. (Construction phases of Units 2 & 8 to overlap with Unit 1)	3 mons	Month 17	Month 20
34	Overhead Line Diversions from Dunstown Moneypoint 400 kV (Unit 2)	3 mons	Month 25	Month 28
35	Substation Operation & Maintenance		Month 23	End of Life

Summary and Risk Impact Assessment of Historic Ground Investigations

Coolnabacky, Timahoe, Co. Laois

September 2023

IE CONSULTING
WATER-ENVIRONMENTAL-CIVIL

Summary and Risk Impact Assessment of Historic Ground Investigations

Client: ESB Engineering and Major Projects (EMP)

Location: Coolnabacky, Timahoe, Co. Laois

Date:11th September 2023

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Document Control

PROJECT NUMBER: IE2219		DOCUMENT REF: IE2219_Report_5906			
1.3	Issue	JM	JK		11-9-23
1.2	Issue	JM	JK		5-9-23
1.0	DRAFT-01	JM	JK		31-08-2023
Revision	Purpose Description	Originated	Checked	Reviewed	Date

Contents

Figures

Tables

Appendices

1. Review of Historic Investigations

1.1. Introduction

IE Consulting were engaged by ESB Engineering and Major Projects (EMP), on behalf of ESB Networks to support a response to Laois County Council (Discharge of Planning Condition 11 for Laois Kilkenny Electricity Reinforcement Project – ABP Reg. Ref. VA0015 – Unit 1) in relation to hydrogeological information detailed in the Construction and Environmental Management Plan (CEMP), issued on 3rd Jul 2023.

1.2. List of Relevant Documentation

Table 1 details the documentation associated with the historic site investigations completed at Coolnabacky. These will be referenced throughout this report.

Document Ref	Document Name	Issued Date	Details
Y2012-12A	Factual Report on Ground Investigation	Jul 2012	Ground Investigation competed by Soil Mechanics as detailed in Table 2
DB/09/ 4848HR02	Site Investigation and Hydrogeological Assessment, Proposed Coolnabacky 400 / 100 kV GIS Substation, Co. Laois	Jul 2013	Appendix 10.1 to EIA for Laois County Council completed by AWN Consulting Ltd.
10310-01	Report to assess the impact of the unauthorized development on the Aquifer at Coolnabacky Construction site	Sep 2017	Hydrological/Hydrogeological study completed by Tobin Consulting Engineers in response to Enforcement notice dated 31st July 2017
17-0439	Coolnabacky 400kV GIS Substation	Jul 2018	Ground Investigation competed by Causeway Geotech as detailed in Table 2
IE2019-4840	Hydrogeological and Hydrological Review	Feb 2021	Assessment completed by IE Consulting
Addendum to IE2019-4840	Hydrogeological and Hydrological Review	26 Feb 2021	Letter issued to Seamus Boland (CEO, Irish Rural Link) for clarification of impact of proposed enabling works on recommendations of IE independent Hydrogeological and Hydrological review for

Document Ref	Document Name	Issued Date	Details
			proposed Coolnabacky substation site
ie2219-5242	Assessment of Tufa Springs	Mar 2022	Assessment of Tufa Springs adjacent to the proposed ESB substation including the details of boreholes installed by Priority Drilling in 2021 as detailed in Table 2
IE2219-5370	Proposed Water Monitoring Programme	Jun 2022	Context, locations, parameters measured in-situ, analysis, frequency and reporting of monitoring programme
DE2188-RO1a	Petrifying Spring Survey and Assessment Coolnabacky, Co. Laois	Dec 2022	Report produced by Denyer Ecology to detailing mapped petrifying springs at Coolnabacky
ie2219-5766	Proposal to Decommission 2 No. Boreholes (BH04 & BH05) and installation of 1 No. replacement borehole (BH04b)	17 May 2023	decommissioning/installation works and associated RAMs

Table 1 – Documentation associated with hydrogeological assessments and site investigations

1.3. List of Historic Investigations

A history of Borehole and Trial pits installed on the site are summarised in Table 2. There are currently 5 No. existing boreholes on the site referred to as; BH01, BH02, BH03, BH04 and BH05. Two boreholes currently labelled BH04 and BH05 were legacy boreholes installed during the 2018 works detailed in the Causeway Geotech Report (No.: 17-0439). BH01 to BH03 were installed in 2021 (installed by Priority Geotech in 2021, as documented in the IE Consulting in report *Assessment of Tufa Springs* – Report No.: ie2219-5242). Table 2 provides a list of all the installed boreholes and trial pit investigations on the site to date with the aim of providing a chronological history of exploratory works at the site.

Generally it can be summarised that the site underwent three campaigns of site investigations including the following:

1. Soil Mechanics (2012) – 10 No. borehole and 15 No. trial pits were installed and decommissioned. These works are documented in Report No.: Y2012-12A; *Factual Report on Ground Investigation*.
2. AWN investigation (2013) – Hydrogeological Investigation and comprised 4 No. boreholes around the perimeter of the site.
3. Causeway Geotech (2018) – 9 No. boreholes and 16 No. trial pits were installed. 5 No. boreholes were decommissioned and all 16 No. trials pits were decommissioned. See Section 1.3.1 for explanation of the remaining 4 No. boreholes (BH01, BH02, BH03 and BH04) for which a standpipe was installed. Existing boreholes BH04 and BH05 utilised in the quarterly monitoring programme were adopted as legacy boreholes from these works.
4. Priority Geotech (2021) – 3 No. boreholes were installed which are currently utilised for the quarterly monitoring program; BH01 to BH03. See Section 1.3.2 for further information.

A plan view of the locations is provided in Figure 1.

Table 2 – History of Boreholes and Trial Pits

Priority, 2021 - Active borehole monitoring wells	Causeway Geotech, 2018 – decommissioned	Causeway Geotech, 2018 – adopted into quarterly monitoring programme	Causeway Geotech, 2018 – decommissioning unknown	AWN Consulting, 2013 - decommissioned	Soil Mechanics, 2012– decommissioned

Name	Coordinates (I.T.M.)		Level (mOD)	Category (BH / TP)	Installation Date	Depth of Exploration Hole (m)	Bedrock Encountered (Yes / No)	Borehole	Trial Pit	Status Details	Reference Report/(s)
	Easting (m)	Northing (m)						Groundwater Strikes (m) / Depth sealed (m)	Groundwater Strikes (m) / Post strike behaviour		
BH-01	653730.67	692898.79	+99.66	BH	14/03/2012	6.50	No	Dry	-	Decommissioned on 14/03/2012	**Y2012-12A** - Factual Report on Ground Investigations by Soil Mechanics (July, 2012)
BH-02	653754.75	692921.31	+98.45	BH	15/03/2012	8.50	No	1.20 m / 4.00 m	-	Decommissioned on 15/03/2012	
BH-03	653774.70	692922.08	+98.27	BH	15/03/2012	5.80	No	0.80m / 3.00m	-	Decommissioned on 20/03/2012	
BH-04	653789.81	692940.62	+98.17	BH	13/03/2012	6.44	No	1.10m / 1.20m	-	Decommissioned per Borehole Log, date not specified	
BH-05	653712.52	692938.97	+98.90	BH	21/03/2012	7.40	No	1.20m / 2.00m	-	Decommissioned on 21/03/2012	
BH-06	653734.32	692954.80	+98.58	BH	20/03/2012	5.90	No	1.10m / 1.50m	-	Decommissioned on 20/03/2012	
BH-07	653759.87	692970.81	+98.39	BH	20/03/2012	5.80	No	5.20m / 5.50m	-	Decommissioned on 20/03/2012	
BH-08	653694.68	692966.94	+98.92	BH	12/03/2012	5.47	No	1.50m / N/A	-	No backfill noted on log, end date 12/03/2012	
BH-09	653718.84	692981.19	+98.75	BH	21/03/2012	7.60	No	1.20m / 2.00m	-	Decommissioned on 22/03/2012	
BH-10	653737.73	692998.07	+98.55	BH	12/03/2012	5.50	No	None observed	-	Decommissioned on 12/03/2012	
TP-S1	653735.74	692861.89	+98.85	TP	08/03/2012	1.60	No	-	1.50m / rose 10 1.20m after 20	Decommissioned on 08/03/2012	

Table 2 – History of Boreholes and Trial Pits

Priority, 2021 - Active borehole monitoring wells	Causeway Geotech, 2018 – decommissioned	Causeway Geotech, 2018 – adopted into quarterly monitoring programme	Causeway Geotech, 2018 – decommissioning unknown	AWN Consulting, 2013 - decommissioned	Soil Mechanics, 2012– decommissioned

Name	Coordinates (I.T.M.)		Level (mOD)	Category (BH / TP)	Installation Date	Depth of Exploration Hole (m)	Bedrock Encountered (Yes / No)	Borehole	Trial Pit	Status Details	Reference Report/(s)
	Easting (m)	Northing (m)						Groundwater Strikes (m) / Depth sealed (m)	Groundwater Strikes (m) / Post strike behaviour		
									minutes		
TP-S2	653853.95	692943.02	+97.52	TP	08/03/2012	1.70	No	-	None observed	Decommissioned on 08/03/2012	
TP-S3	653831.91	692775.11	+97.90	TP	08/03/2012	1.60	No	-	1.30m / steady inflow	Decommissioned on 08/03/2012	
TP-01	653664.19	692955.15	+98.13	TP	08/03/2012	3.00	No	-	1.00m / slight seepage	Decommissioned on 08/03/2012	
TP-02	653745.33	693013.31	+98.37	TP	08/03/2012	3.00	No	-	1.00m / steady inflow	Decommissioned on 08/03/2012	
TP-03	653782.00	692963.62	+98.31	TP	08/03/2012	3.00	No	-	None observed	Decommissioned on 08/03/2012	
TP-04	653700.19	692907.17	+99.46	TP	08/03/2012	3.00	No	-	None observed	Decommissioned on 08/03/2012	
TP-05	653736.53	692945.56	+98.53	TP	08/03/2012	3.00	No	-	1.60m / steady inflow	Decommissioned on 08/03/2012	
TP-06	653658.96	692878.73	+99.25	TP	07/03/2012	3.00	No	-	None observed	Decommissioned on 07/03/2012	
TP-07	653622.65	692851.93	+99.63	TP	07/03/2012	3.00	No	-	2.30m	Decommissioned on 07/03/2012	
TP-08	653591.84	692829.08	+99.74	TP	07/03/2012	3.00	No	-	1.70m	Decommissioned on 07/03/2012	
TP-09	653532.01	692795.09	+100.80	TP	07/03/2012	3.00	No	-	1.80m / slow trickle	Decommissioned on 07/03/2012	
TP-10	653482.02	692759.57	+102.21	TP	07/03/2012	2.80	No	-	2.00m / quick inflow	Decommissioned on 07/03/2012	
TP-11	653444.60	692722.42	+104.21	TP	07/03/2012	3.00	No	-	3.00m / base of pit filled	Decommissioned on 07/03/2012	
TP-12	653171.09	692421.67	+113.44	TP	07/03/2012	3.00	No	-	None observed	Decommissioned on 07/03/2012	

Table 2 – History of Boreholes and Trial Pits

Priority, 2021 - Active borehole monitoring wells	**Causeway Geotech, 2018 – decommissioned**	**Causeway Geotech, 2018 – adopted into quarterly monitoring programme**	**Causeway Geotech, 2018 – decommissioning unknown**	**AWN Consulting, 2013 - decommissioned**	**Soil Mechanics, 2012– decommissioned**

Name	**Coordinates (I.T.M.)**		**Level (mOD)**	**Category (BH / TP)**	**Installation Date**	**Depth of Exploration Hole (m)**	**Bedrock Encountered (Yes / No)**	**Borehole**	**Trial Pit**	**Status Details**	**Reference Report/(s)**
	Easting (m)	**Northing (m)**						**Groundwater Strikes (m) / Depth sealed (m)**	**Groundwater Strikes (m) / Post strike behaviour**		
BH-01	653641.4	692866.5	-	BH	29/05/2013	4.00	No	None observed	-	Standpipe installed	DB/09/4848HR02 – AWN Site Investigation Report, 2013
BH-02	653684.5	692989.5	-	BH	30/05/2013	5.00	No	None observed	-	Standpipe installed	
BH-03	653786.6	693050.0	-	BH	30/05/2013	4.00	No	None observed	-	Standpipe installed	
BH-04	653894.8	692974.7	-	BH	28/05/2013 to 29/05/2013	9.00	Driller described “possible rock”	None observed	-	Standpipe installed	
BH-01	653744.29	692847.44	+101.53	BH	22/06/2018	6.50	No	1.30m / N/A	-	Standpipe installed – adopted as BH5 in quarterly monitoring programme	**17-0439** - Coolnabacky - 400kV GIS Substation Ground Investigation by Causeway Geotech (July, 2018)
BH-02	653763.55	692855.61	+101.02	BH	21/06/2018	6.50	No	1.60m / N/A	-	Standpipe installed – decommissioning information unknown	
BH-03	653793.75	692877.00	+100.92	BH	20/06/2018	8.50	No	5.70m / N/A	-	Standpipe installed - decommissioning information unknown	
BH-04	653775.62	692876.75	+100.93	BH	22/06/2018	9.50	No	1.80m / N/A	-	Standpipe installed – adopted as BH04 in quarterly	

Table 2 – History of Boreholes and Trial Pits

Priority, 2021 - Active borehole monitoring wells	Causeway Geotech, 2018 – decommissioned	Causeway Geotech, 2018 – adopted into quarterly monitoring programme	Causeway Geotech, 2018 – decommissioning unknown	AWN Consulting, 2013 - decommissioned	Soil Mechanics, 2012– decommissioned

Name	Coordinates (I.T.M.)		Level (mOD)	Category (BH / TP)	Installation Date	Depth of Exploration Hole (m)	Bedrock Encountered (Yes / No)	Borehole	Trial Pit	Status Details	Reference Report/(s)
	Easting (m)	Northing (m)						Groundwater Strikes (m) / Depth sealed (m)	Groundwater Strikes (m) / Post strike behaviour		
										monitoring programme	
BH-06	653761.06	692899.36	+101.02	BH	19/06/2018	9.00	No	None observed	-	Decommissioned on 19/03/2012	
BH-07	653739.97	692885.11	+101.70	BH	18/06/2018	6.00	No	None observed	-	Decommissioned on 18/03/2012	
BH-08	653723.11	692880.20	+101.81	BH	15/06/2018	9.00	No	None observed	-	Decommissioned on 15/03/2012	
BH-09	653714.90	692899.34	+102.48	BH	13/06/2018	10.70	No	None observed	-	Decommissioned on 14/06/2018	
BH-10	653768.14	692928.33	+100.77	BH	12/06/2018	9.30	No	None observed	-	Decommissioned on 13/06/2018	
TP-01	652762.54	692473.30	+120.31	TP	13/06/2018	2.10	No	-	None observed	Decommissioned on 13/06/2018	
TP-02	652858.96	692449.29	+119.87	TP	13/06/2018	1.50	No	-	None observed	Decommissioned on 13/06/2018	
TP-03	652957.52	692451.18	+117.37	TP	13/06/2018	2.30	No	-	None observed	Decommissioned on 13/06/2018	
TP-04	653059.67	692459.07	+117.08	TP	13/06/2018	1.50	No	-	None observed	Decommissioned on 13/06/2018	
TP-05	653151.86	692414.82	+116.08	TP	13/06/2018	2.50	No	-	None observed	Decommissioned on 13/06/2018	
TP-06	653233.63	692471.63	+111.55	TP	13/06/2018	2.50	No	-	None observed	Decommissioned on 13/06/2018	
TP-07	653297.01	692547.95	+110.02	TP	12/06/2018	2.50	No	-	None observed	Decommissioned on 12/06/2018	
TP-09	653427.96	692700.83	+106.81	TP	12/06/2018	2.50	No	-	None observed	Decommissioned on 12/06/2018	
TP-10	653504.09	692762.58	+102.65	TP	12/06/2018	2.00	No	-	1.80m / seepage at 1.80m	Decommissioned on 12/06/2018	

Table 2 – History of Boreholes and Trial Pits

Priority, 2021 - Active borehole monitoring wells	**Causeway Geotech, 2018 – decommissioned**	**Causeway Geotech, 2018 – adopted into quarterly monitoring programme**	**Causeway Geotech, 2018 – decommissioning unknown**	**AWN Consulting, 2013 - decommissioned**	**Soil Mechanics, 2012– decommissioned**

Name	**Coordinates (I.T.M.)**		**Level (mOD)**	**Category (BH / TP)**	**Installation Date**	**Depth of Exploration Hole (m)**	**Bedrock Encountered (Yes / No)**	**Borehole**	**Trial Pit**	**Status Details**	**Reference Report/(s)**
	Easting (m)	**Northing (m)**						**Groundwater Strikes (m) / Depth sealed (m)**	**Groundwater Strikes (m) / Post strike behaviour**		
TP-11	653587.91	692815.56	+100.21	TP	12/06/2018	1.50	No	-	1.50m / seepage at 1.50m	Decommissioned on 12/06/2018	
TP-12	653685.71	692843.84	+100.91	TP	12/06/2018	2.50	No	-	1.30m / seepage at 1.30m	Decommissioned on 12/06/2018	
TP-13	653844.10	692856.30	+100.63	TP	11/06/2018	2.60	No	-	None observed	Decommissioned on 11/06/2018	
TP-14	653727.14	692828.78	+101.57	TP	12/06/2018	2.50	No	-	2.30m / seepage at 2.30m	Decommissioned on 12/06/2018	
TP-15	653811.99	692890.35	+100.21	TP	11/06/2018	2.00	No	-	None observed	Decommissioned on 11/06/2018	
TP-16	653757.40	693080.19	+98.48	TP	11/06/2018	2.30	No	-	1.00m / rapid inflow at 1.00m	Decommissioned on 11/06/2018	
TP-28	653757.40	693080.19	+98.48	TP	12/06/2018	0.70	No	-	None observed	Decommissioned on 12/06/2018	
BH-01	653762.00	692995.00	+98.905	BH	26/05/2021	3.00	No	None observed	-	Active - quarterly monitoring point	**IE2219-5242** - Appendix C for Borehole Logs from PGI (May, 2021)
BH-02	653750.00	693080.00	+98.899	BH	26/05/2021	3.00	No	None observed	-	Active - quarterly monitoring point	
BH-03	653833.00	693031.00	+98.484	BH	26/05/2021	3.00	No	None observed	-	Active - quarterly monitoring point	

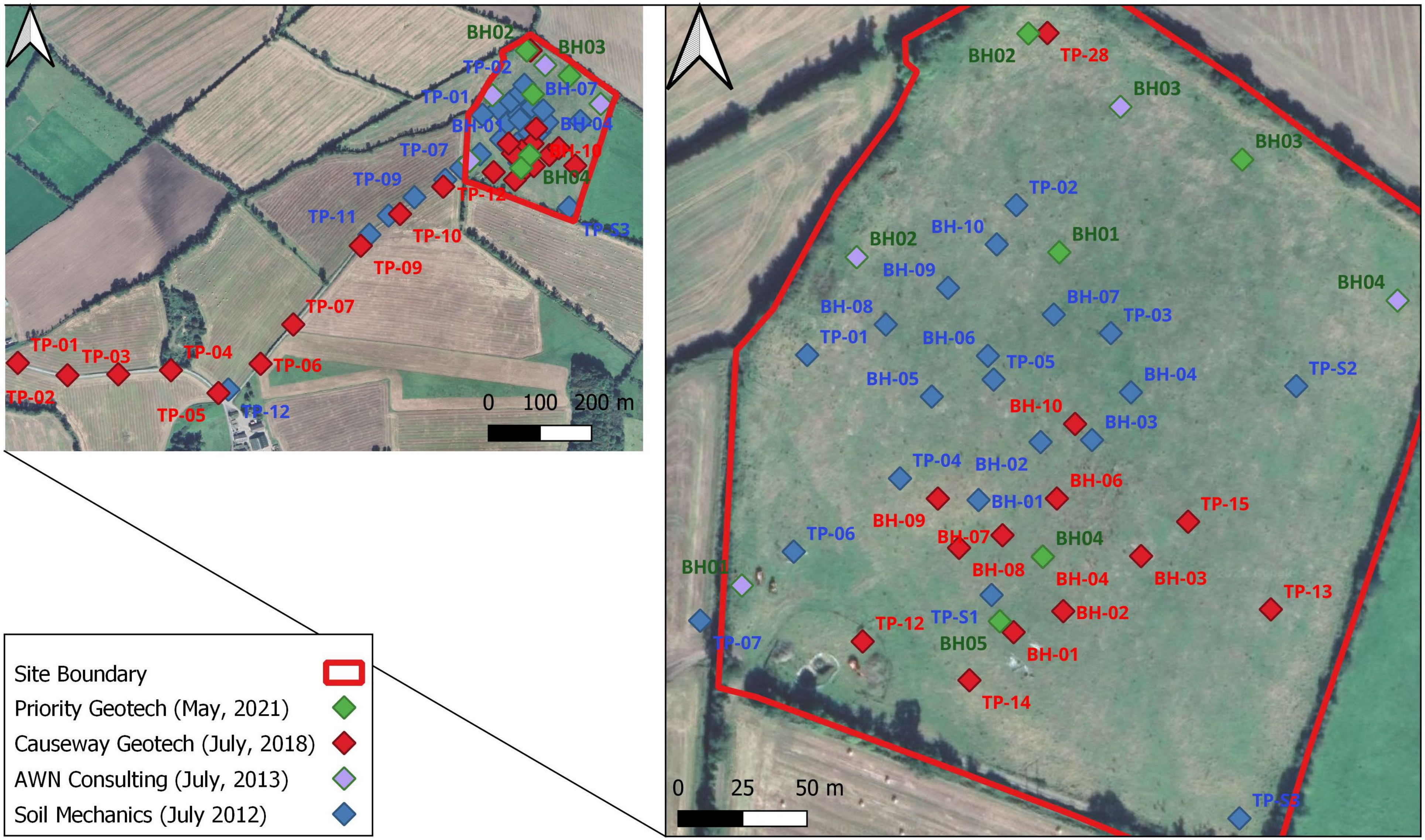


Figure 1 – Locations of historic investigation boreholes and trial pits across the site

1.3.1. Soil Mechanics Site Investigations, 2012

As detailed in Table 2 all borehole and trial pits were decommissioned post data collection. Standard industry practice following a site investigation is to decommission trial pits and boreholes by backfilling of the excavated material, with the originally extracted soil from that location. This provides a low impact method as the backfilled material is of the same composition and identical to the existing stratigraphic material. There is therefore minimal impact.

The only residual impact is there might be a slight area of weakness as the backfilled material will not be as compacted as the surrounding subsoil. However, this is not an issue in terms of impact to the bedrock aquifer as none of the boreholes in this site investigation or subsequent investigations penetrated the groundwater aquifer, instead they reached the shallow water gravel aquifer (BH02 being the deepest borehole at 8.5 m depth).

The Clay encountered during the site investigations is described as grey stiff to very stiff at depth. The grey colour is significant in that it indicates lack of oxygen, which would normally be introduced by vertical percolation of oxygenated rainwater. This, associated with a typical large fines (Silt and Clay) value of 30% to 50% from PSD analysis confirms the low permeability of the clay. The 2012 Ground Investigation report found clay deposits at all locations and did not indicate the possible presence of bedrock. Laboratory tests were undertaken on samples recovered from boreholes and trial pits.

1.3.2. AWN supplementary Investigation 2013

This involved the construction of 4 No. boreholes around the perimeter of the site. One borehole was taken to 8.6 m and encountered angular rock fragments, but was not confirmed as rock. All of these boreholes were fitted with standpipes, but it appears that they were decommissioned following the conclusion of the planning phase.

1.3.3. Causeway Geotech Site Investigations, 2018

In order to optimise the geotechnical design of the structures and access roads Causeway Geotech were engaged by Killeen Civil Engineering acting on behalf of ESB Networks to undertake a supplementary ground investigation. The boreholes were mainly concentrated within the proposed building footprint to provide location specific ground property values. The deepest borehole drilled during the Causeway Geotech site investigations was BH09, drilled to 10.70 m and did not encounter bedrock. However groundwater strikes ranging from 0.80 m (BH03) to 5.2 m (BH07) were encountered in many of the boreholes indicating that there was a shallow localised perched water table underlying the site. This information forms the basis that the bedrock aquifer is > 10 m depth below the site and that there is the presence of a local perched water table at shallow depths below the site, perched on a low permeability clay layer that is typically 6-7m thick.

From the Causeway Geotech 2018 Report (No.: 17-0439), standpipes were installed for 4 No. boreholes only; BH01, BH02, BH03 and BH04. All other boreholes and trial pits were decommissioned at the time of the works.

The coordinates for BH01 which was installed by Causeway Geotech as per the Borehole Log are 653744.29 E, 692847.44 N. It was noted that when this borehole location, was plotted in plan view as per Figure 1, lies 7 m south-east of the existing borehole demarked as “BH05” on site. The coordinates of BH05 (653738.95 E, 692851.67 N) were verified by an IE Consulting geologist on the 9th May 2023 (see Report IE2219-5866). This was the only observed borehole in the immediate area. It is therefore surmised that BH01 of the Causeway Geotech study was adopted as “BH05” in the quarterly monitoring programme. It is thought that there may have been an error transcribing the GPS coordinates recorded in the Causeway Geotech 2018 Report (No.: 17-0439), as this is the only explanation to derive the existence of BH05. BH05 has since collapsed so will be decommissioned and described in further detail in the subsequent sections.

BH02 and BH03 were drilled to depths of 6.5 m and 8.5 m respectively, with standpipes installed, but subsequent decommissioning was not documented in the borehole logs of the report. During the site visit by an IE Consulting geologist on the 9th May 2023 the standpipes associated with these boreholes were not observed. It is likely these were covered over during subsequent activities or that the standpipes were removed at a later date and the boreholes have since collapsed in on themselves. None of these boreholes penetrated the groundwater aquifer, so there is no potential pollution pathway to the bedrock aquifer.

BH04 from the Causeway 2018 investigation was documented at coordinates 653775.62 E, 692876.75 N. However an IE Consulting site visit on the 9th of May 2023 (see Report IE2219-5866) confirmed the monitoring location of BH04 to be 653755.62 E, 692876.75 N.

Therefore it was confirmed that BH04 was the borehole adopted from the Causeway 2018 investigation into the quarterly monitoring data as an additional data point. However because it was not originally located as a construction monitoring borehole, it will need to be re-located outside of the footprint area.

Similar to the 2012 investigation, infiltration tests were undertaken to establish percolation rates through the grey CLAY layer. All tests confirmed low infiltration permeability, but an actual value could not be determined, because the percolation rate was too slow. Similarly laboratory tests comprising PSD analysis indicated fines percentages of 30% to 50%, which would be consistent with a low permeability value.

1.3.4. BH01 to BH03, (Priority, 2021)

3 No. Boreholes were installed in 2021 by Priority Drilling and documented in Tufa Spring Assessment Report ie2219-5242. These boreholes are referred to BH01, BH02 and BH03 in the Borehole Monitoring Programme. See Section 2 for full details. These boreholes were installed to a shallow depths of 3m.

1.4. Conclusions

Bedrock was not encountered or confirmed in any of the site investigation locations. The deepest borehole drilled was BH09 of the Causeway Geotech site investigation, drilled to 10.70 m. It can therefore be extrapolated that the bedrock aquifer is considered as typically > 10 m below the site. Consequently, the bedrock aquifer mapped as Rkd (Regionally Important Aquifer – Karstified diffuse) was not compromised by any of the ground investigations See cross-sections for reference in section 3 below.

The bedrock is overlain by a consistent layer of 6-7m of low permeability Clay. This layer limits any interconnectivity between surface/near surface activities and the bedrock aquifer.

The shallow groundwater is perched on low permeability clay.

The low permeability nature of the clay layer was confirmed by the inability to determine an infiltration rate, the grey colour of the clay and the high percentage of fines in samples of the clay tested by PSD analysis.

The perched watertable can be intercepted at depths of typically 0.80 m but this varies greatly across the site. All existing boreholes are installed within the shallow water aquifer as an effort to understand as a baseline how groundwater hydraulics of the shallow deposits on the site informs the further assessment of the tufa springs.

For boreholes BH02 and BH03 of the Causeway Geotech site investigations where the standpipe was not removed and the decommissioning details are unknown, there is no impact to the bedrock aquifer as these boreholes did not encounter bedrock at depths of 6.5 m and 8.5 m respectively.

2. Existing Boreholes onsite and Monitoring Programme Data

2.1. Borehole locations and Rationale

Table 3 provides a tabulated summary of the existing boreholes onsite and their associated attributes.

Table 3 – Existing Boreholes

Borehole Name	Depth (m)	Installation	Rationale
BH01	3.00	Priority drilling, 2021	Per IE2219-5242; the 3 No. boreholes were selected based on a geophysical survey showing these as locations of higher permeability, having sand and gravel rich lenses. They were installed to understand how the hydraulics of the site interact with the tufa deposits on the stream base in the northern perimeter of the site.
BH02	3.00	Priority drilling, 2021	
BH03	3.00	Priority drilling, 2021	
BH04	9.50	Legacy from Causeway Geotech site investigations in 2018	To collect baseline groundwater level data in the immediate vicinity of the substation building.
BH05	6.50	Legacy from Causeway Geotech site investigations in 2018; referred to as BH01 in Causeway Geotech report; renamed BH05 in the Monitoring Programme	To collect baseline groundwater level data in the immediate vicinity of the substation – note prior to initiation of the monitoring program it was observed that this borehole had collapsed to 2.5m depth and was not a viable monitoring point. It was therefore decided to eliminate this point and utilise the four above listed locations instead.

2.1.1. BHO1 to BH03

A Hydrogeological and Hydrological Review was performed by IE Consulting documented per IE2219-4840, issued 16th February 2021. Recommendation number two (2) from the report included the following:

"*I would recommend that 5 No. shallow groundwater monitoring points are installed around the site at locations away from the proposed footprint*"

The purpose of these monitoring boreholes was to help better understand the groundwater hydraulics of the shallow deposits on the site to inform the further assessment of the tufa.

Subsequent to this in April 2021 Minerex performed a geophysical survey producing EM31 Ground Conductivity Contour Maps which were utilised to select borehole monitoring points. Subsequently the three boreholes BH01, BH02 and BH03 were installed in May 2021. On the 24 June 2021 Denyer Ecology undertook a survey of the petrifying springs with tufa formations. It was established that the streams surrounding the site were groundwater fed. All these activities are detailed in report IE2219-5242 *Assessment of Tufa Springs*.

Based on the report IE2219-5242 it was established through the geophysical survey that the ground underlying the proposed substation site was relatively homogeneous, mostly underlain by sandy and gravelly clay and silt with slightly gravelly clay, confirming that bedrock was > 6 m depth (the maximum depth of penetration of the geophysical method). This is consistent with borehole depth data.

The three boreholes BH01, BH02 and BH03 which were drilled in sand and gravel rich lenses, encountered stiff boulder clay at 3 m depth. Water level monitoring of these boreholes over a six month period showed a fluctuating water table, in response to incident rainfall and a groundwater gradient from southwest to northeast. It was concluded that streams along the northern perimeter of the site were partly fed by groundwater seepage from the site and via a nearby spring as well as from ground to the west of the site.

The tufa streams did not qualify as a clear example of Annex I priority petrifying spring, because of the poor baseline flora population, but have nonetheless been afforded a high level of protection as part of the proposed works, and are annually monitored to ensure that there is no deterioration in their status.

The recommendations from IE2219-5242 included continued groundwater monitoring to ensure no excessive nutrient loading and continued groundwater and surface water monitoring as a strategy to ensure continued protection of the tufa.

2.1.2. Decommissioning of BH04 and BH05

BH4 and BH5 were both installed in an area where excavations and concrete pouring will be required. They were both initially located to provide specific geotechnical design data in the immediate footprint of the substation. These boreholes were subsequently incorporated into the baseline monitoring program as legacy data points and to provide baseline groundwater level and quality data in advance of construction.

However because borehole BH04 sits on the footprint of a proposed building it will be required to be decommissioned and a new borehole BH04b (replacement monitoring well) is proposed to be installed further south of the existing monitoring well. BH05 is also in construction footprint of the substation 110kV building so will therefore also need to be decommissioned. As noted in Table 3 above, this borehole has collapsed at depth, and is no longer viable as a monitoring point.

A method statement Report IE2219-5766 was generated to provide a specification for the decommissioning of 2 No. Boreholes (BH04 & BH05) and the installation of 1 No. replacement borehole (BH04b), together with a site specific environmental and health and safety risk assessment RAMs.

Protection measures will be put in place prior to the main construction works which shall include installation of timber fencing around newly constructed boreholes as well as existing boreholes, plus a silt mesh around the base of the fence to secure well head protection.

BH04b is proposed to be installed as per available guidelines such as Environment Agency, Institute of Geologists of Ireland (IGI) and EPA. BH04b will be drilled to an approximate depth of 6 m. The location is not adjacent to the tufa springs (located to the north of the site), or feeder streams and the target depth is well above the depth of expected bedrock. It will have no connectivity with the bedrock aquifer and will therefore have no impact on the bedrock groundwater aquifer.

2.2. Monitoring Programme

The monitoring program comprises both groundwater and surface water monitoring. This requirement originated from the EIS Sections 12 mitigation measures and 14 Schedule of Commitments. The proposed sample plan and schedule was submitted to Laois County Council and subsequently approved by Laois County Council (LCC) in June 2022.

Document IE2219-5370 set out the monitoring programme, based on collecting samples from the four (4 No) existing monitoring wells (BH1, BH2, BH3 and BH4). During a quarterly monitoring event, visual inspection of the borehole protection will be performed. Any issues with the borehole protection will be reported and documented in the applicable report.

See Table 4 for list of monitoring completed to date on the site. All reports and monitoring completed to date comprises part of the baseline study.

None of the baseline data collected per the listed studies indicate that the existing boreholes or decommissioned boreholes serve as a potential pathway receptors to the bedrock aquifer, this is because of their shallow depths and the low permeability of the clay subsoil.

Table 4 – Monitoring Programme Documentation to date

Monitoring Period	Issued Report Reference	Monitoring Type	Results
2022 Q1	Baseline Surface Water Sampling 30th Mar 2022	Routine	Refer to Appendix A
2022 Q2	Surface Water Sampling 18th May 2022	Routine	
2022 Q2	Surface Water Sampling 20th Jun 2022	Routine	
2022 Q3	Surface Water Sampling 6th Sep 2022	Routine	
2022 Q4	IE2219-5555	Routine	
2023 Q1	IE2219-5752	Routine	
2023 Q1	Baseline Groundwater and Surface Water Report for Kilwex Ltd. By Coyle Environmental	Coyle Environmental Ltd. were commissioned by Kilwex Ltd. to	

Monitoring Period	Issued Report Reference	Monitoring Type	Results
		undertake Baseline compliance monitoring per Planning Permission reference VA0015.	
2023 Q2	IE2219-5796	Routine	
2023 Q2	IE2219-5833	Integration and Assessment of Kilwex Baseline Groundwater and Surface water Report with IE Consulting Quarterly Monitoring Data	

3. Conceptual Model Review

3.1. Evolution of the Conceptual Model

3.1.1. AWN Report (Section 10.1)

AWN prepared a conceptual model labelled Figure 2 for the site. This cross section was produced based on the Soil Mechanics site investigation in 2012. The following points are notable in relation to this schematic:

- BH02 was the deepest borehole drilled during the 2012 site investigations at 8.50 m depth and did not encounter bedrock. BH04 is depicted as being the deepest borehole; however the log shows that BH04 was only drilled to 6.44 m.
- The Clay encountered during the site investigations is described as stiff to very stiff at depth. The 2012 Ground Investigation report found clay deposits at all locations and did not indicate the possible presence of bedrock. The Clay is described as grey, which is consistent with low oxygen concentrations (indicative of poor percolation rates). Similarly PSD analysis of samples from the boreholes found 30% to 50% fines, which would be consistent with low permeability values.
- The shallow water aquifer or perched water in the clayey sand and sandy clay is not depicted even though groundwater strikes were recorded as shallow as depths of 0.80m in BH03.

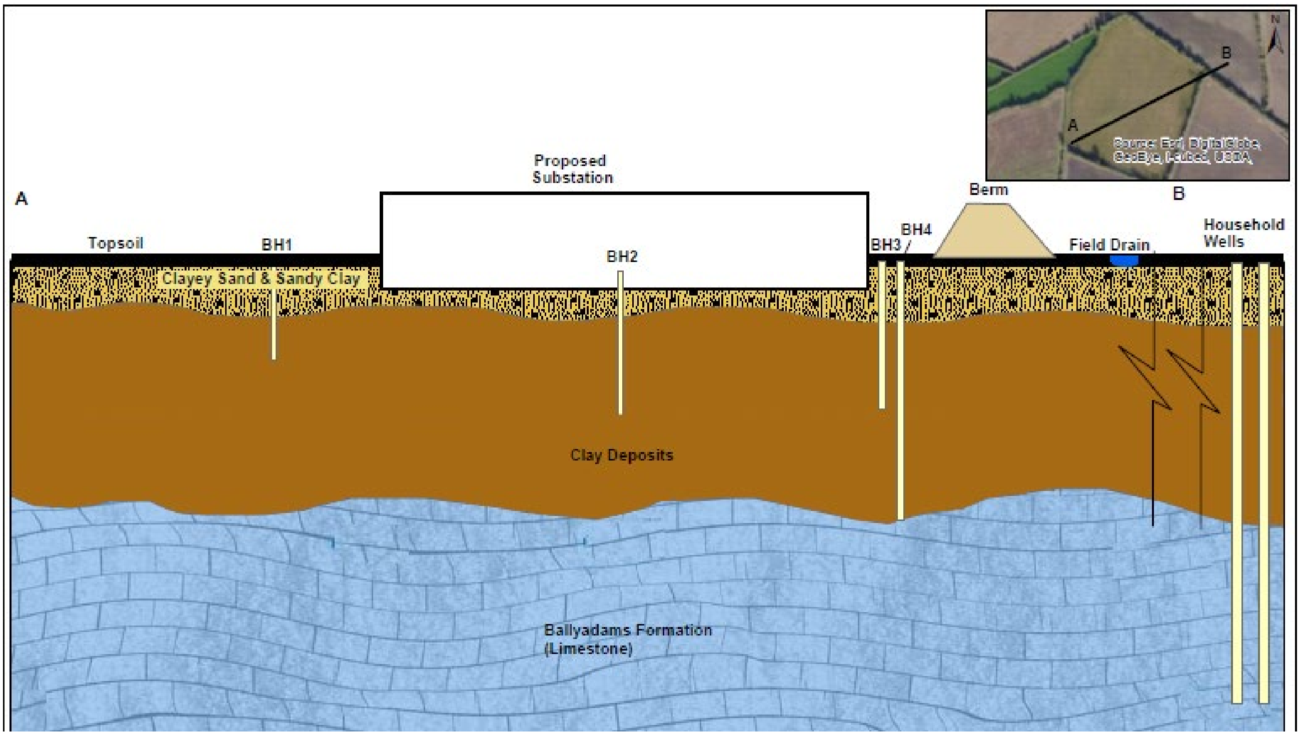


Figure 2 – Conceptual Model Presented in AWN Consulting Ltd. Report (DB/09/4848HR02)

3.1.2. Tobin Report, Sep 2017 (Figure 2-2)

The conceptual model presented in the AWN consulting report was utilised and modified in the Tobin Report to include the following:

- Depth to bedrock was presented as 8.5 m below ground level i.e. 2.5 m foundation depth below ground level plus subsoil of >6 m of subsoil underlying this.

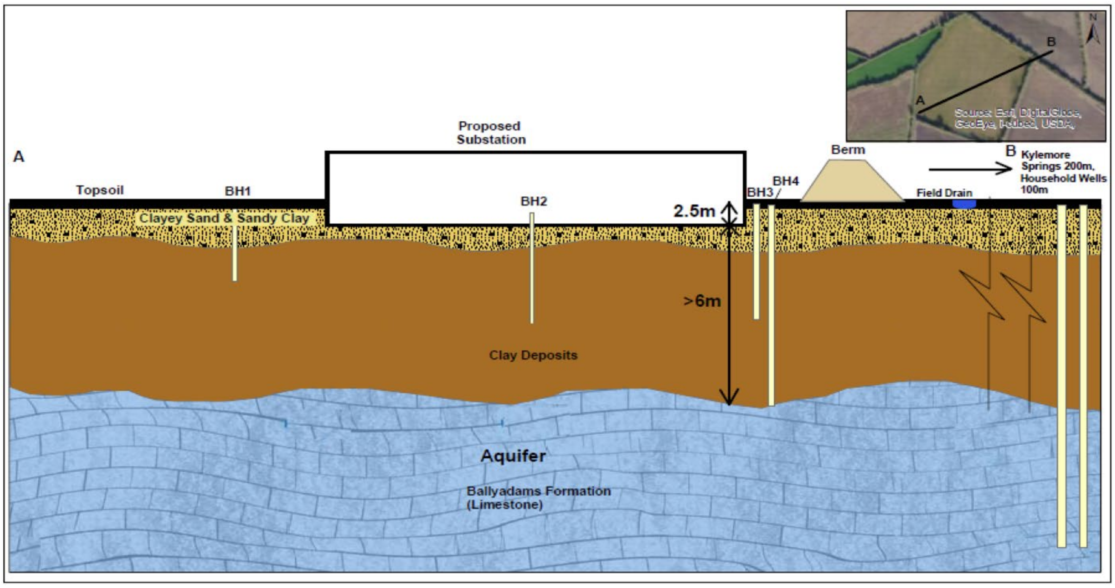


Figure 3– Conceptual Model Presented in Tobin Report (Sep, 2017)

3.2. Current Conceptual Model refinement

Figure 4 and Figure 5 show the cross sections illustrating the latest understanding of potential interaction between infrastructure units and the shallow aquifer.

The shallow water aquifer is interpreted based on the highest water level recorded during the quarterly monitoring baseline programme at the applicable monitoring borehole point. This is represented by the upper blue dashed line. The lower line is water levels recorded during the Q2 2023 monitoring on the 24/05/2023.

Please note in relation to the labelling of the boreholes:

- P, 2021 = Priority Geotech, boreholes used for quarterly monitoring programme (see Section 1.3.4)
- C, 2018 = Causeway Geotech exploratory boreholes or trial pits (see status in Table 2 and Section 1.3.3 for installation details)
- S, 2012 = Soil Mechanics exploratory borehole or trial pit (see status in Table 2 and Section 1.3.1)

  Note: none of the AWN Consulting boreholes were intersected by the cross section.

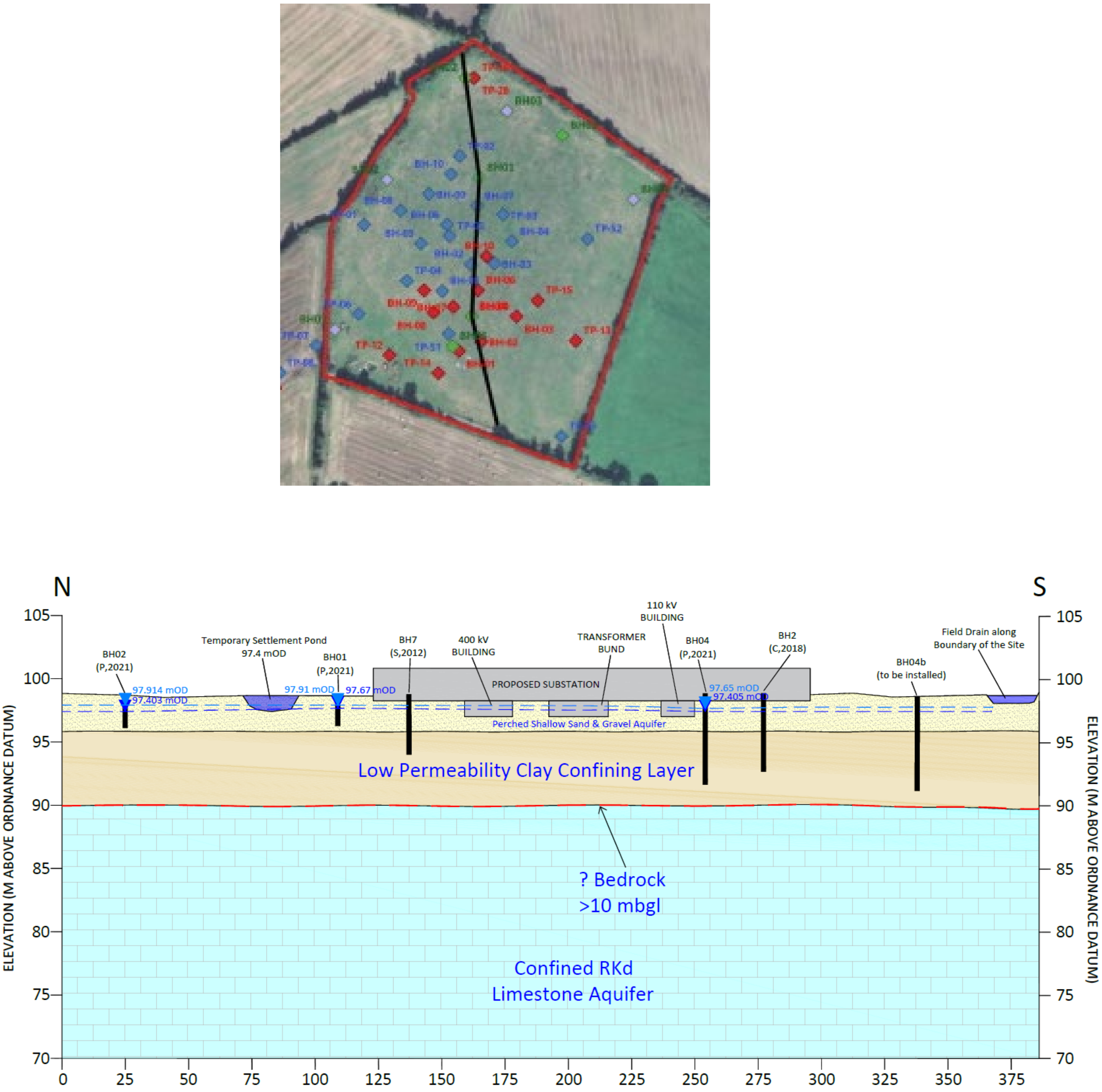
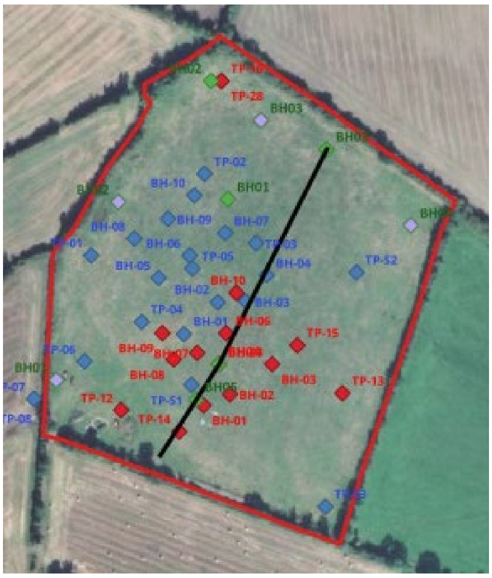


Figure 4 – North-South Cross Section



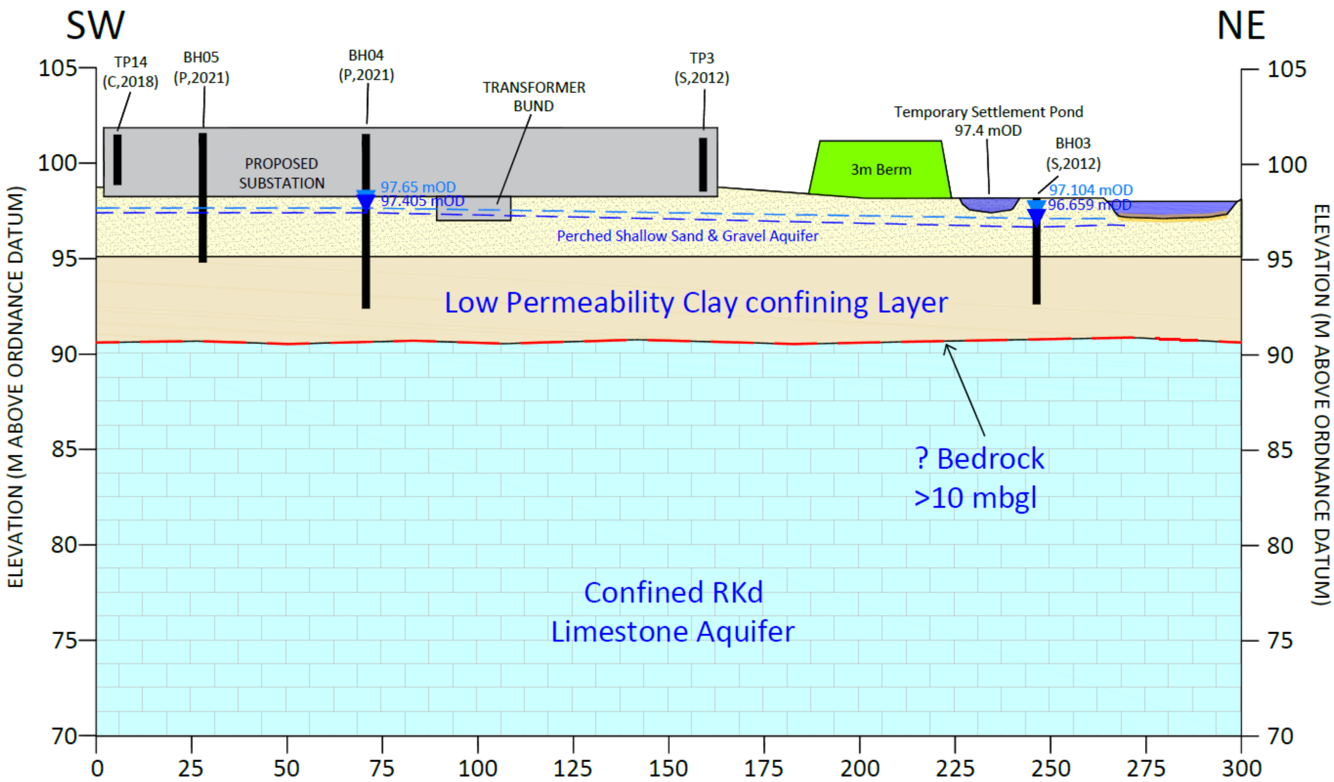


Figure 5 – Southwest-Northeast Cross Section

3.3. Summary Conceptual Model

- The bedrock aquifer was not encountered in any investigation undertaken on the site.
- The bedrock aquifer is protected by a 6-7m thick low permeability confining clay layer.
- There are no borehole derived water supplies within 500 m of the site. However any abstractions are likely to be from the underlying Limestone bedrock, and because this aquifer was not encountered in any investigations and no dewatering of this aquifer will be required during construction, there will be no impact to the drinking water abstractions in the area.
- A Geophysical survey on the site shows the site is homogeneous with the low permeability clay occurring consistently from approximately 3 m below ground level, and that bedrock is a least 6m deep (the limit of penetration for the geophysical method deployed).
- The Clay layer is grey in colour, which is consistent with low permeability rates, the fines content of the clay determined from laboratory testing is high, ranging from 30% to 50%, which again is consistent with low permeability rates, and infiltration tests undertaken in-situ were unable to determine a permeability value, because the rate of infiltration was too low. This confirms the important role that the clay has as a consistent protective 7m thick layer over the bedrock aquifer.
- Groundwater in the sand and gravel deposits on the site will not be in hydraulic continuity with the bedrock aquifer underlying the site because of the low permeability of the intervening 6m+ of Clay. The groundwater in the sand and gravel deposits will take the easier pathway and move in a horizontal direction rather than vertically.
- The maximum depth of excavation will be 2.14m below ground level, and based on groundwater level data, this will require some dewatering of the shallow gravel aquifer.
- There may be some minimal loss of recharge to the tufa, during the construction period, but this will be temporary and minor in nature., Based on the interpreted groundwater flow direction, the recharge area of the tufa springs will be mostly concentrated in the agricultural land to the west of the site, with only approximately 10% recharge from the site area. The impact of any dewatering will therefore be small.
- Recharge from the shallow perched aquifer on the site, will support diffuse baseflow in the adjacent stream, and will be responsible for some of the tufa deposition along this watercourse. However any impacts from construction dewatering on the site, will be less

significant on this feature, because of the diffuse nature of this baseflow component, as opposed to the concentrated point discharge from the springs.

- The recharge pattern will re-establish after construction and the shallow depth of the structure, will not disrupt shallow groundwater flow patterns to any significant extent.
- Dewatering at the site will have no impact on deep water bedrock aquifer therefore no interference to nearby wells.

4. Conclusions

- A review of decommissioned boreholes and trial pits from historic site investigations shows that there was no impact to the deeper aquifer as the bedrock was not encountered in any of the studies. The relatively homogeneous, low permeability clay layer from 3 m depth, and extending for a further 6-7m across the site further protects the deep aquifer in the unlikely event of the boreholes acting as a contamination pathway.
- In situ observations and testing, supported by laboratory testing, confirms the low permeability nature of this clay layer, and its effectiveness as a protective layer for the underlying bedrock aquifer.
- There is no impact to nearby domestic, farm or public drinking water supply wells as these are served by the deep bedrock aquifer.
- Dewatering at the site may have a slight effect on the shallow aquifer which could subsequently impact the supply of groundwater to the tufa streams. However this will be short term and of small magnitude, and will be monitored during construction.
- Dewatering at the site will have no impact on deep water bedrock aquifer therefore no interference to nearby wells
- Any excavation deeper than 0.80 m below ground level would expect to encounter groundwater. Where groundwater needs to be controlled to allow construction to proceed, a dewatering procedure will be implemented (Refer to Section X for the dewatering procedure)

5. References

Documents at the public link: http://eirgridlaoiskilkenny.ie/environmental.html

A review of the information provided on the An Bord Pleanala website, when a search for VA0015 was made http://www.pleanala.ie/search/index.php?q=va0015&case_scope=all&include_reports_etc=0

Eirgrid and ESB reports and drawings-provided on request.

Assessment reports By SLR and Tobins associated with the unauthorised development in

2017 Tobins report (Report to assess the impact of the unauthorized development on the Aquifer at Coolnabacky Construction site) 2017

2018 SLR Hydrogeological assessment of excavations for the construction of a substation prepared for: Eirgrid SLR Ref: 180720 00357 00004

GSI 2000- Kyle & Orchard Springs Source Protection report

GSI 2018 assessment and response to RTS presentation to Minister Naughten

GSI public viewer maps

Site walk-over visit under taken by J Keohane on 18th December 2020

Lyons & Kelly 2016 Monitoring Guidelines for the Assessment of Petrifying Springs in Ireland. Irish Wildlife Manual No. 94 NPWS

ESBI site drainage report PE687-F0261-R261-016 which included Traynor Environmental Site suitability assessment 2012

2012 Soil Mechanics Report No Y2012-12A factual report on ground investigation

Appendices

Appendix A.

Groundwater and Surface Water Monitoring Data

See Appendix 10 of the CEMP

EirGrid
Enforcement Notice
LAOIS KILKENNY
REINFORCEMENT PROJECT -
COOLNABACKY 400 kV SUBSTATION

September 2017

TOBIN CONSULTING ENGINEERS

TOBIN
Patrick J. Tobin & Co. Ltd.

Report to assess the impact of the unauthorized development on the Aquifer at Coolnabacky Construction site

PROJECT: **LAOIS KILKENNY REINFORCEMENT PROJECT - COOLNABACKY 400kV SUBSTATION**

CLIENT: **EirGrid Plc**

COMPANY:

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DOCUMENT AMENDMENT RECORD

PROJECT NUMBER:10310				DOCUMENT REF: 10310-01			
A	Report	JD	220917	ST	220917	DG	220917
Revision	**Description & Rationale**	**Originated**	**Date**	**Checked**	**Date**	**Authorised**	**Date**
TOBIN Consulting Engineers							

TABLE OF CONTENTS

APPENDICIES

1 INTRODUCTION

EirGrid plc received an Enforcement notice dated the 31st July 2017 (Appendix A) in relation to unauthorized works carried out at the townland of Coolnabacky. The notice requirements are:

- *Cease the said development on receipt of this notice;*
- *Carry out the restoration works on site in accordance with the restoration plan dated 4th July 2017, which was received by the planning authority on the 4th July 2017, by 4pm on 8th September 2017; and*
- *Carry out a hydrological / hydrogeological report to assess the impact of the unauthorized development on the aquifer by a suitably qualified person and submit this report to the Planning authority by 4pm on 22nd September 2017.*

TOBIN Consulting Engineers have been engaged by EirGrid as experts in Hydrology and Hydrogeology to carry out the Hydrological / Hydrogeological study - the third requirement of the enforcement notice.

In advance of any restoration works taking place TOBIN Consulting Engineers reviewed the Environmental Impact Assessment (EIA) for the Laois Kilkenny Reinforcement Project submitted in August 2013, specifically Chapter 7 and 8. The restoration plan, dated 4th July, is included in Appendix B.

The report looks at the impact of the unauthorized works along with the impact of the restoration works on the aquifer. The objectives of this report are to provide an independent assessment of the impact of the unauthorized works on the aquifer.

2 PROJECT BACKGROUND

The substation site lies approximately 4 km south-southwest of the town of Stradbally and 2.5 km northeast of Timahoe village. The location of the substation is within an agricultural field. The access route is via an existing farm access lane. The field boundaries are separated by dry ditches and mature tree lines. The site is bordered by agricultural land in all other directions.

In February 2012, in advance of the planning submission for this site, detailed geotechnical and geo-environmental data was collected for this site as part of the Environmental Impact Assessment (EIA) process. Soil Mechanics (SM) was commissioned by ESB International (ESBI), on behalf of EirGrid, to carry out a ground investigation at Coolnabacky, County Laois.

The investigation was carried out to obtain geotechnical and geoenvironmental information for the proposed 400kV substation development. This information was used to complete the environmental assessment.

The planning application included an Environmental Report which was submitted in January 2013. Following a request for further information from An Bord Pleanála (ABP) an Environmental Impact Assessment was submitted in August 2013 and a subsequent oral hearing on the scheme was held in November 2013.

An Bord Pleanála granted permission for the scheme in April 2014 reference: PL11.VA0015.

The following statement was taken from page 7 of the ABP planning approval which highlights the assessment of the application.

Taking all of the above into account, and having regard to the nature, scale and location of the proposed development, and to the demonstrated need for the development, it is considered that, subject to compliance with the conditions set out below, the proposed development:

- *would be in accordance with national policies and guidance, and with regional and local development policies,*
- *would represent a benefit for this region by virtue of the enhancement of electricity supply,*
- *would not seriously injure the amenities of the area or of property of the area,*
- *would not seriously injure the ecology of the area, including bird life, protected species and habitats, and areas designated for environmental protection,*
- ***would not give rise to water pollution, and would not affect drinking water supplies,***
- ***would not adversely affect the hydrology or hydrogeology of the area,***
- ***would not give rise to risk of or exacerbation of flooding,***
- *would not be prejudicial to public health,*
- *would not detract from the character or setting of features of architectural or archaeological heritage, and would not seriously detract from the cultural heritage of the area,*
- *would be acceptable in terms of traffic safety and convenience, and*
- *would, therefore, be in accordance with the proper planning and sustainable development of the area.*

The elements relative to this assessment are highlighted in bold.

The unauthorized works commenced on the Coolnabacky site, in April 2017, prior to the discharging of planning conditions. When the situation came to the attention of EirGrid, all works were ceased and no further works would take place until the planning conditions have been discharged.

Following consultation with Laois County Council at a meeting held on the 30th June 2017 it was agreed to remove the works already undertaken at the drain crossing and tower location shown on Figure 2-1 and the enforcement notice dated 31st July 2017 was issued based on that understanding.

2.1 WHAT IS AN AQUIFER?

Aquifers are quaternary deposits or rocks that contain sufficient void spaces and which are permeable enough to allow water to flow through them in significant quantities. The potential of rock to store and transport water is governed by permeability of which there are two types, intergranular and fissure permeability.

Intergranular permeability is found in sediments, sands, gravels and clays and fissure permeability is found in bedrock, where water moves through (and is stored in) cracks, fissures, planes and solution openings.

Based on the desk study information a Regionally Important Karstified (diffuse) bedrock Aquifer and a Locally Important Sand/Gravel Aquifer underlie the proposed substation. The bedrock aquifer is classified as a Regionally Important Aquifer (Rkd); referring to the Ballyadams Formation.

Gravel deposits are also present in the area which will also act as an aquifer when sufficiently thick, permeable, saturated and extensive. The proposed substation is mapped on the boundary of Timahoe-Stradbally Locally Important Gravel Aquifer however as detailed below in section 2.6 of this report and the EIA, no significant saturated sand and gravel deposit was encountered in the vicinity of the substation site.

2.2 HOW DOES AN AQUIFER WORK?

In general terms it would be expected that the groundwater gradient would follow the topographic variation in an area. Flow paths and distance is dependent on the characteristics of the aquifer type. Most groundwater flow is confined to the upper 10m of weathered bedrock (if present) and gravel aquifers and will discharge to the nearest watercourse. The nearest large river is the Timahoe river, approximately 600m to the south east of the site shown on Figure 2-1. The groundwater flow direction is assumed to also be to the south east.

2.3 SITE TOPOGRAPHY AND SURFACE HYDROLOGY

The substation footprint lies between 100 and 120 metres above ordnance datum (AOD) on gently undulating land as shown on Figure 2-1. Low esker ridges (sand & gravel) form the higher ground. One such esker runs north-south, 250m southeast of the granted Coolnabacky

Substation. Further to the east lies an extensive alluvial flat, drained by a number of deep drains. A dry drain is located to the west of the substation location.

To the south, a number of deep drainage ditches drain to the Timahoe River. While these drains were dry during the site visit in July 2017, a high water table is likely due to the presence of Reed Canary Grass and other semi aquatic vegetation at the base of the drain.

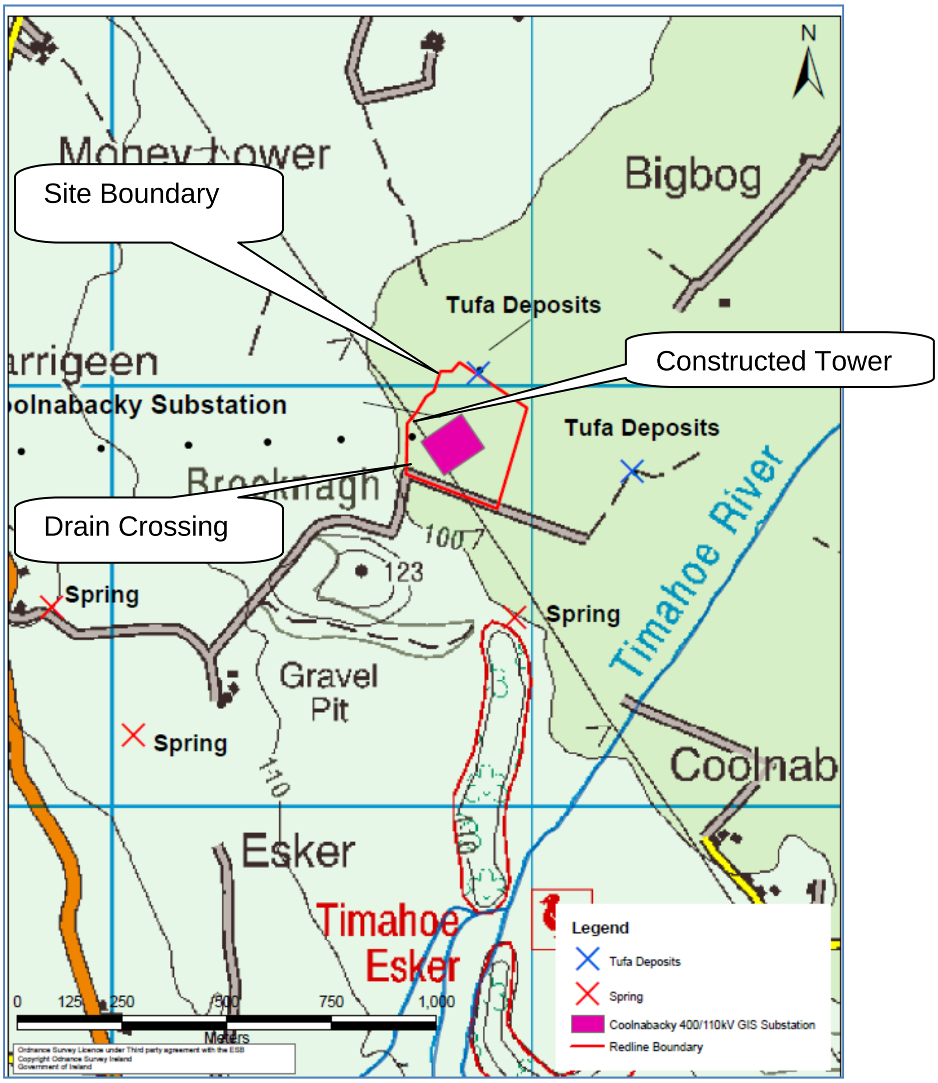


Figure 2-1 Site Outline with nearest surface water features

The area lies at the headwaters of the Timahoe River as shown on Figure 2-1. The topographical gradient at the substation site is relatively flat with a slope ratio of less than 1/50. The area is underlain by a variety of soils. The alluvial flat is underlain by alluvial soil, much of which is characterised by a high water table. The land above and alongside the Timahoe Esker has very well-drained soils. To the south of the substation a former quarry has been reinstated and is currently in agricultural use. The glacial tills at the foot of the Castlecomer Plateau have given rise to well-drained soils. Tufa deposits are present on the site boundary but these are over 100m from the substation footprint, a significant distance outside the recommended 25m buffer stated in the EIA.

2.4 SITE GEOLOGY

The bedrock geology of the area comprises Upper Carboniferous limestone bedrock. The bedrock is summarised below (from McConnell, 1994).

Ballyadams Limestone Formation

This formation consists mainly of medium to dark-grey thick-bedded to massive shelf limestones. The upper part of the formation tends to be cyclic, dark, rather argillaceous thin bedded limestones passing up into massive pale grey limestones which are capped by small scale karstic features (McConnell, 1994). The area lies at the northern end of the Castlecomer Plateau, an elevated syncline (v-shaped fold). The bedrock succession dips southwards at low to moderate angles.

2.5 SITE SUBSOIL GEOLOGY

The subsoils of the area consist of esker sands and gravels, limestone sands and gravels, tills and alluvium.

At the substation, excavated material was stored along the western boundary. The material is consistent with the borehole logs previously completed at the site. The subsoil material comprises limestone till with occasional lenses of sand. The till is predominantly comprised of firm to stiff, grey slightly sandy slightly gravelly clay. No bedrock was encountered in any boreholes completed on site. The deepest borehole at that time extended to 8.5 metres below ground level (see BH 4 in Fig 2-2). No bedrock outcrop is recorded at the site and no exposures were encountered in trial pits, borehole or in adjacent drainage ditches.

Timahoe Sands and Gravels

The Timahoe esker is a prominent feature in the area, traversing a sinuous course from east to west. Much of the deposit has been removed by gravel working. The deposits consist of clean, well sorted sands and gravels. To the south of the substation is a former sand and gravel quarry that has been reinstated and is currently in agricultural use. The site is mapped as lying within the Timahoe gravel – a Locally Important Gravel Aquifer.

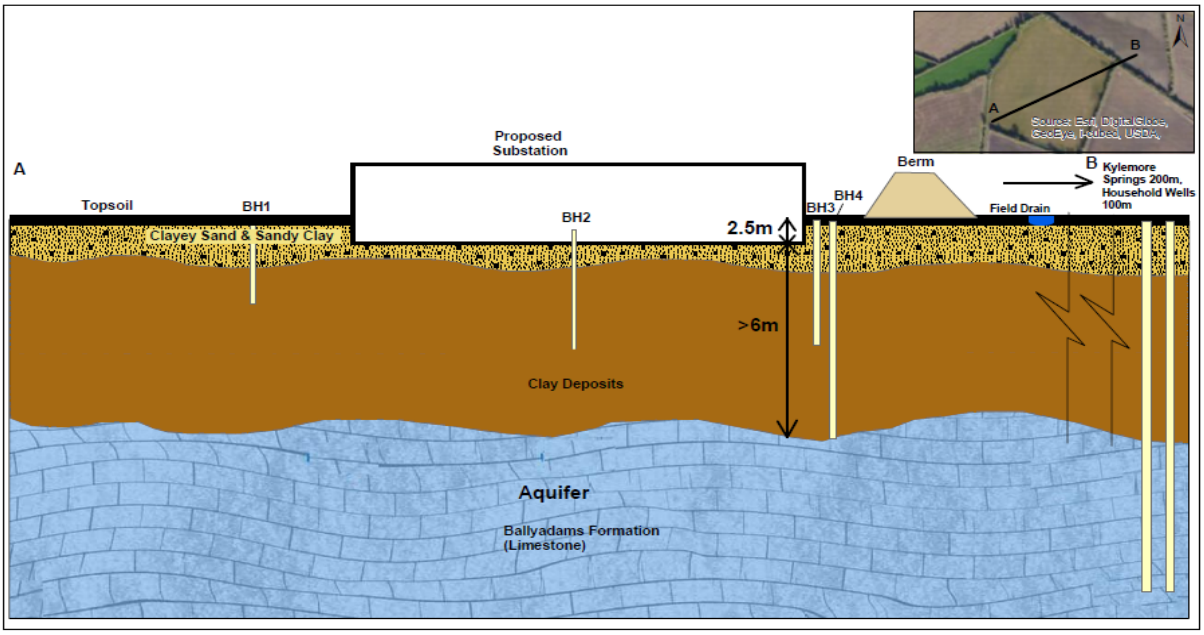


Figure 2-2 Proposed Layout - Conceptual Site Model

2.6 HYDROGEOLOGY

Groundwater can be defined as water that is stored in, or moves through, pores and cracks in sub-soils or bedrock. Aquifers are quaternary deposits or rocks that contain sufficient void spaces and which are permeable enough to allow water to flow through them in significant quantities. The potential of rock to store and transport water is governed by permeability of which there are two types, intergranular and fissure permeability. Intergranular permeability is found in sediments, sands, gravels and clays and fissure permeability is found in bedrock, where water moves through (and is stored in) cracks, fissures, planes and solution openings.

TOBIN Consulting Engineers note the edge of the Timahoe-Stradbally Gravel Aquifer is mapped as underlying the site based on desk study information provided. During 2012 site specific ground investigation works stiff to very stiff clay was encountered at all locations between 2.8 m and 7.6 m below ground level. This stiff clay will impede any vertical groundwater flow to the bedrock aquifer.

2.7 GROUNDWATER PROTECTION ZONES

There is no groundwater source protection zone (SPZ) at the site. The nearest mapped source protection zone is >2km to east, i.e. Kyle Spring SPZ.   There is no connectivity between the site and Kyle Spring as delineated by the Kyle Spring SPZ.

3 WORKS COMPLETED

3.1 UNAUTHORIZED WORKS

Following a desktop review of the EIA documentation and the planning report a site visit took place in July 2017. A partially constructed tower and completed foundation pads were in place at one tower location as shown in Photograph 1. Along with this a number of tower sections and pole sets were stored in the field and there was no ground foundation works associated with these tower sections (Photograph 2). A dry drain crossing was created to facilitate the access to site (Photograph 3). No further works were visible within the site.

Photograph 1 Tower foundation following unauthorized works.

Photograph 2 Materials retained on site following unauthorized works.

Photograph 3 Dry drain crossing following unauthorized works.

3.2 RESTORATION WORKS

Restoration works were undertaken between the 23rd August 2017 and the 5th September 2017. Restoration works included:

- Dismantling the partially erected tower and digging out of the associated bases
- Transportation of all materials from the site
- Removal of stoned access created over drain
- Make good all disturbed lands
- Allow local hedgerows removal to naturally regenerate

A pre mobilisation meeting on the 9th August 2017 was attended by TOBIN Consulting Engineers to discuss the proposed works. Following this meeting the contractor Reach Active provided a method statement (Appendix C) for review and subsequent approval by TOBIN Consulting Engineers prior to works starting.

This method statement was reviewed against the proposed mitigation within the EIA to ensure compliance with the EIA requirements.

The removal of a single tower required minimal disturbance to ground. The proposed restoration works posed little risk of sediment loss on a level site with no streams within 100m. TOBIN Consulting Engineers confirmed, based on ground conditions and the detailed mitigation measures outlined in the EIA, there was no requirement for the use of silt traps as a part of these restoration works. This was due to the large distance (>100m) to any stream, negligible gradient on site and limited excavation works.

The restoration works were undertaken in accordance with the Method Statements from Reach Active and were supervised by TOBIN Consulting Engineers staff, John Dillon PGeo and Monika Kabza PGeo.

John Dillon has 14 years' experience in providing project management, project co-ordination and specialist contribution to hydrogeology, hydrology and geology reports for planning applications, environmental impact statements and waste licence applications. His experience also includes groundwater resource exploration and development, groundwater vulnerability, groundwater protection assessment, design and management of site investigation/remediation programmes, contaminated land site investigation, water quality monitoring and hydrogeology.

Monika Kabza has 10 years' experience in hydrology and hydrogeology, her background includes the completing the National Vulnerability Mapping and delineating the Zone of Contribution for Group Water Schemes. Their CV's are attached (Appendix D).

A site welfare compound was located in the adjoining farmyard, away from the restoration works. Welfare facilities were provided and used by all site staff. Any effluent generated by temporary onsite sanitary facilities was taken off-site for appropriate treatment. Site vehicles and equipment were refuelled in a designated area at the site compound. All equipment was in good working order during the works. Spill kits and hydrocarbon absorbent packs were available for use. These measures were consistent with the mitigation measures detailed in section 8.5 of the EIA.

When the work started the foundation caps, as shown in Photograph 4, were removed. This allowed the tower steelwork to be disassembled. Once the steelwork sections were removed the topsoil and subsoil surrounding each tower leg was excavated to approximately 2 m depth. This enabled the concrete to be broken down using a rock breaker. This is shown in Photographs 5 - 7 where concrete is broken into manageable sized pieces for removal.

When all the concrete for that leg was removed using an excavator this was stored separately for removal. The stored subsoil and topsoil was used to reinstate the area where the foundation was removed. Photograph 8 shows the stored topsoil and Photograph 9 shows the subsoil being used for reinstatement. This process was completed for the remaining three tower legs and the area following restoration is shown in Photograph 10.

All the concrete was removed from site and environmentally disposed of using a licensed contractor, AES based in Kyletalesha, Portlaoise, County Laois.

All overhead line materials that were stored on the site were removed to the ESB Networks compound. Following the completion of the site works the drain crossing was removed and restored as shown in Photograph 11. A number of Photographs are included below of the restoration works undertaken by Reach Active.

Photograph 4 Tower legs pre-removal.

Photograph 5 Tower leg removal.

Photograph 6 Tower leg removal.

Photograph 7 Tower leg removal.

Photograph 8 Stored topsoil to be reinstated.

Photograph 9 Tower leg reinstatement with subsoil.

Photograph 10 Site location following restoration works.

Photograph 11 Reinstated Drain and Dry Bank following removal of drain crossing.

4 ASSESSMENT OF IMPACT ON AQUIFER

Below is a summary of the impact assessment of the unauthorised works and the restoration works undertaken to comply with enforcement notice from Laois County Council.

4.1 ASSESSMENT OF UNAUTHORISED WORKS

A partially constructed tower and completed foundation pads were in place at one tower location (See Photograph 1). Material stored on site comprised raw materials including steelwork is shown in Photograph 2. The dry drainage ditch crossing and site access are shown in Photograph 3. Based on site walkover no changes to the overall site topography or runoff patterns occur as a result of the dry drain installation. No impermeable surfaces were constructed for the site access. There was no evidence of siltation of the nearby drains occurring as a result of the unauthorized works. Natural stones and soil were stored in a neat stockpile on site and partially revegetated. Areas identified as tower bases for the remaining towers on site were left indistinguishable from the adjoining areas.

Based on the initial site walkover in July 2017 and an inspection of the nearest potential receptors there was no identifiable hydrological or hydrogeological impact as a result the works completed up to that point.

4.2 ASSESSMENT OF RESTORATION WORKS

Restoration works were initiated by Reach Active following completion of the relevant Health and Safety requirements for the site. The excavation works were supervised by TOBIN Consulting Engineers staff as detailed in Section 3.2 above. The Photographs 5 to 8 illustrate the dry conditions encountered on site and also highlight the presence of glacial till material encountered underlying the site. As can be seen in Figures 5 to 8 the dry conditions on site did not require any additional measures such as groundwater pumping.

No significant sand and gravel deposits were encountered. Minor groundwater seeps were encountered in two of four tower leg excavations, however no accumulation of groundwater occurred in the excavations. The minor seep is consistent with ground conditions detailed in the EIA provided to TOBIN Consulting Engineers. The material encountered, as shown in Photographs 5 to 9, was consistent with the descriptions provided to TOBIN Consulting Engineers from the original ground investigation data by Soil Mechanics. Photographs 10 and 11 demonstrate the site condition of the tower base and drainage ditch following completion of the works.

The Contractor Reach Active fully adhered to the method statement and completed daily risk assessments on the site. These restoration works were completed by the same contractor as the unauthorized works. The contractor showed a high level expertise and professionalism during the restoration works.

No contamination of the existing drains occurred. All the materials that have previously been stored on site were removed with no impact on the Hydrology / Hydrogeology of the site. All mitigation measures detailed in section 8.5 of the EIA and relevant to the restoration works were implemented including the provision of welfare facilities, provision of spill kits etc.

Following the completion of the restoration works TOBIN Consulting Engineers can confirm that given the absence of a source of contamination and the depth of low permeability subsoil, no feasible source-pathway-receptor exists on site to the Regionally Important Aquifer (Rkd); referring to the Ballyadams Formation. All three elements (source, pathway and receptor) are required to present a potential impact to the receptor(s).

No saturated gravels were encountered on site and therefore there was no impact on the Timahoe - Stradbally Locally Important Gravel Aquifer, a result of this development.

5 CONCLUSION

All restoration works were completed by the 5th September 2017. TOBIN Consulting Engineers supervised the restoration works and the contractor fully adhered to the method statement in terms of Hydrology and Hydrogeology.

The unauthorized development and restoration works were assessed by the Hydrologist / Hydrogeologist and the conclusion is that the works:

- Did not adversely affect the hydrology or hydrogeology of the area;
- Did not give rise to water pollution, and did not affect drinking water supplies; and
- Did not give rise to risk of or exacerbation of flooding.

The original assessment approved by An Bord Pleanála considered the overall scheme with a more significant impact and concluded there would be no adverse impact on the Hydrology / Hydrogeology of the area. The above conclusion on a smaller area is consistent with the assessment made within the Environmental Impact Assessment that formed part of the planning approval for the overall substation proposal.

It is concluded the unauthorized works and subsequent restoration works did not have an adverse impact on the aquifers.

Appendix A

Rcv'd 01 AUG 2017

→ RMcC / TF / JF

REGISTERED POST

PLANNING AND DEVELOPMENT ACTS 2000 - 2016
(SECTION 154)
ENFORCEMENT NOTICE
(UNAUTHORISED DEVELOPMENT)

Enforcement notice served on: **UD17/33**

Fintan Slye, Director, EirGrid Public Limited Company, The Oval, 160 Shelbourne Road,
Ballsbridge, Dublin 4, D04 Y2Y4

Notice

Laois County Council, as local authority with responsibility for enforcement of the Planning and Development Act 2000 – 2016 in the County of Laois, hereby issues this Enforcement Notice to you pursuant to Section 153 and Section 154 of the Planning and Development Act 2000,as amended, in respect of unauthorised development carried on by you at the townland of Coolnabacky, in the barony of Cullenagh, and County of Laois and postal address of Coolnabacky, Timahoe, Co. Laois, more particularly identified in the map annexed to this notice and outlined with a red line. The lands in question are referred to below as "the lands".

or

You are a director of the body corporate responsible for carrying out unauthorised development on them.

Nature of Unauthorised Development

The unauthorised development consists of

Unauthorised site development works in non compliance with conditions of Strategic Infrastructure Development Ref 11.VA0015.

This development is unauthorised because:

- * The carrying on of this development on the lands is not exempted development and is unauthorised development comprising unauthorised works.
- * The carrying out of development which is the subject of a permission granted under either under Section 34 or 37 of the Planning and Development Act 2000, as amended, or under Part IV of the Local Government (Planning and Development) Act 1963 in non-compliance with a condition to which that permission is subject is unauthorised works and amounts to unauthorised development as defined in section 2 of the Planning and Development Act 2000, as amended.
- * The development commenced on or after 1 October 1964.

Requirements

Pursuant to Section 154(5)(a) and (b) of the Planning and Development Act 2000, as amended:

You are hereby required to:

- Cease the said development on receipt of this notice.
- Carry out the restoration works on site in accordance with the restoration plan dated 4th July 2017, which was received by the Planning Authority on 4th July 2017, by 4pm on 8th September 2017.
- Carry out a hydrological/hydrogeoloical report to assess the impact of the unauthorized development on the aquifer by a suitably qualified person and submit this report to the Planning authority by 4pm on 22nd September 2017.

Warning

Pursuant to Section 154(5)(c) and (e) of the Planning and Development Act 2000, as amended:

Please note that, unless you take the steps specified above within the time stated (or such extended period not exceeding six months as the Council may expressly allow):

1. You may be guilty of an offence; and
2. The Council may enter on the land and take such steps, including the removal, demolition, or alteration of any structure, and may recover any expenses reasonably incurred by it in that behalf.

Costs

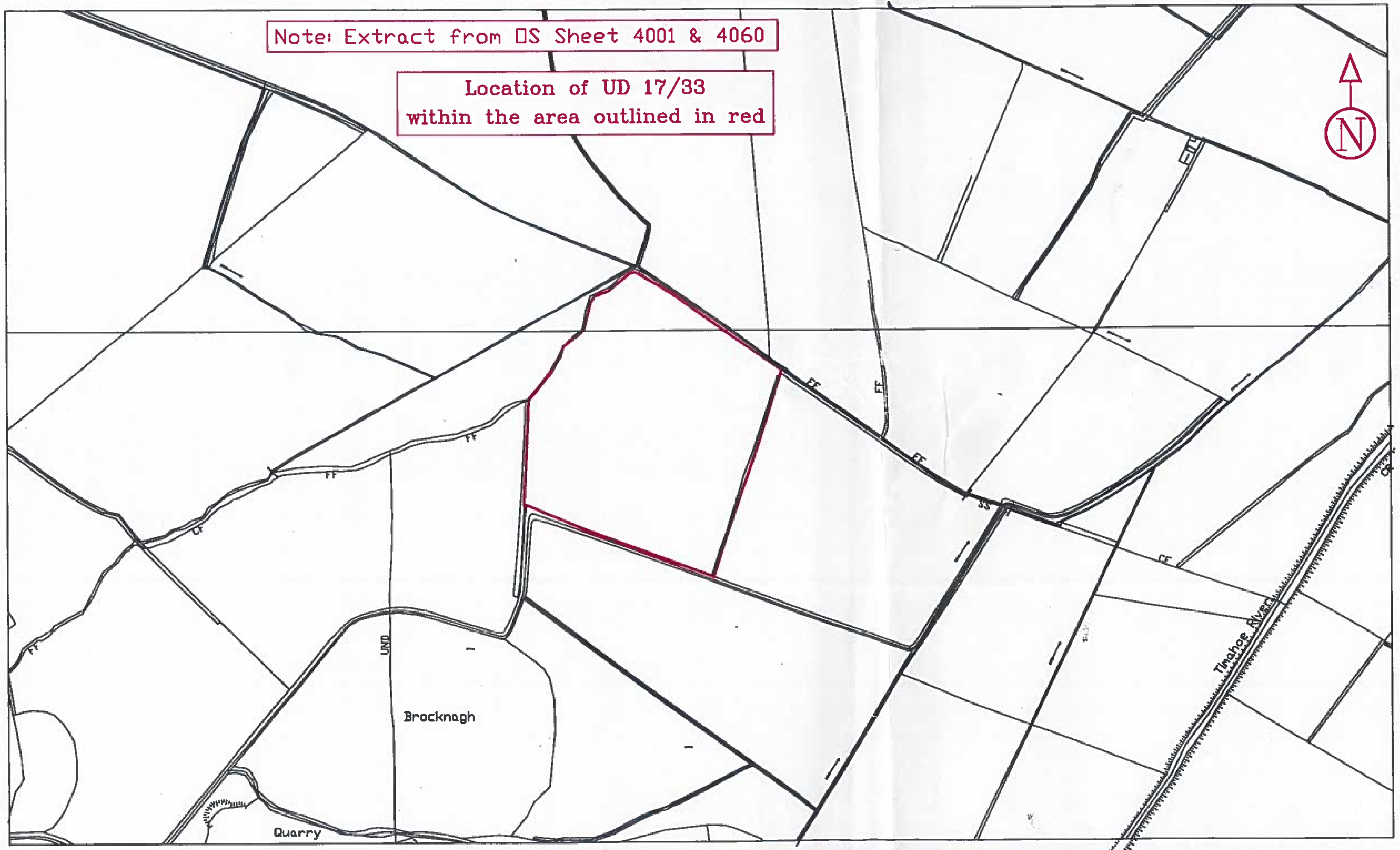
Pursuant to Section 154(5)(d) of the Planning and Development Act 2000, as amended:

You are hereby required to refund to the Council the sum of €1,200, being the costs and expenses reasonably incurred by it in relation to the detection and issue of this Enforcement Notice and Warning Letter dated 30/05/2017. This sum includes costs incurred in respect of the remuneration and other expenses of employees, consultants and advisers.

Signed on behalf of Laois County Council:

ANGELA MCEVOY
SENIOR PLANNER
PLANNING

Dated: 31st **JULY 2017**



Note: Extract from OS Sheet 4001 & 4060

Location of UD 17/33
within the area outlined in red

Laois County Council
Comhairle Chontae Laoise

Kieran Kehoe,
Director of Services, Planning

County Hall
Portlaoise,
Phone (057) 8664000

Planning Enforcement

Unauthorised Development

Location:
Unauthorised development at
Coolnaback, Timahoe, Co. Laois.

Drawn: Y.O'Reilly., Exe. Tech.

Checked:

Orignal scale: 1:5000

Date: 26/07/2017

Drawing No: 17/33-01

UD 17/33

Appendix B

EIRGRID

www.eirgrid.com
The Oval, 160 Shelbourne Road
Ballsbridge, Dublin D04 FW28, Ireland
Telephone +353 1 677 1700
Email info@eirgrid.com

FAO: Michael Callan,

Assistant Staff Officer,
Planning Enforcement,
Laois County Council,
Áras an Chontae,
Portlaoise,
Co. Laois.

4th July 2017.

Re: Unauthorised Development at Coolnabacca, Co. Laois.

Ref. U.D. 17/33

Proposal to restore the lands at Coolnabacca to their original condition.

Dear Michael,

EirGrid acknowledges receipt of the Letter from Laois County Council, dated 21st June 2017 requesting a proposal to restore the lands to their original condition.

Our proposal in respect of same is set out below. In order to restore the lands EirGrid propose to undertake the following works:

- Dismantling the partially erected tower and digging out of the associated bases
- Transportation of all materials from the site
- Removal of stoned access created over drain
- Make good all disturbed lands
- Allow local hedgerows removal to naturally regenerate

The following plant would be required to undertake these works:

- Lorries
- Excavators
- Rock breaker
- Dumper
- Associated site facilities

The timeframe to undertake these works would be five weeks, which includes the time for mobilization of contractors.

We also note that such works set out in this proposal comprises development as defined under the Planning and Development Act, 2000 (as amended).

Yours sincerely,

Des Cox
Senior Planning Consultant,
EirGrid PLC.

EirGrid Plc
The Oval
160 Shelbourne Road
Ballsbridge
Dublin D04 FW28
Ireland

Company Registration
No. 338522

Appendix C

Document	ERA HV 232	**Removal of 110kV Tower foundation Athy-Portlaoise Diversion**		**Page**	1 of 31
Issued	24-05-2012			**Reviewed By**	D Crowley
Reviewed	30-03-2017			**Written by**	J Cosgrove
Review Due	24-04-2017			**Type**	Generic
Owner	ERA				

Method Statement

Removal of 110kV Tower Foundations
Athy-Portlaoise Diversion

Data Protection: The information and data provided herein shall not be duplicated, disclosed or disseminated by the recipient in whole or in part for any purposes whatsoever without prior written permission of ERA

1. CONTENTS

Revision history

Rev	Date	By	Approval (ERA)	Reviewed (ESB)	Description of Modification
5	30.11.16	DF			Table of Contents Revision History Method for Placing Tower Base Tower Placement Check Sheet
6	23.03.17	MF			Risk Assessment review
7	30/03/17	DC			Update for Athy-Portlaoise 110kV Diversion.
8	04/08/17	JC			Update for Athy Portlaoise Remedial Works
9	19/ 08/2017	JC			Revised as per Eirgrid Request

2. PURPOSE

Health & safety method statements have proved to be an effective & practical management tool, especially for higher risk work. A health & safety method statement draws together the information compiled about the various hazards and the ways in which they are to be controlled for any particular job.

The health, safety, Environmental & welfare method statements takes into account the conclusions of assessments made under all the Safety, Health, Environmental and welfare legal obligations of the country ERA are operating in. Additional, site specific, personal risk assessments will be necessary. Account has been taken of the Company's health & safety organization, current legislation, codes of practice, training procedures & staff selection processes.

This is a generic document and the details described will apply under most circumstances, however conditions vary from site to site. Design & work planning and personal risk assessment should be used to identify and control the hazards at all stages during the job.

3. SCOPE

This Method Statement is prepared for the:

- Set up site (enclosure).
- Access Road.
- Scan dig area and prepare Permit to dig for crew.
- Break concrete and Excavate out the existing foundations to depth as required.
- Reinstate hole with existing backfill and topsoil
- Removal of drain crossing reinstatement of site

following completion of works

4. RISK ASSESSMENT

Excavations:

- All excavation work will be carried out in accordance with this method statement, ESBN procedures and in accordance with COP Avoiding Danger from Underground Services and A Guide to Safety in Excavations.
- ERA will issue excavation permits to the machine operators and copies of these permits will be kept in the cab of the machine carrying out the excavation.
- Prior to excavation work commencing, each area will be scanned for services along with consultation with ESB (Central Site), relevant Station personnel, Bord Gais, Eir and the local council.
- Excavations will be fenced off, signposted and protected if they are left unattended irrespective if the depth of the excavations.
- All areas must be scanned prior to excavation / clearance works and the scan log sheet will be filled out. All known services will be clearly marked and identified on site. Trial holes may need to be dug to determine exact location and depths of services.
- All services should be assumed live at all times.
- When working near live sewage gloves must be worn at all times and good hygiene practices to be carried out by all personnel.
- Pumps will be available, if required to keep the excavations free of water.
- Flooded trenches are to be drained as soon as possible and are to be fully inspected by a competent person, prior to work re-commencing.
- Areas that have been scanned and have a permit will be identified in the scan log sheet, and where there may be continuous excavation works required the area where the permit and scan has been carried out will be marked with a physical barrier.

- Properly secured stop blocks or a suitable alternative shall be used (when possible) where trucks or other plant are tipping into the excavation or when they are in close proximity to the excavation.
- Only hand digging is permitted within 0.5 m of known services.
- For all excavations, excavated spoil will be placed at a safe distance away from the open excavations, to avoid risk of danger to persons at ground level or at work below, and also to facilitate safeguarding of excavations if they remain open overnight. All unwanted spoil will be removed from the site to a licensed tip by a licensed hauler. Relevant permits will be stored in the health and safety file. Safe distances will be determined on site taking account of live apparatus, ground conditions, weather, soil types, and evidence of collapse or weakening of the side walls of the excavations, etc.
- If it will be required to leave any excavation open overnight, the excavation will be protected by the erection of suitable fencing and Danger/ Warning notices. Where excavation is taking place, the safety of ERA staff and all others must be fully catered for, including the provision of fencing and signage.
- Where excavation is taking place near, or in the vicinity of, existing structures, care will be taken to avoid damage to or subsidence of these foundations etc.
- There will be suitable access provided to all excavations.
- All excavations greater than 2 meters' depth that require personnel to access will be inspected with the results recorded on the AF3.
- Slinger/Signaler will assist with the directing and loading/offloading at all times.

Vehicular and Pedestrian Traffic:

- Access/ egress to the work sites will be signposted and all personnel coming on to site must sign in on the J.S.S.P daily. Signage will also be erected on the public road to warn the public of the presence of construction traffic in the area. Controls will be put in place on access/ egress routes within the work area to ensure pedestrian safety.
- Extreme care is required when exiting/ entering the sites at all times.

Additional Controls:

- GA1 Cert available for Excavators, Site Dumpers
- GA2 forms to be completed for all of the above.
- CSCS trained staff for Slinger/Signaler, Excavator / Dumper drivers and for locating Underground Services.
- Clean as you go system in place. Regular housekeeping will be conducted to reduce trip hazards. The works area will be maintained at all times to achieve a safe place of work.
- Workers must be aware at all times of site restrictions and close proximity of Overhead lines and the presence of a large number of heavy plant working on site.
- Note in this case Height Restrictor at 4.7m will be required on the excavator for works below the 110kv line
- All vehicles, plant and machinery to have flashing beacons and rear mounted cameras as required.
- When operating machinery mobile phones are not to be used.
- On site speed limit of 10 Km/h to be obeyed at all times.
- Manual handling of items should be kept to a minimum.
- All employees will have manual handling training
- Mechanical handling equipment shall be used, where possible
- Slinger/Signaler will assist with the directing and loading/offloading at all times.
- Barriers and signage will be checked regularly by the site supervisor
- Drains should be inspected on a daily basis

Personal Protective Equipment Required

- Safety Boots with ankle protection
- Safety Helmets and chin straps.
- High Visibility Vests.
- Gloves.
- Safety Glasses
- Ear defenders for Sheet Piling/Rock Breaking

5. HEALTH AND SAFETY INSTRUCTIONS FOR PERSONS INVOLVED WITH THE WORK

- Conduct work in compliance with this work method statement.
- Comply with site safety rules as indicated during induction
- Comply with requirements of permit system
- Obey all instructions from PSCS and ESB Staff

6. INSPECTION AND MAINTENANCE

All safety critical equipment will be inspected immediately prior to use. Complex equipment is allocated a unique number and is maintained by qualified technicians at least in line with manufacturers' recommendations.

Lifting equipment is formally inspected and marked every six months, and weekly by the user GA2. Electrical equipment is formally inspected marked every twelve months. Formal defect reporting systems are in place. Maintenance and inspection details are recorded and kept.

7. TRAINING

- Induction Training by PSCS
- Tool Box Talk on contents of Method Statement by ERA management
- Manual Handling Training
- FAS Safe Pass Training
- CSCS Slinger / Signaler
- CSCS Track Machine Operator
- CSCS Dumper Operator
- Certification for all slings, chains and lifting appliances within site safety file
- Abrasive wheel training as required
- First Aid Training

8. COMMUNICATION AND INFORMATION

Before planned work takes place, a briefing pack of information will be collated. The contents of this pack will be discussed with those carrying out the work. The briefing pack will be available at the point of work and may contain;

Completed JSSP	Appropriate plans, drawings and sketches
Manufacturers operating instructions	The work instruction
Information relating to any safety documents relevant to the job (i.e. PTW etc.)	Other information which may assist in reducing on site risks (i.e. Jumper configuration sheet & Polarity check sheet)

Certain tasks require that all those doing the work agree clear communication systems before work starts. Special consideration should be given to the nature of the work and the environment (e.g. noise, poor visibility, intricacy of the work etc.). Mobile phones or 2 way radios are supplied.

9. STEP BY STEP SEQUENCE INVOLVED IN DOING WORK

Site Set-up (enclosure):

- All persons will have attended an onsite induction prior to entering the site and this method statement(s) will be communicated to and signed off by all personnel engaged in the works.
- A daily JSSP will be completed and signed by all site visitors
- A suitable site entrance will be established with cones and signage erected on the roadside.
- Parking areas will be identified close to the work zone to allow safe loading and unloading of plant, materials and employee movement.
- Site welfare facilities will be identified and arrangements made for their use by ERA staff.
- A site exclusion zone will be established. This zone should be large enough to accommodate all activities associated with the civil works to be undertaken. This area will be delineated using white fencing post and 6mm blue nylon rope.
- A site multi board will be erected at the site entrance and will contain details of the site rules and PPE requirements.
- Addition signage such as ‘Deep Excavation’ and ‘No Entry’ will be erected along the perimeter line.
- Barriers using timber handrails will be erected around the excavation area.
- An area on site will be designated for the temporary stockpiling of excavated material.
- The entire site will be scanned for underground services with a Cable Avoidance Tool.
- A scan log sheet will be completed by a competent person.
- An excavation permit will then be completed before the works can commence.
- Ensure appropriate training records and certifications are included in the site safety folder.

Access Road / Site Area

- Route and direction of access road will be pre-agreed with Reach Active 360 Excavator and Site Dumper will be used.
- All soft material, including topsoil will be excavated and side casted with the Excavator.
- Where required, a sub base layer of aggregate will be placed
- Terram will be rolled out the full length of the access road footprint with a top/ finish layer of aggregate if required.
- Area will be rolled with Excavator to provide compaction of aggregate

- Where works are taking place underneath Overhead Lines – a Height Restrictor will be fitted to the Excavator and adjusted to ensure Close Proximity is not breached.

Excavate out the existing bases to the depth as required.

- With the excavation permit in place, the excavator can set up over the first existing leg base[A], as is on site.
- Typically, a 13-ton excavator with a selection of rock breaker, trenching, digging and grading buckets will excavate to the required depth (3.2 m below original GL)
- The excavator driver will endeavor to maintain clean vertical faces to the excavation. Over-break and loose debris will be removed as the excavation proceeds.
- Spoil will be side cast and stockpiled not less than 3.5 m from the closest edge of the excavation.
- Where necessary spoil may be loaded directly into a site dumper or other transport provided that the operator of such transport is clear of the vehicle. This particularly applies to Dumper drivers.
- Once the excavation is complete, an AF3 form will be completed every day that the excavation remains open.
- All excavated material will be removed off site to a licensed waste disposal company.
- Once the excavation is complete, Hole [A] will be photographed for future reference and will be checked on site by a competent person.
- Hole A will then be back filled and compacted every 300mm with the existing spoil previously removed from the hole.
- This process will be repeated for legs B, C AND D

  Once backed and top 300mm top soiled, the area will be grass seeded as per existing grass specification.

Breaking out Rock

- Rock, when encountered shall be removed, to complete the excavation to required dimensions as per the design.
- A hydraulic rock breaker attachment shall be fitted to the excavator quick hitch and will be used to transfer impact forces, and to fracture the rock and reduce it to a size that will allow it to be removed using a standard bucket.
- A second excavator may be made available depending on the extent of the rock removal required.
- In addition to the standard PPE, ear defenders and eye protection shall be worn in the vicinity of the rock breaking activity.

10. SUPERVISION

- Project Manager
- Site Manager
- Civils Supervisor
- PICW

11. SPECIFICATION

All work must be carried out and completed in accordance with current method statements and client's O/H Line Construction Standards

12. EMERGENCY ARRANGEMENTS

Site first aider	Diarmuid Crowley (086) 0492744	Nearest Hospital	Hospital Tel.: 00353 57 862 1364 or 112
First aid located at	Site office/Vans	Fire point located at	Site office
Assembly point	Site compound	Spill kit located at	Site stores

13. AMENDMENTS – SIGNING SHEET

I herby verify that I have read and understand this document and have been given the appropriate training to carry out the work safely. My duties as an employee have been explained to me, with regards to Health & Safety

Print Name (Block Capitals)	Signature	Date

Risk Assessment

Ref	**Description**	**Hazards**	**Actual Risks**	**Without Controls**			**Control Measures**	**With Controls**		
				L	**S/C**	**RR**		**S/C**	**L**	**RR**
1	**Vehicle / Mobile Plant and Pedestrian Movement on Site**	**Slips, Trips & Falls Impact with Vehicles Blocked escape routes**	**Death Major Injuries Personal/public injury**	**5**	**5**	**25**	**Traffic Management Plan agreed with all parties available and briefed to all staff Pedestrians separated from vehicle movement by use of barriers and delineation. Reversing minimized to restricted area and controlled by use of banksman. Vehicles equipped with safety and warning devices. Driver monitoring systems. All vehicles maintained and records kept. All operators competent and certificated. High visibility clothing worn at all times. Ensure a traffic management plan is available where necessary.**	**5**	**1**	**5**
2	**Access and egress**	**Slips, trips, falls. Animals**	**Personal/public injury**	**3**	**3**	**9**	**Choose the correct point to gain access and egress to and from your work. Examine each site for the presence of animals that could cause you harm. At all times use the correct PPE for the task being performed and use in the correct manner. Be mindful of changes in site conditions as your work progresses e.g. change in weather conditions Always ask the owner about animals and livestock, be cautious around dogs,**	**3**	**1**	**3**

							even if they are friendly, and always keep gates locked after entry / exit to prevent livestock escaping. document on the JSSP			
3	**Manual handling**	**Pulling** **Pushing** **Lifting** **Lowering**	**Personal/public injury**	**3**	**4**	**12**	**Ensure the public is kept away from operations. Assess the task and use mechanical means if possible. Gloves must be used. Operative must be trained in manual handling procedure. Correct manual handling procedure must be adopted. Assess the item, which requires lifting. If it is too heavy to manually lift use mechanical means. If possible to lift manually use kinetic lifting technique as shown during your Manual handling Awareness Training. Seek assistance to make the lift.**	**4**	**1**	**4**
4	**Ground Work**	**Falling Objects/ Strain/ Trips**	**Soft tissue damage. Fracture, Cuts, Bruises/ Lacerations/ Fractures**	**4**	**5**	**20**	**Remain outside the exclusion zone. Use sash line to raise and lower equipment. Do not throw materials up. Request permission to enter the exclusion zone. Use correct manual handling procedures. Keep the site clear of materials, which could cause trips. Practice good housekeeping.**	**5**	**1**	**5**
5	**Visibility. Inadequate lighting**	**Poor visibility due to weather conditions. Slips, Trips and Falls**	**Ranging from minor bruising to fractures and possible fatality**	**4**	**5**	**20**	**Cease operations when visibility makes works area hazardous. Improve site visibility by using appropriate lighting where possible. Keep signage clean to maintain reflectivity. Ensure sufficient temporary lighting is available, stationary or mobile and regular checks**	**5**	**2**	**10**

							to ensure suitability by a competent operative **In case of lights failing, ensure they are supplied from two independent power sources. Hang lights to suitable points above head height wherever possible to avoid tripping hazards.** **Check the PAT test date is in compliance.**			
6	**Signage**	**Geography of work pace, junctions & slip roads,**	**Injury through vehicular accident, struck by vehicle. Ranging from minor bruising to fractures and possible fatality**	**5**	**5**	**25**	**Extend start of coning/ signage to provide better advanced warning to approaching traffic. Make sure traffic flows from junctions'/slip roads are incorporated into traffic management plan, consider additional control by traffic signals. Always ensure signs and cones are clean. Always have sand bags in the vehicle to secure signage on windy days. Place a courtesy sign at the entrance to the job site.**	**5**	**2**	**10**
7	**Controlling traffic**	**Collision or struck by vehicle**	**Injury through vehicular accident, struck by vehicle. Ranging from minor bruising to fractures and possible fatality**	**5**	**5**	**25**	**Position signs/lights for maximum warning and allow sufficient space for passing/waiting traffic. Make sure control method reflects traffic flow. Have manual control means available for emergency use. Complete a traffic management plan where necessary, only trained TM personnel can alter the flow of traffic**	**5**	**2**	**10**
8	**Pedestrian access**	**Struck by vehicles** **Uneven ground**	**Ranging from minor bruising**	**5**	**5**	**25**	**Install suitable safe pedestrian access points. Install diversions using pedestrian barriers as required.**	**5**	**2**	**10**

			to fractures and possible fatality				**Consider escort person for extreme situations. Keep pedestrian access routes clear and free from obstacles.**			
9	**Weather Conditions**	**Road accidents** **Accidents on site** **Lightning** **High Winds**	**Soft tissue damage. Fracture, Cuts, Bruises/ Lacerations/ Fractures**	**4**	**5**	**20**	**Remain outside the exclusion zone Endless sash lines to be attached to all loads being dismantled and erected. Co-ordinate with spotter/observer on a regular basis for sudden changes in weather conditions.** **Vehicle lights must be on at all times during adverse weather where visibility is limited. The site engineer will determine if work should stop on site due to the dangers of adverse weather. Suitable PPE to be provided for inclement weather.** **No work to take place near electrical structures when the lightning risk is high. Staff to remain a minimum of 10m away from structure. Follow the guidelines when operating vehicles always document changes in the weather in the JSSP i.e. wind, rain, ice, sun**	**5**	**2**	**10**
10	**Working at Heights**	**Falls from heights. Falling Objects.**	**Cuts & Bruises, Sprains, fractures & Fatalities.**	**5**	**5**	**25**	**A Harness must be worn at all times where there is a danger of a fall; it must also be attached to a suitable anchor point. Programmed inspection of harness belt and climb safe/ Daily inspection of climbing irons harness and climb safe. Recorded on the GA3 forms. Training, Experience and Knowledge required for task. Exclusion zone to be put in place and an observer to control the area when others work at height.**	**5**	**2**	**10**

11	**Pole climbing**	**Pole rot, Conductor damage, Animals, Creosote, Falls, Pole breaking**	**Death, Serious Injury, Fracture, Lacerations, Soft tissue damage.**	**5**	**5**	**25**	**Carry out pre-climb checks on poles to be climbed. Carry out checks on all adjacent poles. Carry out condition assessment on conductor in the span to be worked on and in the adjacent spans. Check all climbing equipment and ensure that all equipment is to the correct specification and is in a serviceable state for the purpose intended. Correct PPE to be worn. A physical exclusion zone must be in place around the pole before work commences. Hands must be covered to protect against contact with creosote. Hammer test the pole before climbing. Hammer test the pole while climbing. Climb safe must be used correctly Programmed inspection of harness belt and clickers (GA1). Weekly Inspection GA2. Daily inspection of harness and lanyards (ERA form). All correct PPE to be worn. Only trained personnel must work aloft. Adequate light must be used in darkness. The auxiliary belt must be used when drilling and climbing over objects. Climbing operations must cease for 0.5Hrs after thunder or lightning is heard or observed. Climbing must cease in excessive winds.**	**5**	**2**	**10**

12	Poor housekeeping	Slips, trips and falls.	Sprains, sprains, back injury , cuts	3	3	9	Maintain a good standard of housekeeping at all times, route cables and hoses so they do not obstruct the work area or walkways. Do not let bolts or tools accumulate at the feet of the operator. Remove waste material and transport it regularly to the disposal point and place it in an appropriate skip. Place all general and special waste in the bins provided.	3	1	3
13	Sharp edges and pinch points	Cuts and crush injuries.	Cuts , pinching , trapped fingers	3	3	9	All operatives must wear suitable gloves at all times. Care must be taken to avoid trapping your hands and/or fingers beneath objects being handled and during handling or lifting operation (pinch points), avoid and document pinch points in your JSSP. Dress all sharp edges when possible.	3	1	3
14	Ascending and descending from ladders	Falls from heights. Proximity to live overhead services, Falling objects	Death, Major injury, Fractures, Minor injury	5	5	25	Inspect the ladder before each use ensuring tag is affixed and in date, do not use if there is any damage to the ladder, report it immediately to your supervisor and quarantine ASAP. The ladder must be footed at all times. Keep ladder free of dirt grease or oil. Use correctly. Do not carry items up or down the ladder. The three points of contact must be maintained at all times. Watch out for live overhead services. Look for loose items where the ladder is resting	5	2	10

							(roofing materials, fascia, soffit) handling of material at ladder top and working to be limited to 30minutes per activity.			
15	**Use of All Terrain Vehicle**	**Speeding, loss of control, Overturning, carrying of passengers, carrying of materials**	**Death, Major injury, Fractures, Minor injury**	**5**	**5**	**25**	**Trained operatives only, no passengers, no operatives under 16 years. Correct PPE to be worn, Helmet, High visibility clothing, glove's. Reduced speed. No abnormal loading of the ATV. Use of cargo boxes to hold equipment. Limited use on roads. Switch on lights for better visibility of ATV.**	**5**	**2**	**10**
16	**Working from an MEWP**	**Over turning, Objects falling from heights, Incorrect use for lifting objects. Poor assessment of ground condition (soft, slope or level).**	**Injury to personnel, due to overturning, unstable load, falling out of the basket. Objects falling from the basket.**	**5**	**5**	**25**	**Only trained certificated MEWP operative to use. GA1 available in date and free of defects. Weekly GA2 to be carried out on MEWP and daily ERA inspection. Correct PPE to be worn. Harness to be worn at all times and attached to the designated anchor point in the MEWP with short 1 meter lanyard. Programmed inspection of harness and lanyards. Daily inspection. Recorded on the GA3 forms. The SWL load is not to be exceeded. The permitted amount of personnel is not exceeded. An assessment of the ground condition, slope and level for the position of the MEWP. Use of spreader plates underneath all outrigger plates when deployed. Ensure the Vehicle is fitted with lights**	**5**	**2**	**10**

							and rotating beacon. Only operate when safe to do so. Never operate a MEWP in high winds as per manufacturer's guidelines. **During erection works, area below MEWP to be have an exclusion zone erected and warning signs erected. Storage of material on the body of MEWP to be restricted due to hindrance of operation and risk of structural damage.**			
17	**Electrical Hand/Tools,**	**Hand injury , impact , fire**	**Electric Shock, Wrist Sprain, Entrapment**	**5**	**5**	**25**	**All Electrical tools and extension cables must have a valid PAT Test Certificate. Inspect before use, report any defects. Care must be taken during the drilling operation to avoid the drill from jamming causing it to make sudden twisting movements. Correct PPE to be worn. Tools should only be used for design purpose.**	**5**	**2**	**10**
18	**Hazardous substances**	**Respiratory problems, Chemical burns, Allergic reactions**	**Asphyxiation & respiratory damage, burns, Scarring**	**5**	**5**	**25**	**Carry out a risk assessment based on the material present. Wear the correct PPE, as stipulated in the assessment.** **Ensure all operatives have knowledge, training and experience. Have the material Safety Data sheet for the substance for reference. Smoke, fume and dust suppression if required. Emergency equipment present if necessary. Always ensure a trained first aider is on site.**	**5**	**3**	**15**

20	**Environmental Considerations**	**Pollution of the environment from work activities**	**Spillage of oils or fuels , waste left behind**	**3**	**4**	**12**	**Good housekeeping. Spillage containment and disposal. Smoke, fume and dust suppression. Emergency procedures. Ensure all operatives have knowledge, training and experience. Have the material Safety Data sheet for the substance for reference Ensure all operatives are trained in the use of spill kit awareness and deployment.**	**3**	**2**	**6**
21	**Lifting Equipment Teleporter.**	**Failing of equipment Striking of operatives Striking and overhead utility services Noise Overturning**	**Death Major injury Occupational Health injuries**	**5**	**5**	**25**	**Machine driver and Banksman to be trained and certified CSCS. All equipment to be inspected and colour coded, never use a piece of equipment that is not tagged (inspected). Lifting plan to be used if required. Ensure correct use of ground pads at all times. Check for overhead service if live and in local works area stop work. Relocate machinery away from hazard. Ensure Lifting equipment is certificated, maintained and checked daily by operator. Record of inspection to be filled out weekly (GA2) and daily ERA check sheet. Use correct safety pins, shackles etc. at all times**	**5**	**2**	**10**
22	**Use of Mobile Phone on Site**	**Lack concentration and control of equipment**	**Serious, Fatal Injury**	**4**	**5**	**20**	**While plant is in use, operators must not use mobile phones on site. All others only use phone when safe to do so. Drivers of vehicles must not use mobile phones when driving**	**5**	**1**	**5**

23	**Excavations**	**Overhead and Underground cables. Striking Underground services, eg. Gas, electricity, water, etc. Trench Collapse Impact with persons & structures from moving vehicles. Manual handling materials.**	**Electrocution, Death, injury, Burns Explosion Drowning Crush injuries Asphyxiation Damage to plant and Equipment**	**5**	**5**	**25**	**Use of cable plans, location equipment and cables marked prior to work. Trial holes. Safe digging Procedures. Exclusion zones around excavations. Display warning signs. Correct PPE to be worn. Complete a location survey. Check for signs of manhole covers and trenches. Mark services on the ground. Avoid parking on any areas suspected of having underground services. Scan ground after excavating 300mm of ground in case services are too deep to be picked up in original survey. Use of Trained, knowledgeable and experienced staff. Permit to work and Permit to dig in place and signed prior to any work. Spoil to be stored as correct distance from edge of excavation. Depth = distance from edge. Goal posts and bunting to be used for highlighting presence of overhead cables.**	**5**	**2**	**10**
24	**Animals/Livestock**	**Injury / bites / loss of control**	**Personnel injury, members of public**	**5**	**5**	**25**	**Ask the owner about animals and livestock, be cautious around dogs, even if they are friendly, and always keep gates locked after entry/exit to prevent livestock escaping. Fields with cattle, bulls maybe included within the herd. Erect exclusion zone to keep cattle away from works. Document on the JSSP**	**5**	**2**	**10**

25	**Fire**	**Burns, property damage, Soft tissue damage. Fracture, Cuts, Bruises, Lacerations, Fractures**	**Explosion, Death, injury, Burns, Property damage, vehicles / homes burns**	**3**	**5**	**15**	**Firefighting training provided.** **Provide suitable / sufficient firefighting equipment. Never use water extinguisher on an electrical fire** **Provide waste containers & remove rubbish on regular basis.** **Store flammable materials & substances correctly. No smoking/no naked flame notices erected. Ensure the first aid kit is fully stocked.**	**5**	**2**	**10**
26	**Working in a Noisy Environment**	**Noise**	**Damage to ears.** **Deafness** **Tinnitus.** **Stress.**	**4**	**3**	**12**	**PPE. Ear protection.** **Noise assessments.** **If noise levels exceed: (1) 80 dB(A)** **Notify employees, hearing protection advised.** **(2) 85dB(A)** **Notify employees, make hearing protection mandatory.** **Provide health surveillance** **Post warning signs.** **Silenced plant. Well-maintained & certified plant/equipment.** **Screen off area.**	**3**	**1**	**3**
27	**Contact with Electricity**	**Injury to Person** **Electrocution** **Burns** **Death**	**Injury to Person** **Electrocution** **Burns** **Death**	**5**	**5**	**25**	**Ensure adequate clearances are maintained from adjacent live equipment. Where necessary erect suitable barriers and use excavators fitted with height restrictors.** **Goal Posts or Controlled Gate System to be used for access under existing lines. Where clearances cannot be maintained lines to be made dead and earthed and permit to work issued. Protect against adjacent live parts.**	**5**	**2**	**10**

28	Plant & Equipment	Contact with persons on site Collision with other site traffic Poor working order Overturning	Electrocution, Death, injury, Burns Explosion Crush injuries Asphyxiation Damage to plant and Equipment Environmental Damage Occupational Health injuries	4	5	20	All operating staff trained in plant operation e.g. CPCS. Plant maintained and certificated. Lifting plan developed where necessary. Suitable and adequate plant for the operation. Specific risk assessment carried out. Do not leave keys in plant. Visually inspect plant to check it is in good order daily and complete inspection sheet. All plant should be properly certified Report and repair defects immediately – machine will be taken out of use until serious defects are repaired All personnel on site must wear correct PPE. High visibility clothing to ensure they can be seen on site by machine operators. All plant on site will be fitted with reversing alarms and flashing beacons. Site operatives attending plant should observe a safe distance from working plant, e.g. staying clear from the rear of a tipping lorry.	5	2	10
29	Refueling Plant	Explosion Slips / Trips Ground Contamination	Death Serious Injury Damage to plant and Equipment Environmental Damage Occupational Health injuries	3	5	15	Switch off engines, lights and mobile phones. No smoking. Use only approved containers. Diesel tanks, fuel cans, etc., should be stored and used so that leakages/spillages can be contained. Spill kits must be available on site. In the event of spillage during refueling – use spill kit & bag contaminated materials to dispose of as hazardous waste. Larger volumes of fuel to be stored in bunded fuel bowsers. No smoking Replace hoses after use Over 18 years old personnel to refuel.	5	1	5
30	Tower climbing	Fatigue of Steel,	Death, Serious Injury,	5	5	25	Carry out pre-climb checks on towers to be climbed. Carry out condition	5	2	10

		Conductor damage, **Failure of prefabricated components due to over stressed,** **Loose components** **Falls,** **Weather conditions (Ice on tower structure)**	**Fracture,** **Lacerations,** **Soft tissue damage.**				**assessment on conductor in the span to be worked on and in the adjacent spans. Check all climbing equipment and ensure that all equipment is to the correct specification and is in a serviceable state for the purpose intended. Correct PPE to be worn. A physical exclusion zone must be in place around the tower before work commences. Operatives to be trained in use of clickers. Programmed inspection of harness belt and clickers (GA1). Weekly Inspection GA2. Daily inspection of harness and lanyards (ERA form). All correct PPE to be worn. Only trained personnel must work aloft. Adequate light must be used in darkness. Climbing operations must cease for 0.5Hrs after thunder or lightning is heard or observed. Climbing must cease in excessive winds. Excessive ice on the structure must be assessed and reported to supervisor.**			

RISK INDEX

The risk index is then simply defined by multiplying together the frequency index and severity index. With this ranking system this will yield a number between 1 and 25.

Refer to the following table and read off the priority rating:

LIKELIHOOD	**1**	**1**	**2**	**3**	**4**	**5**
	2	**2**	**4**	**6**	**8**	**10**
	3	**3**	**6**	**9**	**12**	**15**
	4	**4**	**8**	**12**	**16**	**20**
	5	**5**	**10**	**15**	**20**	**25**
		1	**2**	**3**	**4**	**5**
		SEVERITY/CONSEQUENCE				

The following shading indicates the level of risk:

Intolerable	16 - 25
Tolerable	6 - 15
Negligible	1 - 5

To evaluate risk: - Likelihood (L) * Severity (S) = Risk (R), Defined as High (16 - 25), Medium (6 - 15) or Low (1 - 5)

14. APPENDIX A: TOWER PLACEMENT CHECK SHEET

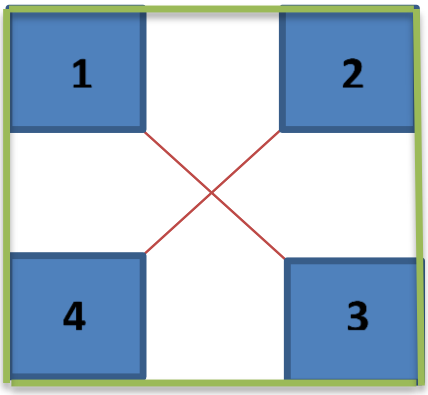
Project		**Tower Type**	
Foundation Type		**Tower No.**	
Relevant ESB Contact		**Phone Number**	
Relevant Drawings			

Aspect of tower orientation & placement	**Y/N**	**Comments**
Has the tower been correctly set-out by ESB? Including 4 corners of each foundation and the 2 center lines?		
Have those Pegs been recorded with GPS?		
Have they been extended to avoid hazard?		
Has the Z measurement on the Pegging Diagram been correctly marked?		
Are the Rings in the correct position over Z on the 804 subbase?		
Have the Screeds inside the rings been poured and the Steel plates Placed & leveled correctly?		
Have the 2 string lines and 4 plum-bobs been correctly positioned?		
Are the levels, diagonals, and faces all within the allowable tolerances using the method outlined in the method sheet?		
Are all measurements for each step recorded in the Engineers Level Book and available for inspection?		
Has the ESB contact been notified of any issues that may have arisen during the previous checks?		

Record the pre-pour measurements below

DIAGONALS	
1-3	
2-4	

LEVELS	
1	
2	
3	
4	



FACES	
1-2	
2-3	
3-4	
4-1	

Aspect of tower orientation & placement	**Y/N**	**Comments**
Has the finish level for pour 2 been marked on the legs of the tower and the banks of the trench?		
Have you ensured that the concrete has been brought up evenly around each leg and no force that could affect the positioning of the tower has been exerted on the base?		
How many hours passed before straps were removed?		
Have the post pour checks been completed and recorded on The foundation log sheet?		
Are the post pour checks all within tolerance? If not, has the ESB contact been notified?		

Checked By	Site Engineer/Manager Date:	Print: Signed:

Appendix D

Curriculum Vitae

Experience

John has over ten years experience in the areas of environmental management and assessment with particular reference to EIA, groundwater assessments and contamination assessment.

John provides specialist contribution to the project management of Environmental Impact Assessments as well as the preparation of individual sections (soil and water aspects of the environment); Groundwater resource exploration and development; Groundwater vulnerability and protection assessment; Design and management of site investigation/remediation programmes; Water quality monitoring and hydrogeology.

John oversaw the soils and geology baseline surveys, and completed the soil, geology and hydrogeology impact prediction and mitigation specification for the various commercial, industrial, waste facilities. John's previous experience includes:

- Preparation of Environmental Impact Statements
- Preparation of waste management permits/licenses
- Pumping well design and data analysis
- Report writing for contaminated land site investigations, including review of all chemical data produced from site investigation works, source-pathway-receptor based qualitative risk assessment and subsequent development of remediation strategies.
- Organising and conducting long term groundwater monitoring programmes at various sites. This also included analysis of the monitoring results and compilation of quarterly and annual reports.

EPA Source Protection Zones

Article 7 of the Water Framework Directive (WFD) requires member states to establish "safeguard zones" for those bodies of water, including groundwater, utilised in the production of drinking water. As part of a CDM/TOBIN/OCM team, John has produced over 14 safeguard zones/SPZs reports for various borehole and springs sources around Ireland.

Templemore Flood Relief Scheme

John assisted in the co-ordination, liaised with the client, statutory consultees & key stakeholders to determine key issues in relation to geology and hydrogeology for the application. John also provided geological and hydrogeological technical input which also involved leading a technical team undertaking assessments for the EIS. John also carried out contamination review for this project.

Clifden and Costello Regional Water Supply Scheme

John assisted in the management and co-ordination of geology and water chapters, liaised with the client, statutory consultees and key stakeholders to determine key issues in relation to geology and hydrogeology. John completed the soils, geology and water chapter of the EIS for Costello RWSS and Clifden RWSS.

Bilston Gasworks, Birmingham, UK

Supervision of site investigation, enabling works and resident engineer for the remediation of the former gasworks site on Ward Street, Bilston, West Midlands, with the intended end use for residential and open space development. Remediation included remediation of LNAPL and removal of spent oxide, ammonium tanks and Gas holders

Profile

John is a Hydrogeologist and holds the position of Senior Scientist with TOBIN Consulting Engineers.

His experience includes both fieldwork and report writing, including groundwater and surface water sampling and water quality monitoring, data interpretation and supervision of drilling for various residential and commercial developments

Qualifications

- M.Sc DIC Environmental Engineering
  Imperial College London, 2003
- B.Sc. Environmental Science
  National University of Ireland, Galway, 2000

Professional Membership

- IAHMember of the International Association of Hydrogeologists (Irish Group)
- Professional Geologist (PGeo)
- Member of the International Association of Hydrogeologists (Irish Group) (IAH)
- Member of the Irish Mining and Quarrying Society (IMQS)
- Chartered Waste manager (MCIWM)

Health & Safety Training

- Safe Pass Certificate
- Location of Underground Services (LUGS) Certificate
- Quarry Pass Training and Certification
- Landowner Survey Training
- First Aider

Key Skills

- Project Management
- Route & Site Selection
- Environmental Impact Assessment for soils, geology and water
- Environmental Monitoring
- Contaminated Land Investigation and Remediation
- Data Analysis and Interpretation
- Contaminated Land Investigation and Remediation
- Landowner Consultation
- Expert Witness

Monika Kabza

Geologist

Experience

Monika Kabza is a qualified Hydrogeologist and has extensive experience in sediment mapping, zone of contribution (ZOC) delineation, interpretation and 3D conceptualization, as well as the supervision and reporting of site and drilling operations. Her experience also includes research, analysis, and interpretation of site investigation results, GIS mapping and modelling, creating maps and report writing.

- Involved in defining the Zone of Contribution (ZOC) for groundwater abstraction points for the Geological Survey of Ireland (GSI) and National Federation of Group Water Schemes (NFGWS).
- Assists with biannual groundwater level monitoring and contributes to the periodic data reports and interpretive assessment reports.
- Assistant project manager for the Site Suitability course (SSA).
- Supervision of drilling for the Lisheen Wind Farm (Phase 2) site investigation (2014).
- Worked as an assistant hydrogeologist on data collation and data entry into a GSI database (2013-2015).
- Was involved in the Environmental Protection Agency (EPA) groundwater sampling project, collecting water samples from EPA monitoring sites.
- Assisted with karst land form mapping and identification as part of the Kilmaine and Swinford Source Protection Reports for the EPA.
- Worked on the National Vulnerability Mapping Project at the GSI (2007-2013).

Her background of completing National Vulnerability Mapping and delineating the Zone of Contribution for Group Water Schemes gave her excellent experience, particularly in the context of the Irish geological/hydrogeological environment.

Demonstrates and teaches participants of the “Site Suitability Assessment for On-site waste water treatment systems” how to classify log and record soil and subsoil classification according to GSI protocol BS5930 from 2007. Monika has presented the National Vulnerability Mapping to the monthly technical discussion meeting at the Geological Survey of Ireland, International Association of Hydrogeologist (IAH Irish Group) and local authorities.

Profile

Monika Kabza holds the position of Geologist and is based currently in the Geological Survey of Ireland.

Monika is a qualified Hydrogeologist and is an experienced geological field mapper and in the supervision of drilling operations.

Her experience also includes research, analysis and interpretation of site investigation results.

Qualifications

- M.Sc (Hon.)Groundwater Engineering, AGH University of Science and Technology in Krakow, Poland, 2003

Professional Membership

- Member of the International Association of Hydrogeologists (Irish Group) (IAH)
- Member of the Institute of Geologist of Ireland (IGI)
- Professional Geologist (P.Geo.)
- European Geologist (EurGeol.)

Health & Safety Training

- TOBIN Health & Safety Awareness

Key Skills

- Report Writing
- GIS Software
- Environmental Field Assessment
- Landowner liaison
- Subsoil Permeability Mapping
- Drilling Supervision and subsoil logging
- Word/Excel/PowerPoint

Coolnabacky – 400kV GIS Substation Ground Investigation

Client:	ESB Networks
Client's Representative:	Killeen Civil Engineering
Report No.:	17-0439
Date:	July 2018
Status:	Final for Issue

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Approved: ISO 9001 • ISO 14001 • OHSAS 18001

CONTENTS

Document Control Sheet

Note on: Methods of describing soils and rocks & abbreviations used on exploratory hole logs

APPENDICES

Document Control Sheet

Report No.:		17-0439			
Project Title:		Coolnabacky 400kV GIS Substation			
Client:		ESB Networks			
Client's Representative:		Killeen Civil Engineering			
Revision:	A00	**Status:**	Final for Issue	**Issue Date:**	31 July 2018
Prepared by:		**Reviewed by:**		**Approved by:**	
Sean Ross Sean Ross BSc MSc		Matthew Gilbert MEarthSci FGS		Darren O'Mahony BSc MSc MIEI	

The works were conducted in accordance with:

UK Specification for Ground Investigation 2nd Edition, published by ICE Publishing (2012)

British Standards Institute (2015) BS 5930:2015, Code of practice for site investigations.

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

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

Laboratory testing was conducted in accordance with:

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

METHODS OF DESCRIBING SOILS AND ROCKS

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

Abbreviations used on exploratory hole logs	
U	Nominal 100mm diameter undisturbed open tube sample (thick walled sampler)
UT	Nominal 100mm diameter undisturbed open tube sample (thin walled sampler)
P	Nominal 100mm diameter undisturbed piston sample
B	Bulk disturbed sample
LB	Large bulk disturbed sample
D	Small disturbed sample
C	Core sub-sample (displayed in the Field Records column on the logs)
L	Liner sample from dynamic sampled borehole
W	Water sample
ES / EW	Soil sample for environmental testing / Water sample for environmental testing
SPT (s)	Standard penetration test using a split spoon sampler (small disturbed sample obtained)
SPT (c)	Standard penetration test using 60 degree solid cone
x,x/x,x,x,x	Blows per increment during the standard penetration test. The initial two values relate to the seating drive (150mm) and the remaining four to the 75mm increments of the test length. The length achieved is stated (mm) for any test increment less than 75mm
N=X	SPT blow count 'N' given by the summation of the blows 'X' required to drive the full test length (300mm)
N=X/Z	Incomplete standard penetration test where the full test length was not achieved. The blows 'X' represent the total blows for the given test length 'Z' (mm)
V VR	Shear vane test (borehole) Hand vane test (trial pit) Shear strength stated in kPa V: undisturbed vane shear strength VR: remoulded vane shear strength
dd/mm/yy: 1.0 dd/mm/yy: dry	Date & water level at the borehole depth at the end of shift and the start of the following shift
Abbreviations relating to rock core – reference Clause 36.4.4 of BS 5930: 2015	
TCR (%)	Total Core Recovery: Ratio of rock/soil core recovered (both solid and non-intact) to the total length of core run.
SCR (%)	Solid Core Recovery: Ratio of solid core to the total length of core run. Solid core has a full diameter, uninterrupted by natural discontinuities, but not necessarily a full circumference and is measured along the core axis between natural fractures.
RQD (%)	Rock Quality Designation: Ratio of total length of solid core pieces greater than 100mm to the total length of core run.
FI	Fracture Index: Number of natural discontinuities per metre over an indicated length of core of similar intensity of fracturing.
NI	Non Intact: Used where the rock material was recovered fragmented, for example as fine to coarse gravel size particles.
AZCL	Assessed zone of core loss: The estimated depth range where core was not recovered.
DIF	Drilling induced fracture: A fracture of non-geological origin brought about by the rock coring.
(xxx/xxx/xxx)	Spacing between discontinuities (minimum/average/maximum).

Coolnabacky – 400kV GIS Substation

1 AUTHORITY

On the instructions of Killeen Civil Engineering, ("the Client's Representative"), acting on the behalf of ESB Networks ("the Client"), a ground investigation was undertaken at the above location to provide geotechnical and environmental information for input to the design and construction of a proposed substation, accompanying structures and access roads.

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

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

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

2 SCOPE

The extent of the investigation, as instructed by the Client's Representative, included boreholes, trial pits, soil sampling, groundwater monitoring, in-situ and laboratory testing, and the preparation of a factual report on the findings.

3 DESCRIPTION OF SITE

As shown on the site location plan in Appendix A, the works were conducted on the site of agricultural fields 2.5km north of Timahoe in Co. Laois with access off the R426. The site is bounded on all sides by agricultural land. An infilled quarry bounds the site immediately south of the site. The site is undulating ranging between 98 and 101mOD.

4 SITE OPERATIONS

4.1 Summary of site works

Site operations, which were conducted between 11th June and 22nd June 2018, comprised:

- nine light cable percussion boreholes;
- a standpipe installation in two boreholes;
- sixteen machine dug trial pits;
- an infiltration test performed in two trial pits; and
- indirect CBR tests at fifteen locations.

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

4.2 Boreholes

Nine boreholes (BH01-BH04 and BH06-BH10) were put down to completion in minimum 200mm diameter using a Dando 2000 light cable percussion boring rig. All boreholes were terminated either at their scheduled completion depths, or else on encountering virtual refusal on obstructions or in very stiff deposits.

Hand dug inspection pits were carried out between ground level and 1.20m depth to ensure boreholes were put down at locations clear of services or subsurface obstructions.

Disturbed (bulk and small bag) samples were taken within the encountered strata. Undisturbed (U100) samples were taken where appropriate and as directed within fine soils.

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

Any water strikes encountered during boring were recorded along with any changes in their levels as the borehole proceeded.

4.3 Standpipe installations

A groundwater monitoring standpipe was installed in BH01 and BH04.

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

4.4 Trial Pits

Seventeen trial pits (TP01–TP07, TP09-TP16 and TP28) were excavated using a 3t tracked excavator fitted with a 600mm wide bucket, to depths of 2.5m.

Disturbed (small jar and bulk bag) samples were taken at standard depth intervals and at change of strata.

Any water strikes encountered during excavation were recorded along with any changes in their levels as the excavation proceeded. The stability of the trial pit walls was noted on completion.

Appendix C presents the trial pit logs with photographs of the pits and arising provided in Appendix D.

4.5 Infiltration tests

An infiltration/soakaway test was carried out at two locations (SATP15 and SATP16) in accordance with BRE Digest 365 - Soakaways (BRE, 2016). The tests were conducted in similarly numbered trial pits.

Appendix E presents the results and analysis of the infiltration test. The absence of the outflow from the pits precluded calculation of infiltration coefficients.

4.6 Indirect CBR tests

An indirect CBR test was conducted at fifteen locations (TP01-TP07 and TP09-TP16) using a Dynamic Cone Penetrometer (DCP). The equipment was developed in conjunction with the UK Transport Research Laboratory, is used widely throughout the world, and is referred to in the UK Highway Agency Interim Advice Note 73/06.

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

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

The frequently elevated CBR values are a consequence of the coarse-grained content of the penetrated soils and are often not representative of the soil matrix.

4.7 Surveying

The as-built exploratory hole positions were surveyed following completion of site operations by a Site Engineer from Causeway Geotech. Surveying was carried out using a Trimble R6 GPS system employing VRS and real time kinetic (RTK) techniques.

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

4.8 Groundwater and ground gas monitoring

Following completion of site works, groundwater monitoring was conducted on two rounds. Ground water monitoring was carried out using a water interface probe.

Details of groundwater are presented in Table 1 below.

Date	Standing water levels (mbgl)	
	BH01	BH04
27/06/2018	1.1	1.24
11/07/2018	1.34	1.22

5 LABORATORY WORK

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

5.1 Geotechnical laboratory testing of soils

Laboratory testing of soils comprised:

- **soil classification:** moisture content measurement, Atterberg Limit tests and particle size distribution analysis.

- **soil chemistry:** pH and water soluble sulphate content

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

The test results are presented in Appendix G.

6 GROUND CONDITIONS

6.1 General geology of the area

Published geological mapping indicate the superficial deposits underlying the site comprise alluvium and glacial gravels. These deposits are underlain by limestones of the Ballyadams Formation

6.2 Ground types encountered during investigation of the site

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

- **Topsoil:** encountered typically in 300-500mm thickness across the site.
- **Made Ground (fill):** reworked topsoil encountered to a depth of 700mm in TP10.
- **Alluvium/glacial gravels:** typically, soft to firm sandy gravelly clay/silt or medium dense sandy gravel/gravelly sand. Encountered to a depth of 3.8m in BH09.
- **Glacial Till:** sandy gravelly clay, frequently with low cobble content, typically firm or stiff in upper horizons, becoming very stiff with increasing depth.

6.3 Groundwater

Groundwater was encountered during percussion boring through soil as water strikes at a range of depths as shown in Table 2 below.

GI Location	Groundwater strikes (mbgl)	Comments
BH01	1.3	Slow
BH02	1.6	Slow
BH03	5.7	Slow
BH04	1.8	Slow
TP10	1.8	Slow
TP11	1.5	Slow
TP12	1.3	Slow
TP14	2.3	Slow
TP16	1.0	Fast

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

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

7 REFERENCES

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

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

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

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

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

Building Research Establishment (2007), BRE Digest 365: Soakaways.

Project No.:	17-0439	**Client:**	ESB Networks
Project Name:	Coolnabacky 400kV GIS Substation	**Client's Representative:**	Killeen Civil Engineering

Legend Key

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Title:

Site Location Plan

Last Revised:	**Scale:**
30/07/2018	1:15000

Project No.: 17-0439

Project Name: Coolnabacky 400kV GIS Substation

Client: ESB Networks

Client's Representative: Killeen Civil Engineering

Legend Key

🟥 Locations By Type - TP

Title:

Exploratory Hole Location Plan (1 of 3)

Last Revised:	**Scale:**
30/07/2018	1:2500

Project No.: 17-0439

Project Name: Coolnabacky 400kV GIS Substation

Client: ESB Networks

Client's Representative: Killeen Civil Engineering

Legend Key

🟥 Locations By Type - TP

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Title:
Exploratory Hole Location Plan (2 of 3)

Last Revised:	**Scale:**
30/07/2018	1:2500

CAUSEWAY GEOTECH

Project No.: 17-0439

Project Name: Coolnabacky 400kV GIS Substation

Client: ESB Networks

Client's Representative: Killeen Civil Engineering

Legend Key

● Locations By Type - CP

🟥 Locations By Type - TP

Title:

Exploratory Hole Location Plan (3 of 3)

Last Revised:	**Scale:**
30/07/2018	1:2500

APPENDIX B

Borehole logs

CAUSEWAY GEOTECH

Project No.: 17-0439	**Project Name:** Coolnabacky 400kV GIS Substation		**Borehole No.:** **BH01**
Coordinates: 653744.29 E 692847.44 N	**Client:** ESB Networks		Sheet 1 of 1
	Client's Representative: Killeen Civil Engineering		**Scale:** 1:50
Ground Level: 101.53 mOD	**Dates:** 22/06/2018		**Driller:** BM **Logger:** GH

Method	**Plant Used**	**Top**	**Base**
Cable Percussion	Dando 2000	0.00	6.50

Depth (m)	**Sample / Tests**	**Casing Depth (m)**	**Water Depth (m)**	**Field Records**	**Level (mOD)**	**Depth (m) (Thickness)**	**Legend**	**Description**	**Water**	**Backfill**
						(0.30)		TOPSOIL: Firm brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse		
					101.23	0.30		Firm grey sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium.		
0.50	B3									
1.00	B4									
						(1.50)				
1.20	D9									
1.20 - 1.65	SPT (C) N=11	1.20	Dry	N=11 (2,2/3,3,3,2) Slight Trace at 1.30m					▼	
					99.73	1.80		Soft to firm grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse		
2.00	B5 D10									
2.00 - 2.45	SPT (C) N=7	2.00	1.90	N=7 (2,2/2,1,2,2)						
						(1.20)				
3.00	B6				98.53	3.00		Firm to stiff grey sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subangular to subrounded		
3.00 - 3.45	U1	3.00	Dry	Ublow=50 50%						
4.00	B7 D11									
4.00 - 4.45	SPT (S) N=17	4.00	Dry	N=17 (3,3/4,4,4,5)						
						(3.50)				
5.00	B8 D12									
5.00 - 5.45	SPT (S) N=28	4.20	Dry	N=28 (7,4/4,5,8,11)						
6.00 - 6.45	U2	4.20	Dry	Ublow=50 0%						
6.50 - 6.55	SPT (S)			N=50 (25 for 25mm/50 for 25mm)	95.03	6.50		End of Borehole at 6.50m		

Remarks

Hand dug inspection pit excavated.

Terminated in stiff deposits

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
1.30			

Chiselling Details

From (m)	To (m)	Time (hh:mm)

Water Added

From (m)	To (m)

Casing Details

To (m)	Diam (mm)
4.50	200

CAUSEWAY GEOTECH	**Project No.:** 17-0439	**Project Name:** Coolnabacky 400kV GIS Substation	**Borehole No.:** **BH02**
	Coordinates: 653763.55 E 692855.61 N	**Client:** ESB Networks	Sheet 1 of 1
		Client's Representative: Killeen Civil Engineering	**Scale:** 1:50
			Driller: BM
	Ground Level: 101.02 mOD	**Dates:** 21/06/2018	**Logger:** BM

Method	Plant Used	Top	Base
Cable Percussion	Dando 2000	0.00	6.50

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
						(0.30)		TOPSOIL: Firm brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse		
					100.7 2	0.30		Firm grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is rounded fine.		
0.50	B1									
1.00	B2					(1.40)				
1.20	D7									
1.20 - 1.65	SPT (C) N=12	1.20	Dry	N=12 (3,4/4,4,2,2)						
				Water Strike at 1.60m					▼	
					99.32	1.70		Firm grey sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium.		
2.00	B3									
	D8									
2.00 - 2.45	SPT (C) N=8	2.00	Dry	N=8 (4,3/2,2,2,2)						
						(1.90)				
3.00	B4									
	D9									
3.00 - 3.45	SPT (S) N=8	3.00	Dry	N=8 (2,2/2,2,2,2)						
					97.42	3.60		Firm to stiff grey slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subangular to subrounded		
4.00	B5									
	D10									
4.00 - 4.45	U12	4.00	Dry	Ublow=80 0%						
4.40 - 4.85	SPT (S) N=18	4.20	Dry	N=18 (3,4/4,4,5,5)						
5.00	B6					(2.90)				
	D11									
5.00 - 5.45	SPT (S) N=30	4.20	Dry	N=30 (25,10/5,5,6,14)						
6.00 - 6.45	U13	4.20	Dry	Ublow=67 0%						
6.50 - 6.55	SPT (S)	4.20	Dry	N=50 (25 for 25mm/50 for 25mm)	94.52	6.50		End of Borehole at 6.50m		

Remarks

Hand dug inspection pit excavated.

Terminated in stiff deposits

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
1.60			

Chiselling Details

From (m)	To (m)	Time (hh:mm)

Water Added

From (m)	To (m)

Casing Details

To (m)	Diam (mm)
6.50	200

CAUSEWAY GEOTECH

Project No.: 17-0439	**Project Name:** Coolnabacky 400kV GIS Substation				**Borehole No.:** BH03
Coordinates: 653793.75 E 692877.00 N	**Client:** ESB Networks				Sheet 1 of 1
	Client's Representative: Killeen Civil Engineering				**Scale:** 1:50
					Driller: BM
Ground Level: 100.92 mOD	**Dates:** 20/06/2018				**Logger:** GH

Method	Plant Used	Top	Base
Cable Percussion	Dando 2000	0.00	8.50

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
						(0.30)		TOPSOIL: Firm brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse		
					100.62	0.30		Medium dense grey gravelly silty fine to coarse SAND. Gravel is subangular to subrounded fine to medium.		
0.50	B1									
1.00	B2									
						(1.50)				
1.20	D10									
1.20 - 1.65	SPT (C) N=12	1.00	Dry	N=12 (2,3/2,3,3,4)						
					99.12	1.80		Soft to firm grey sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse		
2.00	B3 D11									
2.00 - 2.45	SPT (C) N=9	2.00	Dry	N=9 (2,2/3,2,2,2)						
						(1.20)				
3.00	B4				97.92	3.00		Firm to stiff grey sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subangular to subrounded		
3.00 - 3.45	U16	2.00	Dry	Ublow=50 60%						
4.00	B5 D12									
4.00 - 4.45	SPT (S) N=20	4.00	Dry	N=20 (3,4/4,5,5,6)						
5.00	B6 D13									
5.00 - 5.45	SPT (S) N=26	4.20	Dry	N=26 (4,5/5,6,7,8)						
				Water Strike at 5.70m		(5.50)			▼	
6.00	B7									
6.00 - 6.45	U17	4.20		Ublow=70 100%						
7.50	D14									
7.50 - 7.95	SPT (S) N=47	4.20		N=47 (6,6/9,10,13,15)						
8.00	B8									
8.50	B9 D15				92.42	8.50		End of Borehole at 8.50m		
8.50 - 8.62	SPT (S)	4.20		N=50 (34 for 100mm/50 for 25mm)						

Remarks

Hand dug inspection pit excavated.

Terminated in stiff deposits

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
5.70			

Chiselling Details

From (m)	To (m)	Time (hh:mm)

Water Added

From (m)	To (m)

Casing Details

To (m)	Diam (mm)
4.20	200

CAUSEWAY GEOTECH

Project No.: 17-0439	**Project Name:** Coolnabacky 400kV GIS Substation				**Borehole No.:** BH04
Coordinates: 653775.62 E 692876.75 N	**Client:** ESB Networks				Sheet 1 of 1
	Client's Representative: Killeen Civil Engineering				**Scale:** 1:50
					Driller: BM
Ground Level: 100.93 mOD	**Dates:** 22/06/2018				**Logger:** GH

Method	Plant Used	Top	Base
Cable Percussion	Dando 2000	0.00	9.50

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
						(0.30)		TOPSOIL: Firm brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse		
					100.63	0.30		Medium dense grey sandy clayey subangular to subrounded fine to coarse GRAVEL. Sand is fine to coarse		
0.50	B1									
1.00	B2									
						(1.50)				
1.20	D9									
1.20 - 1.65	SPT (C) N=13	1.00	Dry	N=13 (2,2/3,3,3,4)						
				Slight Seepage at 1.80m	99.13	1.80		Soft grey sandy slightly gravelly SILT. Sand is fine to coarse. Gravel is subrounded fine to coarse.	▼	
2.00	B3 D10									
2.00 - 2.45	SPT (C) N=8	2.00	Dry	N=8 (3,1/2,2,2,2)						
						(1.30)				
3.00	B4 D11				97.83	3.10		Firm grey sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subangular to subrounded		
3.00 - 3.45	SPT (S) N=12	3.00	Dry	N=12 (2,2/3,2,3,4)						
4.00	B5 D12									
4.00 - 4.45	SPT (S) N=22	4.00	Dry	N=22 (4,9/6,6,6,4)						
						(2.90)				
5.00	B6									
5.00 - 5.45	U16	4.20	Dry	Ublow=50 100%						
6.00	D13				94.93	6.00		Stiff grey slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subangular to subrounded		
6.00 - 6.45	SPT (S) N=27	4.20	Dry	N=27 (4,5/6,6,7,8)						
						(1.50)				
7.00	B7									
7.50	D14				93.43	7.50		Very stiff grey slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subangular to subrounded		
7.50 - 7.95	SPT (S) N=36	4.20	Dry	N=36 (7,7/8,8,9,11)						
						(2.00)				
9.00	B8 D15									
9.00 - 9.45	SPT (S) N=45	4.20	Dry	N=45 (7,8/8,11,12,14)						
					91.43	9.50		End of Borehole at 9.50m		

Remarks
Hand dug inspection pit excavated.

Terminated in stiff deposits

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
1.80			

Chiselling Details

From (m)	To (m)	Time (hh:mm)

Water Added

From (m)	To (m)

Casing Details

To (m)	Diam (mm)
9.50	200

CAUSEWAY GEOTECH

Project No.: 17-0439	**Project Name:** Coolnabacky 400kV GIS Substation		**Borehole No.:** BH06
Coordinates: 653761.06 E 692899.36 N	**Client:** ESB Networks		Sheet 1 of 1
	Client's Representative: Killeen Civil Engineering		**Scale:** 1:50
Ground Level: 101.02 mOD	**Dates:** 19/06/2018		**Driller:** BM **Logger:** GH

Method	Plant Used	Top	Base
Cable Percussion	Dando 2000	0.00	9.00

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
						(0.30)		TOPSOIL: Firm brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse		
					100.72	0.30		Firm grey sandy SILT. Sand is fine to medium.		
0.50	B1 ES10									
1.00	B2 ES11					(1.50)				
1.20	D12									
1.20 - 1.65	SPT (C) N=14	1.00	Dry	N=14 (2,3/4,3,3,4)						
					99.22	1.80		Medium dense grey slightly sandy subangular to subrounded fine to coarse GRAVEL. Sand is fine to coarse		
2.00	B3 D13									
2.00 - 2.45	SPT (C) N=24	2.00	1.60	N=24 (3,5/7,7,6,4)		(1.20)				
3.00	B4 D14				98.02	3.00		Firm to stiff grey slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium. Cobbles are subangular to subrounded		
3.00 - 3.45	SPT (S) N=21	3.00	2.90	N=21 (7,6/5,5,5,6)						
4.00	B5									
4.00 - 4.20	U19	4.00	Dry	Ublow=60 0%						
4.50 - 4.90	U20	4.20	Dry	Ublow=80 80%						
5.00	B6 D15									
5.00 - 5.45	SPT (S) N=39		Dry	N=39 (5,7/7,9,10,13)						
6.00	B7 D16					(6.00)				
6.00 - 6.45	SPT (S) N=47		Dry	N=47 (12,8/9,12,12,14)						
7.50	B8									
7.50 - 7.90	U21		Dry	Ublow=70 90%						
8.00	D17									
9.00	B9 D18				92.02	9.00		End of Borehole at 9.00m		
9.00 - 9.07	SPT (S)		Dry	N=50 (25 for 50mm/50 for 25mm)						

Remarks

Hand dug inspection pit excavated.

Terminated in stiff deposits

Water Strikes

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

Chiselling Details

From (m)	To (m)	Time (hh:mm)

Water Added

From (m)	To (m)
1.20	3.00

Casing Details

To (m)	Diam (mm)
4.20	200

CAUSEWAY GEOTECH	Project No.: 17-0439	Project Name: Coolnabacky 400kV GIS Substation	Borehole No.: BH07
	Coordinates: 653739.97 E 692885.11 N	Client: ESB Networks	Sheet 1 of 1
		Client's Representative: Killeen Civil Engineering	Scale: 1:50
			Driller: BM
	Ground Level: 101.70 mOD	Dates: 18/06/2018	Logger: GH

Method	Plant Used	Top	Base
Cable Percussion	Dando 2000	0.00	6.00

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
						(0.40)		TOPSOIL: Firm brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse		
					101.30	0.40		Firm brownish grey sandy slightly gravelly SILT. Sand is fine to coarse. Gravel is subrounded fine.		
0.50	B1 ES7									
1.00	B2 ES8									
1.20	D9									
1.20 - 1.65	SPT (C) N=10	1.00	Dry	N=10 (2,2/2,3,3,2)		(1.60)				
2.00	B3 D10				99.70	2.00		Dense grey sandy subangular to subrounded fine to coarse GRAVEL. Sand is fine to coarse		
2.00 - 2.45	SPT (C) N=30	2.00	1.10	N=30 (4,6/7,9,9,5)		(0.80)				
					98.90	2.80		Very stiff grey slightly sandy gravelly CLAY with high cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles and boulders are subangular to subrounded		
3.00	B4 D11									
3.00 - 3.45	SPT (S) N=52	3.00	2.10	N=52 (22,9/9,14,14,15)						
4.00	B5 U14	4.10	Dry	Ublow=80 0%						
						(3.20)				
4.50	D12									
4.50 - 4.95	SPT (S) N=30	4.10	Dry	N=30 (5,6/6,8,8,8)						
5.00	B6 D13									
5.00 - 5.45	SPT (S) N=42	4.10	Dry	N=42 (6,7/7,9,11,15)						
6.00 - 6.10	SPT (S)	4.10	Dry	N=50 (25 for 75mm/50 for 25mm)	95.70	6.00		End of Borehole at 6.00m		

Remarks

Hand dug inspection pit excavated.

Terminated in stiff deposits

Water Strikes				Chiselling Details		
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hh:mm)

Water Added		Casing Details	
From (m)	To (m)	To (m)	Diam (mm)
1.20	3.00	4.20	200

CAUSEWAY GEOTECH

Project No.: 17-0439	**Project Name:** Coolnabacky 400kV GIS Substation				**Borehole No.:** BH08
Coordinates: 653723.11 E 692880.20 N	**Client:** ESB Networks				Sheet 1 of 1
Ground Level: 101.81 mOD	**Client's Representative:** Killeen Civil Engineering				**Scale:** 1:50
	Dates: 15/06/2018				**Driller:** BM **Logger:** GH

Method	Plant Used	Top	Base
Cable Percussion	Dando 2000	0.00	9.00

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
					101.61	(0.20) 0.20		TOPSOIL: Firm brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse		
								Firm brownish grey sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subrounded to subangular fine to coarse.		
0.50	B1 ES10									
1.00	B2 ES11					(1.80)				
1.20	D12									
1.20 - 1.65	SPT (C) N=10	1.00	Dry	N=10 (1,3/3,3,3,1)						
2.00	B3 D13				99.81	2.00		Medium dense grey sandy clayey subangular to subrounded fine to coarse GRAVEL. Sand is fine to coarse		
2.00 - 2.45	SPT (C) N=18	2.00	1.00	N=18 (2,3/3,4,4,7)		(1.00)				
3.00	B4 D14				98.81	3.00		Very stiff grey slightly sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles and boulders are subangular to subrounded		
3.00 - 3.45	SPT (S) N=56	3.00	1.40	N=56 (3,25/8,9,9,30)						
4.00	B5 D15									
4.50 - 4.90	U20	4.00	Dry	Ublow=80 60%						
5.00	B6 D16									
5.00 - 5.45	SPT (S) N=44	4.20	Dry	N=44 (5,7/9,9,11,15)						
6.00	B7 D17					(6.00)				
6.00 - 6.45	SPT (S) N=55	4.20	Dry	N=55 (8,11/11,13,13,18)						
7.50	B8									
7.50 - 7.90	U21			Ublow=70 100%						
8.00	D18									
9.00	B9 D19				92.81	9.00		End of Borehole at 9.00m		
9.00 - 9.02	SPT (S)			N=50 (25 for 10mm/50 for 15mm)						

Remarks

Hand dug inspection pit excavated.

Terminated in stiff deposits

Water Strikes

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

Chiselling Details

From (m)	To (m)	Time (hh:mm)

Water Added

From (m)	To (m)

Casing Details

To (m)	Diam (mm)
4.20	200

CAUSEWAY GEOTECH

Method	Plant Used	Top	Base
Cable Percussion	Dando 2000	0.00	10.70

Project No.: 17-0439

Coordinates:
653714.90 E
692899.34 N

Ground Level: 102.48 mOD

Project Name: Coolnabacky 400kV GIS Substation

Client: ESB Networks

Client's Representative: Killeen Civil Engineering

Dates: 13/06/2018 - 14/06/2018

Borehole No.: BH09

Sheet 1 of 2

Scale: 1:50

Driller: BM

Logger: GH

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
						(0.50)		TOPSOIL: Soft to firm brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse		
0.50	B1 ES10				101.98	0.50		Stiff brown slightly sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
1.00	B2 ES11									
1.20	D12									
1.20 - 1.65	SPT (C) N=26	1.20	0.60	N=26 (4,4/5,7,7,7)		(1.70)				
2.00	B3 D13									
2.00 - 2.45	SPT (C) N=31	2.00	1.30	N=31 (4,5/8,8,6,9)	100.28	2.20		Dense brown sandy subangular to subrounded fine to coarse GRAVEL. Sand is fine to coarse		
3.00	B4 D14					(1.60)				
3.00 - 3.45	SPT (C) N=34	3.00	1.40	N=34 (6,6/12,9,7,6)						
					98.68	3.80		Firm to stiff grey slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subangular to subrounded		
4.00	B5 D15									
4.00 - 4.40	U20	4.00	3.6	Ublow=60 100%						
5.00	B6 D16									
5.00 - 5.45	SPT (S) N=25	4.20	Dry	N=25 (4,5/5,5,7,8)						
6.50	B7 D17									
6.50 - 6.90	U21									
7.00 - 7.40	U22			Ublow=80 80%		(6.90)				
8.00	B8									
8.50	D18									
8.50 - 8.95	SPT (S) N=25	4.20	Dry	N=25 (4,5/5,5,7,8)						
9.50	B9									
~~10.00~~	~~D19~~									

Remarks
Hand dug inspection pit excavated.

Terminated in stiff deposits

Water Strikes

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

Chiselling Details

From (m)	To (m)	Time (hh:mm)

Water Added

From (m)	To (m)
1.00	3.80

Casing Details

To (m)	Diam (mm)
4.20	200

CAUSEWAY GEOTECH

Project No.:	17-0439
Project Name:	Coolnabacky 400kV GIS Substation
Borehole No.:	BH09
Coordinates:	653714.90 E 692899.34 N
Client:	ESB Networks
	Sheet 2 of 2
Client's Representative:	Killeen Civil Engineering
Scale:	1:50
Driller:	BM
Ground Level:	102.48 mOD
Dates:	13/06/2018 - 14/06/2018
Logger:	GH

Method	**Plant Used**	**Top**	**Base**
Cable Percussion	Dando 2000	0.00	10.70

Depth (m)	**Sample / Tests**	**Casing Depth (m)**	**Water Depth (m)**	**Field Records**	**Level (mOD)**	**Depth (m) (Thickness)**	**Legend**	**Description**	**Water**	**Backfill**
10.00 - 10.40	U23			Ublow=80 50%			▨	Firm to stiff grey slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subangular to subrounded		■
10.60 - 10.82	SPT (S)	4.20	Dry	N=50 (2,25/50 for 75mm)	91.78	10.70				
								End of Borehole at 10.70m		

Remarks

Hand dug inspection pit excavated.

Terminated in stiff deposits

Water Strikes

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

Chiselling Details

From (m)	To (m)	Time (hh:mm)

Water Added

From (m)	To (m)
1.00	3.80

Casing Details

To (m)	Diam (mm)
4.20	200

CAUSEWAY GEOTECH

				Project No.: 17-0439	**Project Name:** Coolnabacky 400kV GIS Substation	**Borehole No.:** **BH10**
				Coordinates: 653768.14 E 692928.33 N	**Client:** ESB Networks	Sheet 1 of 1
Method	**Plant Used**	**Top**	**Base**		**Client's Representative:** Killeen Civil Engineering	**Scale:** 1:50
Cable Percussion	Dando 2000	0.00	9.30			**Driller:** BM
				Ground Level: 100.77 mOD	**Dates:** 12/06/2018 - 13/06/2018	**Logger:** GH

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
					100.57	(0.20) 0.20		MADE GROUND: Reworked topsoil. Soft brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse		
					100.37	(0.20) 0.40		MADE GROUND: Soft grey sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse		
0.50	B1 ES9							Medium dense grey very sandy clayey subangular to subrounded fine to coarse GRAVEL. Sand is fine to coarse		
1.00	B2 D13 ES10									
1.20 - 1.65	SPT (C) N=23	1.20	0.50	N=23 (6,6/7,5,4,7)						
						(2.50)				
2.00	B3 D14 ES11									
2.00 - 2.45	SPT (C) N=22	2.00	1.10	N=22 (3,4/4,7,6,5)						
					97.87	2.90		Stiff grey slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subangular to subrounded		
3.00	B4 D15 ES12									
3.00 - 3.45	SPT (S) N=26	3.00	2.30	N=26 (4,3/5,6,9,6)		(1.10)				
4.00	B5				96.77	4.00		Stiff grey slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles and boulders are subangular to subrounded		
4.00 - 4.45	U19	4.00	3.9	Ublow=60 100%						
5.00	B6 D16									
5.00 - 5.45	SPT (S) N=105	4.50	Dry	N=105 (10,10/19,20,25,41)						
6.00	B7									
6.50 - 6.95	U20	4.50	Dry	Ublow=75 100%						
						(5.30)				
7.00	D17									
8.00	B8 D18									
8.00 - 8.25	SPT (S)	4.50	Dry	N=75 (10,17/75 for 100mm)						
					91.47	9.30		End of Borehole at 9.30m		

Remarks

Hand dug inspection pit excavated.

Terminated in stiff deposits

Water Strikes

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

Chiselling Details

From (m)	To (m)	Time (hh:mm)

Water Added

From (m)	To (m)
1.20	3.00

Casing Details

To (m)	Diam (mm)
4.50	200

APPENDIX C

Trial pit logs

CAUSEWAY GEOTECH	**Project No.:** 17-0439	**Project Name:** Coolnabacky 400kV GIS Substation	**Trial Pit No.:** **TP01**
	Co-ordinates: 652762.54 E 692473.30 N	**Client:** ESB Networks	Sheet 1 of 1
Method: Trial Pitting		**Client's Representative:** Killeen Civil Engineering	**Scale:** 1:25
Plant: 3T Excavator	**Ground Level:** 120.31 mOD	**Date:** 13/06/2018	**Logger:** ST

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water
				(0.20)		TOPSOIL	
			120.11	0.20		Brown very sandy rounded fine to coarse GRAVEL of mixed lithologies, predominantly limestone with low cobble content. Sand is fine to coarse. Cobbles are rounded	
0.50	B2						
0.50	D3						
0.50	ES1						
				(1.80)			
			118.31	2.00 (0.10)		Very stiff brownish grey CLAY	
			118.21	2.10		End of trial pit at 2.10m	

Remarks
No groundwater encountered

DCP carried out

Terminated on very stiff material

Water Strikes:

Struck at (m):	Remarks:

Stability:
Stable

Width: 1.20
Length: 2.00

CAUSEWAY GEOTECH	**Project No.:** 17-0439	**Project Name:** Coolnabacky 400kV GIS Substation	**Trial Pit No.:** **TP02**
	Co-ordinates: 652858.96 E 692449.29 N	**Client:** ESB Networks	Sheet 1 of 1
Method: Trial Pitting		**Client's Representative:** Killeen Civil Engineering	**Scale:** 1:25
Plant: 3T Excavator	**Ground Level:** 119.87 mOD	**Date:** 13/06/2018	**Logger:** ST

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water
				(0.10)	▨	TOPSOIL	
			119.77	0.10		Firm brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse of mixed lithologies, predominantly limestone	
0.50 0.50 0.50	B2 D3 ES1			(1.10)			
			118.67	1.20		Grey sandy subrounded fine to coarse GRAVEL of mixed lithologies, predominantly limestone. Sand is fine to coarse	
				(0.30)			
1.50 1.50 1.50	B6 D5 ES4		118.37	1.50		End of trial pit at 1.50m	

Remarks
No groundwater encountered

DCP carried out.

Terminated on continual collapse of pit sides

Water Strikes:

Struck at (m):	Remarks:

Stability:
Unstable

Width: 1.20
Length: 2.00

	Project No.: 17-0439	**Project Name:** Coolnabacky 400kV GIS Substation	**Trial Pit No.:** **TP03**
	Co-ordinates: 652957.52 E 692451.18 N	**Client:** ESB Networks	Sheet 1 of 1
Method: Trial Pitting		**Client's Representative:** Killeen Civil Engineering	**Scale:** 1:25
Plant: 3T Excavator	**Ground Level:** 117.37 mOD	**Date:** 13/06/2018	**Logger:** ST

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	
			117.07	(0.30) 0.30	▨	TOPSOIL		
0.50 0.50 0.50 1.50 1.50 1.50	B1 D2 ES3 B5 D6 ES4		115.67	(1.40) 1.70	⁙	Brown gravelly silty fine to coarse SAND with low cobble content. Gravel is subangular fine to coarse of mixed lithologies, predominantly limestone. Cobbles are subangular		0.5 1.0 1.5
2.30 2.30	B7 D8		115.07	(0.60) 2.30	░	Grey very sandy subrounded fine to coarse GRAVEL of mixed lithologies, predominantly limestone with low cobble content. Sand is fine to coarse. Cobbles are subrounded		2.0
						End of trial pit at 2.30m		2.5 3.0 3.5 4.0 4.5

Remarks No groundwater encountered DCP carried out. Terminated due to continual collapse of pit sides.	**Water Strikes:**		**Stability:** Unstable
	Struck at (m):	Remarks:	**Width:** 1.20 **Length:** 2.50

CAUSEWAY GEOTECH

Project No.: 17-0439	**Project Name:** Coolnabacky 400kV GIS Substation		**Trial Pit No.:** **TP04**
Co-ordinates: 653059.67 E 692459.07 N	**Client:** ESB Networks		Sheet 1 of 1
Method: Trial Pitting	**Client's Representative:** Killeen Civil Engineering		**Scale:** 1:25
Plant: 3T Excavator	**Ground Level:** 117.08 mOD	**Date:** 13/06/2018	**Logger:** ST

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water
				(0.10)		TOPSOIL	
			116.98	0.10		Brown very gravelly fine to coarse SAND with low cobble content. Gravel is subrounded fine to coarse of mixed lithologies, predominantly limestone	
0.50 0.50 0.50	B1 D3 ES2						
				(1.40)			
1.50 1.50 1.50	B4 D5 ES6		115.58	1.50		End of trial pit at 1.50m	

Remarks
No groundwater encountered

DCP carried out.

Terminated on continual collapse of pit sides.

Water Strikes:

Struck at (m):	Remarks:

Stability:
Unstable

Width: 1.20
Length: 2.00

CAUSEWAY GEOTECH	**Project No.:** 17-0439	**Project Name:** Coolnabacky 400kV GIS Substation	**Trial Pit No.:** **TP05**
	Co-ordinates: 653151.86 E 692414.82 N	**Client:** ESB Networks	Sheet 1 of 1
Method: Trial Pitting		**Client's Representative:** Killeen Civil Engineering	**Scale:** 1:25
Plant: 3T Excavator	**Ground Level:** 116.08 mOD	**Date:** 13/06/2018	**Logger:** ST

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water
				(0.20)		TOPSOIL	
			115.88	0.20		Brown very sandy clayey subangular fine to coarse GRAVEL of mixed lithologies predominately limestone. Sand is fine to coarse.	
0.50 0.50 0.50	B1 D2 ES3						
				(1.80)			
1.50 1.50 1.50	B4 D5 ES6						
			114.08	2.00		Light brown very gravelly fine to coarse SAND with high cobble content. Gravel is subangular fine to coarse of mixed lithologies, predominantly limestone. Cobbles are subangular	
				(0.50)			
2.50 2.50	B7 D8		113.58	2.50		End of trial pit at 2.50m	

Remarks
No groundwater encountered

DCP carried out.

Terminated at scheduled depth.

Water Strikes:

Struck at (m):	Remarks:

Stability:
Unstable

Width: 1.20

Length: 2.50

CAUSEWAY GEOTECH	**Project No.:** 17-0439	**Project Name:** Coolnabacky 400kV GIS Substation	**Trial Pit No.:** **TP06**
	Co-ordinates: 653233.63 E 692471.63 N	**Client:** ESB Networks	Sheet 1 of 1
Method: Trial Pitting		**Client's Representative:** Killeen Civil Engineering	**Scale:** 1:25
Plant: 3T Excavator	**Ground Level:** 111.55 mOD	**Date:** 13/06/2018	**Logger:** ST

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	
				(0.30)	▨	TOPSOIL		
			111.25	0.30	▨	Brown gravelly fine to coarse SAND. Gravel is subrounded fine to coarse of mixed lithologies, predominantly limestone		
0.50 0.50 0.50	B2 D3 ES1			(0.70)				0.5
			110.55	1.00	▨	Firm brown sandy CLAY. Sand is fine to coarse		1.0
1.50 1.50 1.50	B5 D6 ES4			(1.00)				1.5
			109.55	2.00	▨	Firm light brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is subrounded fine to coarse of mixed lithologies, predominantly limestone		2.0
				(0.50)				
2.50 2.50	B7 D8		109.05	2.50		End of trial pit at 2.50m		2.5
								3.0
								3.5
								4.0
								4.5

Remarks
No groundwater encountered

DCP carried out.

Terminated at scheduled depth.

Water Strikes:	
Struck at (m):	Remarks:

Stability:
Stable

Width: 1.50

Length: 2.50

CAUSEWAY GEOTECH	**Project No.:** 17-0439	**Project Name:** Coolnabacky 400kV GIS Substation	**Trial Pit No.:** **TP07**
	Co-ordinates: 653297.01 E 692547.95 N	**Client:** ESB Networks	Sheet 1 of 1
Method: Trial Pitting		**Client's Representative:** Killeen Civil Engineering	**Scale:** 1:25
Plant: 3T Excavator	**Ground Level:** 110.02 mOD	**Date:** 12/06/2018	**Logger:** ST

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water
				(0.20)	▨	TOPSOIL	
			109.82	0.20	▨	Brown very gravelly clayey fine to coarse SAND. Gravel is subrounded fine to coarse of mixed lithologies, predominantly limestone	
0.50 0.50 0.50	B2 D3 ES1						
				(1.40)			
1.50 1.50 1.50	B4 D6 ES5						
			108.42	1.60	▨	Firm brown slightly gravelly very sandy CLAY. Sand is fine to coarse. Gravel is subrounded fine to coarse of mixed lithologies, predominantly limestone	
				(0.90)			
2.50 2.50	B7 D8		107.52	2.50		End of trial pit at 2.50m	

Remarks
No groundwater encountered

DCP carried out.

Terminated at scheduled depth.

Water Strikes:

Struck at (m):	Remarks:

Stability:
Stable

Width: 1.20
Length: 2.00

CAUSEWAY GEOTECH	**Project No.:** 17-0439	**Project Name:** Coolnabacky 400kV GIS Substation	**Trial Pit No.:** **TP09**
	Co-ordinates: 653427.96 E 692700.83 N	**Client:** ESB Networks	Sheet 1 of 1
Method: Trial Pitting		**Client's Representative:** Killeen Civil Engineering	**Scale:** 1:25
Plant: 3T Excavator	**Ground Level:** 106.81 mOD	**Date:** 12/06/2018	**Logger:** ST

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water
				(0.80)		Brown gravelly silty fine to coarse SAND. Gravel is subrounded fine to medium of mixed lithologies, predominantly limestone.	
0.50 0.50 0.50	B2 D3 ES1						
			106.01	0.80 (0.40)		Grey very gravelly fine to coarse SAND. Gravel is subrounded fine to coarse of mixed lithologies, predominantly limestone	
			105.61	1.20		Light brown slightly gravelly fine to coarse SAND. Gravel is subrounded fine to coarse of mixed lithologies, predominantly limestone	
1.50 1.50 1.50	B5 D6 ES4						
				(1.30)			
2.50 2.50	B7 D8		104.31	2.50		End of trial pit at 2.50m	

Remarks
No groundwater encountered

DCP carried out.

Terminated at scheduled dpeth.

Water Strikes:

Struck at (m):	Remarks:

Stability:
Stable

Width: 1.20
Length: 2.00

CAUSEWAY GEOTECH

Project No.: 17-0439	**Project Name:** Coolnabacky 400kV GIS Substation		**Trial Pit No.:** **TP10**
Co-ordinates: 653504.09 E 692762.58 N	**Client:** ESB Networks		Sheet 1 of 1
Method: Trial Pitting	**Client's Representative:** Killeen Civil Engineering		**Scale:** 1:25
Plant: 3T Excavator	**Ground Level:** 102.65 mOD	**Date:** 12/06/2018	**Logger:** ST

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water
				(0.70)	▩	MADE GROUND: Reworked topsoil. Firm brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subrounded fine to coarse of mixed lithologies, predominantly limestone	
0.50 0.50 0.50	B2 D3 ES1						
			101.95	0.70	⁙	Grey gravelly fine to coarse SAND. Gravel is subrounded fine to coarse of mixed lithologies, predominantly limestone	
				(1.30)			
1.50 1.50 1.50	B5 D6 ES4						
		Seepage at 1.80m					▼
			100.65	2.00		End of trial pit at 2.00m	

Remarks
DCP carried out.

Terminated due to influx of water.

Water Strikes:

Struck at (m):	Remarks:
1.80	Seepage at 1.80m

Stability:
Unstable

Width: 1.20
Length: 2.00

CAUSEWAY GEOTECH

Project No.: 17-0439

Project Name: Coolnabacky 400kV GIS Substation

Trial Pit No.: TP11

Co-ordinates: 653587.91 E 692815.56 N

Client: ESB Networks

Sheet 1 of 1

Method: Trial Pitting

Client's Representative: Killeen Civil Engineering

Scale: 1:25

Plant: 3T Excavator

Ground Level: 100.21 mOD

Date: 12/06/2018

Logger: ST

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water
				(0.30)	▨	TOPSOIL	
			99.91	0.30	⁘	Grey gravelly fine to coarse SAND. Gravel is subrounded fine to coarse of mixed lithologies, predominantly limestone	
0.50 0.50 0.50	B2 D3 ES1						
				(1.20)			
1.50 1.50 1.50	B4 D5 ES6	Seepage at 1.50m	98.71	1.50		End of trial pit at 1.50m	▼

Remarks
DCP carried out.

Terminated due to continual collapse of pit sides.

Water Strikes:

Struck at (m):	Remarks:
1.50	Seepage at 1.50m

Stability: Unstable

Width: 1.20

Length: 2.00

CAUSEWAY GEOTECH	**Project No.:** 17-0439	**Project Name:** Coolnabacky 400kV GIS Substation	**Trial Pit No.:** **TP12**
	Co-ordinates: 653685.71 E 692843.84 N	**Client:** ESB Networks	Sheet 1 of 1
Method: Trial Pitting		**Client's Representative:** Killeen Civil Engineering	**Scale:** 1:25
Plant: 3T Excavator	**Ground Level:** 100.91 mOD	**Date:** 12/06/2018	**Logger:** ST

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water
				(0.30)	▨	TOPSOIL	
			100.61	0.30	▨	Grey very gravelly silty fine to coarse SAND. Gravel is subrounded fine to coarse of mixed lithologies, predominantly limestone	
0.50 0.50 0.50	B2 D3 ES1			(1.00)			
		Seepage at 1.30m	99.61	1.30	▨	Stiff greyish brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subrounded fine to coarse of mixed lithologies, predominantly limestone	▼
1.50 1.50 1.50	B5 D6 ES4			(1.20)			
2.50 2.50	B7 D8		98.41	2.50		End of trial pit at 2.50m	

Remarks
DCP carried out.

Terminated at scheduled depth.

Water Strikes:

Struck at (m):	Remarks:
1.30	Seepage at 1.30m

Stability:
Stable

Width: 1.20

Length: 2.00

CAUSEWAY GEOTECH

Project No.: 17-0439

Project Name: Coolnabacky 400kV GIS Substation

Trial Pit No.: TP13

Co-ordinates: 653844.10 E 692856.30 N

Client: ESB Networks

Sheet 1 of 1

Method: Trial Pitting

Client's Representative: Killeen Civil Engineering

Scale: 1:25

Plant: 3T Excavator

Ground Level: 100.63 mOD

Date: 11/06/2018

Logger: ST

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water
				(0.30)	▨	Topsoil	
			100.33	0.30 (0.10)	▨	Stiff light brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subrounded fine to coarse of mixed lithologies.	
			100.23	0.40 (0.80)	▨	Grey silty gravelly fine to coarse SAND. Gravel is subrounded fine to coarse of limestone.	
			99.43	1.20 (1.40)	▨	Very soft grey slightly sandy slightly gravelly CLAY with high cobble content. Sand is fine to coarse. Gravel is subrounded fine to coarse of limestone. Cobbles are of limestone.	
			98.03	2.60		End of trial pit at 2.60m	

Remarks

No groundwater encountered

DCP carried out.

Terminated at scheduled depth.

Water Strikes:

Struck at (m):	Remarks:

Stability: Unstable

Width: 1.20

Length: 2.40

CAUSEWAY GEOTECH	**Project No.:** 17-0439	**Project Name:** Coolnabacky 400kV GIS Substation	**Trial Pit No.:** **TP14**
	Co-ordinates: 653727.14 E 692828.78 N	**Client:** ESB Networks	Sheet 1 of 1
Method: Trial Pitting		**Client's Representative:** Killeen Civil Engineering	**Scale:** 1:25
Plant: 3T Tracked Excavator	**Ground Level:** 101.57 mOD	**Date:** 12/06/2018	**Logger:** ST

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water
				(0.30)	▨	TOPSOIL	
0.50 0.50 0.50	B2 D3 ES1		101.27	0.30 (0.70)	⁙	Grey very gravelly fine to coarse SAND. Gravel is subrounded fine to coarse of mixed lithologies, predominantly limestone	
1.50 1.50 1.50	B4 D5 ES6		100.57	1.00 (1.20)	▤	Firm brown slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse of mixed lithologies, predominantly limestone	
2.40 2.40	B7 D8	Seepage at 2.30m	99.37	2.20 (0.30)	⁙	Grey very gravelly fine to coarse SAND. Gravel is subrounded fine to coarse of mixed lithologies, predominantly limestone	▼
			99.07	2.50		End of trial pit at 2.50m	

Remarks

DCP carried out.

Terminated on scheduled depth at collapsing of pit sides.

Water Strikes:

Struck at (m):	Remarks:
2.30	Seepage at 2.30m

Stability: Unstable

Width: 1.20

Length: 2.50

CAUSEWAY GEOTECH

	Project No.: 17-0439	**Project Name:** Coolnabacky 400kV GIS Substation	**Trial Pit No.:** **TP15**
	Co-ordinates: 653811.99 E 692890.35 N	**Client:** ESB Networks	Sheet 1 of 1
Method: Trial Pitting		**Client's Representative:** Killeen Civil Engineering	**Scale:** 1:25
Plant: 3T Excavator	**Ground Level:** 100.21 mOD	**Date:** 11/06/2018	**Logger:** RS

Depth (m)	Sample / Tests	Field Records
0.50	ES1	
0.50		HVP=177, HVR=86
0.70	B2	
0.70	D3	
1.50	ES4	
1.70	B5	
1.70	D6	

Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water
99.91	0.30 (0.30)		TOPSOIL	
99.81	0.40 (0.10)		Stiff light brown slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subrounded fine to coarse of unknown	
99.31	0.90 (0.50)		Stiff grey mottled brown slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is subrounded fine to coarse of limestone	
98.21	2.00 (1.10)		Firm grey slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is subrounded fine to coarse of limestone.	
			End of trial pit at 2.00m	

Remarks
No groundwater encountered

DCP carried out.

Terminated due to continual collapse of pit sides.

Water Strikes:

Struck at (m):	Remarks:

Stability: Unstable

Width: 1.20

Length: 2.50

CAUSEWAY GEOTECH

Project No.: 17-0439

Project Name: Coolnabacky 400kV GIS Substation

Trial Pit No.: TP16

Co-ordinates: 653757.40 E 693080.19 N

Client: ESB Networks

Sheet 1 of 1

Method: Trial Pitting

Client's Representative: Killeen Civil Engineering

Scale: 1:25

Plant: 3T Excavator

Ground Level: 98.48 mOD

Date: 11/06/2018

Logger: RS

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Water
				(0.30)	TOPSOIL	
0.30		HVP=196, HVR=80	98.18	0.30 (0.05)	Stiff light brown slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subrounded fine to coarse of unknown	
			98.13	0.35	Grey slightly silty gravelly fine to coarse SAND. Gravel is subrounded fine to coarse of limestone	
0.50	ES1					
				(0.65)		
0.80 0.80	B2 D3					
		Rapid Inflow at 1.00m	97.48	1.00	Soft brownish grey slightly sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subrounded fine to coarse of limestone. Cobbles are subrounded of limestone	▼
1.50	ES4					
				(1.30)		
2.00 2.00	B5 D6					
			96.18	2.30	End of trial pit at 2.30m	

Remarks
DCP carried out.

Terminated due to continual collapse of pit sides.

Water Strikes:

Struck at (m):	Remarks:
1.00	Rapid Inflow at 1.00m

Stability: Unstable

Width: 1.40

Length: 2.20

CAUSEWAY GEOTECH

	Project No.: 17-0439	**Project Name:** Coolnabacky 400kV GIS Substation	**Trial Pit No.:** **TP28**
	Co-ordinates: 653757.40 E 693080.19 N	**Client:** ESB Networks	Sheet 1 of 1
Method: Trial Pitting		**Client's Representative:** Killeen Civil Engineering	**Scale:** 1:25
Plant: 3T Excavator	**Ground Level:** mOD	**Date:** 12/06/2018	**Logger:** ST

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water
				(0.20) 0.20	▨	TOPSOIL	
0.50 0.50 0.50	B2 D3 ES1			(0.50) 0.70	░	Brown gravelly fine to coarse SAND. Gravel is subrounded fine to coarse of mixed lithologies, predominantly limestone	
						End of trial pit at 0.70m	

0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5

Remarks No groundwater encountered. Terminated on Archaeologists instructions.	**Water Strikes:**		**Stability:** Stable
	Struck at (m):	Remarks:	**Width:** 1.20 **Length:** 2.00

APPENDIX D

Trial pit photographs

TP01

TP01

TP01

TP01

TP01

TP02

TP02

TP02

TP02

TP03

TP03

TP03

TP03

TP04

TP04

TP04

TP04

TP05

TP05

TP05

TP05

TP06

TP06

TP06

TP06

TP07

TP07

TP07

TP07

TP08

TP08

TP08

TP09

TP09

TP09

TP09

TP09

TP09

TP10

TP10

TP10

TP10

TP10

TP10

TP11

TP11

TP11

TP11

TP11

TP12

TP12

TP12

TP12

TP12

TP12

TP12

TP12


Project: ESB S C
Project No.: 17-0439
FH No.: TP 13
Date: 11/06/2018
0.1
0.2
0.3
0.4
0.5

TP13

TP13

TP13

TP13

TP14

TP14

TP14

TP14

TP14

TP14

TP15

TP15

TP15


CAUSEWAY
Project: ESB S C
Project No: 17-0439
TP No: TP 15
Date: 11/06/2018

TP15


CAUSEWAY GEOTECH
Project: ESB S C
Project No.: 17-0439
TH No.: TP 15
Date: 11/06/2018

TP15

TP15


CAUSEWAY GEOTECH
Project: ESB S C
Project No.: 17-0439
EH No.: TP 15
Date: 11/06/2018
(m) 0.1 0.2 0.3 0.4 0.5

TP15


Project: ESB S C
Project No.: 17-0439
EH No.: TP 16
Date: 11/06/2018

TP16


Project: ESB S C
Project No.: 17-0439
EH No.: TP 16
Date: 11/06/2018

TP16

TP16

TP16


CAUSEWAY
Project: ESB S C
Project No.: 17-0439
EH No.: TP 16
Date: 11/06/2018
0.1
0.2
0.3
0.4
0.5


Project: ESB S C
Project No: 17-0439
TP No: TP 16
Date: 11/06/2018
0.1
0.2
0.3
0.4
0.5

TP16

APPENDIX E

Infiltration test results

Soakaway Infiltration Test

Project No.: 17-0439
Site: ESB Site in Coolnabacky, Co. Laois
Test Location: SA TP15
Test Date: 19 June 2018

Analysis using method as described in BRE Digest 365 and CIRIA Report C697-The SUDS Manual

	width (m)	length (m)
test pit top dimensions	0.70	1.30
test pit base dimensions	0.70	0.50

test pit depth (m) 1.30

depth to groundwater before adding water (m) = Dry

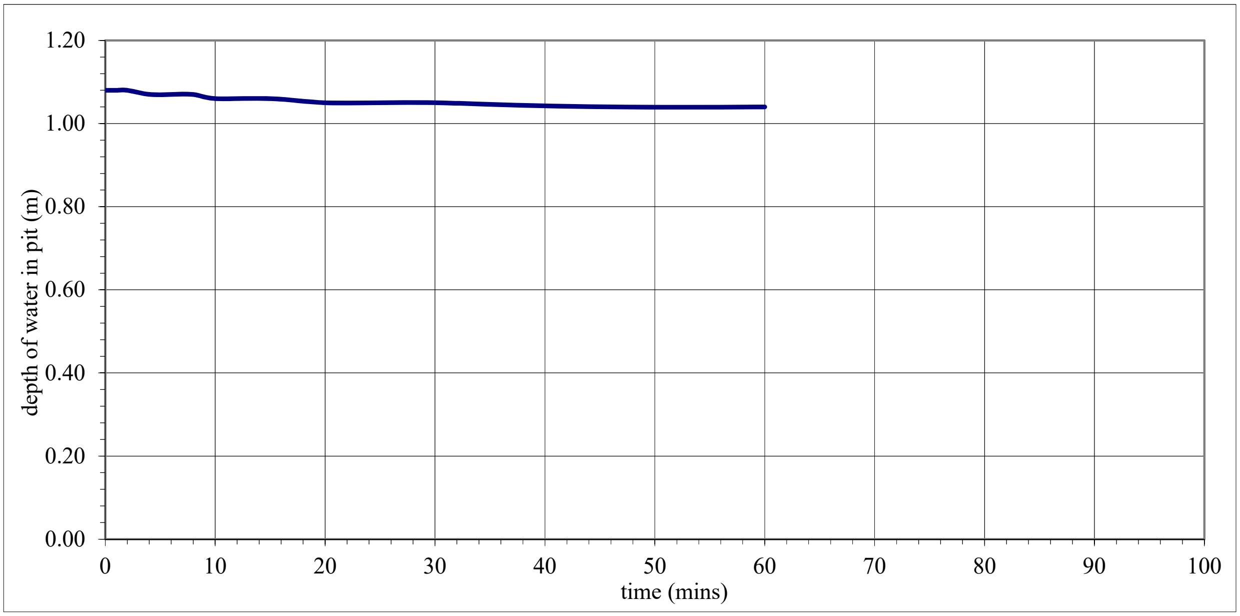
time (mins)	depth to water surface (m)	depth of water in pit (m)
0	0.22	1.08
1	0.22	1.08
2	0.22	1.08
4	0.23	1.07
6	0.23	1.07
8	0.23	1.07
10	0.24	1.06
15	0.24	1.06
20	0.25	1.05
25	0.25	1.05
30	0.25	1.05
45	0.26	1.04
60	0.26	1.04

From graph below:
test start - 75% depth at
0.81 m water depth
time is not determined

test end - 25% depth at
0.27 m water depth
time is not determined

infiltration rate (q) is very low

time (mins)	depth to water (m)	depth of water in pit (m)	time elapsed (mins)	volume of water lost (m^3)	Area of walls and base at 50% drop (m^2)	q (m/min)	q (m/h)



Soakaway Infiltration Test

Project No.: 17-0439
Site: ESB Site in Coolnabacky, Co. Laois
Test Location: SA TP16
Test Date: 19 June 2018

Analysis using method as described in BRE Digest 365 and CIRIA Report C697-The SUDS Manual

	width (m)	length (m)
test pit top dimensions	0.80	1.30
test pit base dimensions	0.80	0.50

test pit depth (m) 2.30

depth to groundwater before adding water (m) = Dry

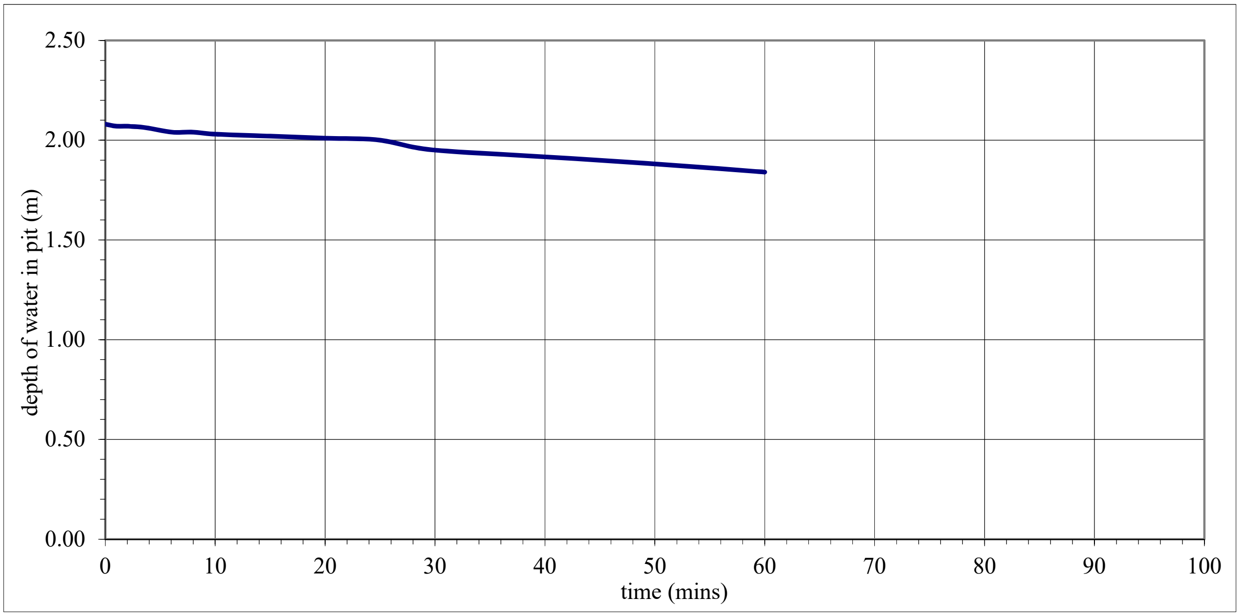
time (mins)	depth to water surface (m)	depth of water in pit (m)
0	0.22	2.08
1	0.23	2.07
2	0.23	2.07
4	0.24	2.06
6	0.26	2.04
8	0.26	2.04
10	0.27	2.03
15	0.28	2.02
20	0.29	2.01
25	0.30	2.00
30	0.35	1.95
45	0.40	1.90
60	0.46	1.84

From graph below:
test start - 75% depth at
1.56 m water depth
time is not determined

test end - 25% depth at
0.52 m water depth
time is not determined

infiltration rate (q) is very low

time (mins)	depth to water (m)	depth of water in pit (m)	time elapsed (mins)	volume of water lost (m^3)	Area of walls and base at 50% drop (m^2)	q (m/min)	q (m/h)



APPENDIX F

Indirect CBR tests

Causeway Geotech Ltd

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project: **Coolnabacky 400kV GIS Substation**

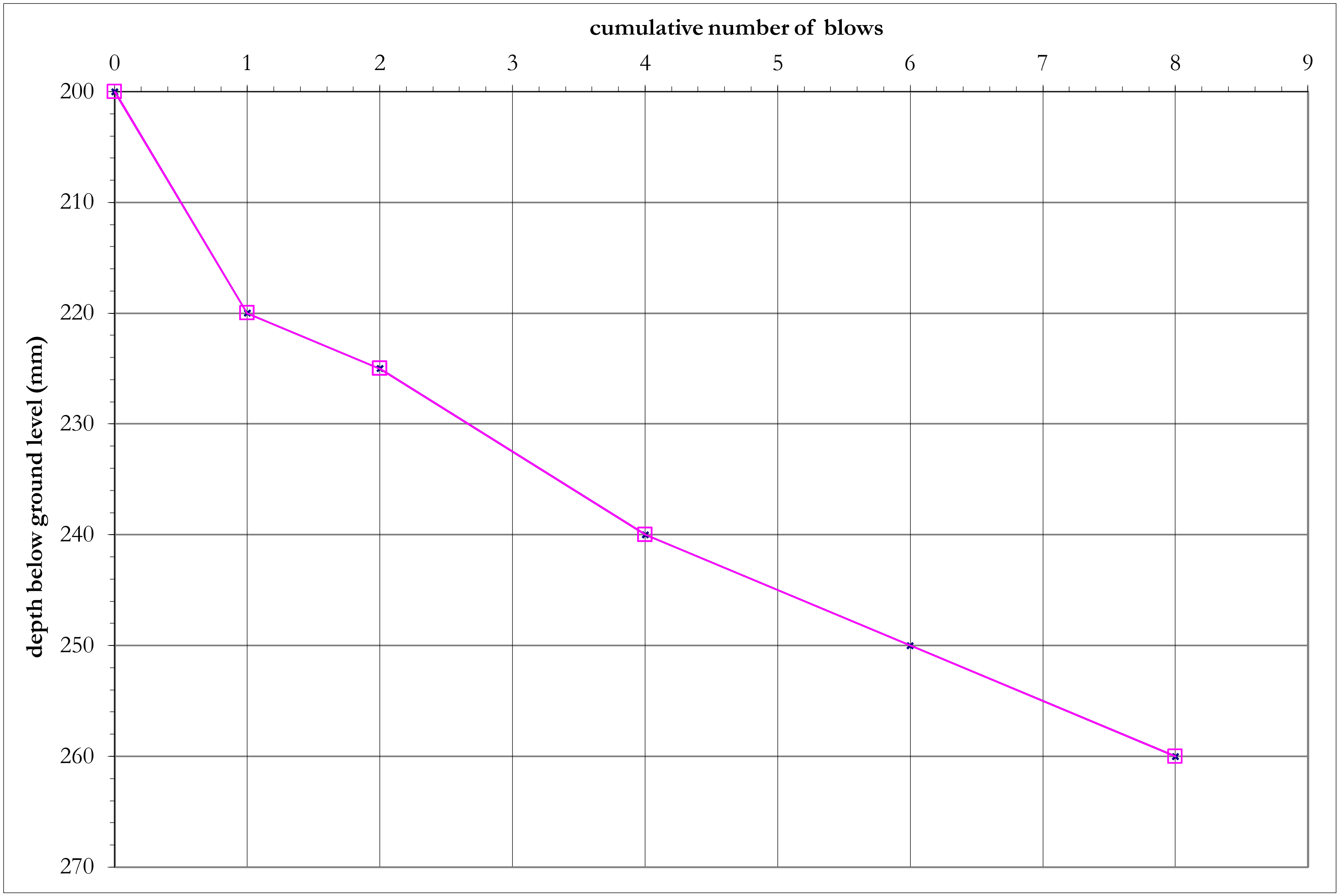
Test Number: **TP01**

CBR estimated using Kleyn & Van Heerden (1983):

Log CBR = 2.632-1.28 Log (mm/blow)

Project No: **17-0439**

Date: **13-Jun-18**



depth from to (mm)	mm/blow	CBR (%)
200 220	20	9.3
220 225	5	55
225 240	7.5	33
240 260	5	55

Causeway Geotech Ltd

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project: **Coolnabacky 400kV GIS Substation**

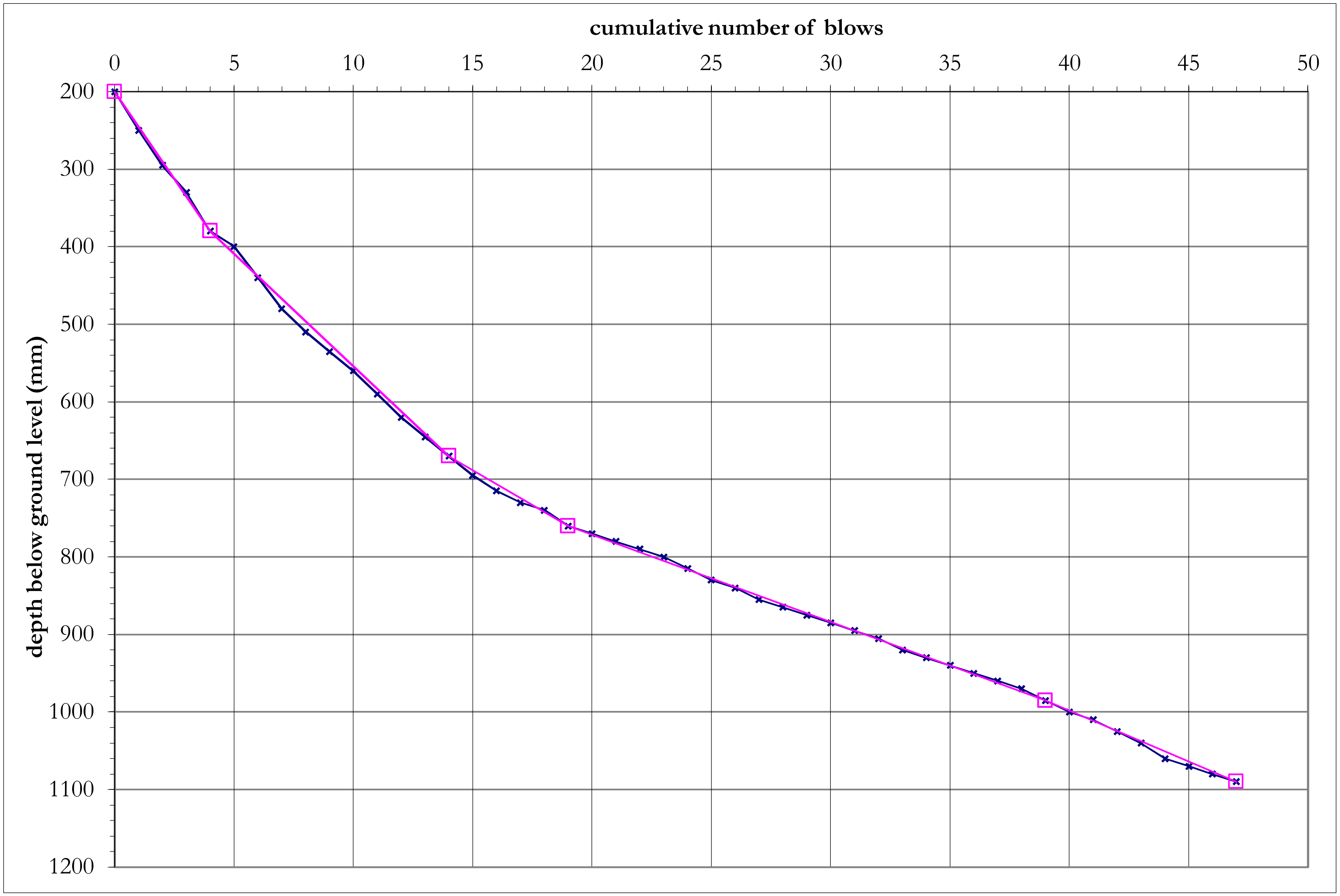
Test Number: **TP02**

CBR estimated using Kleyn & Van Heerden (1983):

Log CBR = 2.632-1.28 Log (mm/blow)

Project No: 17-0439

Date: 13-Jun-18



depth from to (mm)	mm/blow	CBR (%)
200 380	45	3.3
380 670	29	5.8
670 760	18	11
760 985	11	19
985 1090	13	16

Causeway Geotech Ltd

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project: **Coolnabacky 400kV GIS Substation**

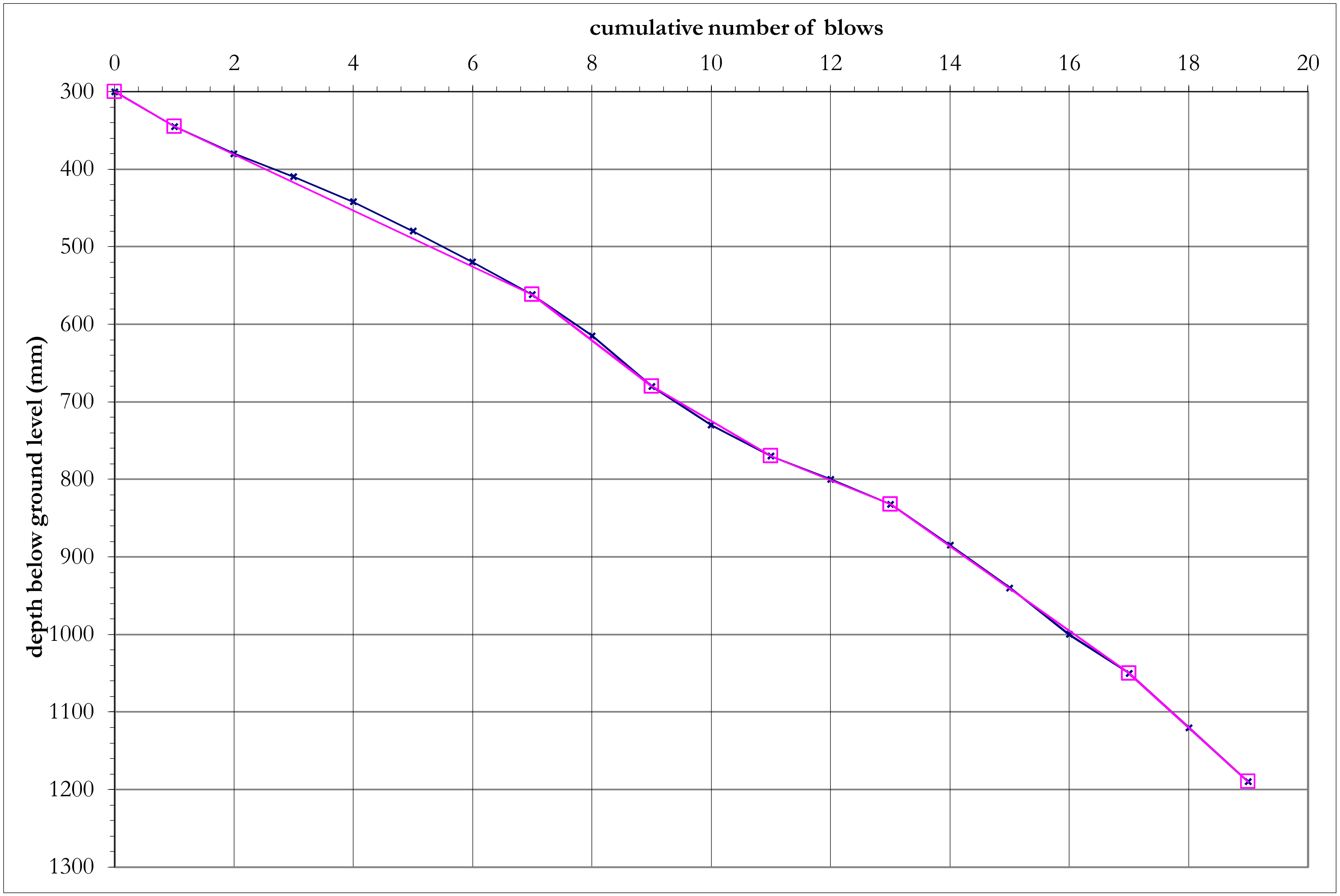
Test Number: **TP03**

CBR estimated using Kleyn & Van Heerden (1983):

Log CBR = 2.632-1.28 Log (mm/blow)

Project No: **17-0439**

Date: **13-Jun-18**



depth from to (mm)	mm/blow	CBR (%)
300 345	45	3.3
345 562	36	4.3
562 680	59	2.3
680 770	45	3.3
770 832	31	5.3
832 1050	55	2.6
1050 1190	70	1.9

Causeway Geotech Ltd

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project: **Coolnabacky 400kV GIS Substation**

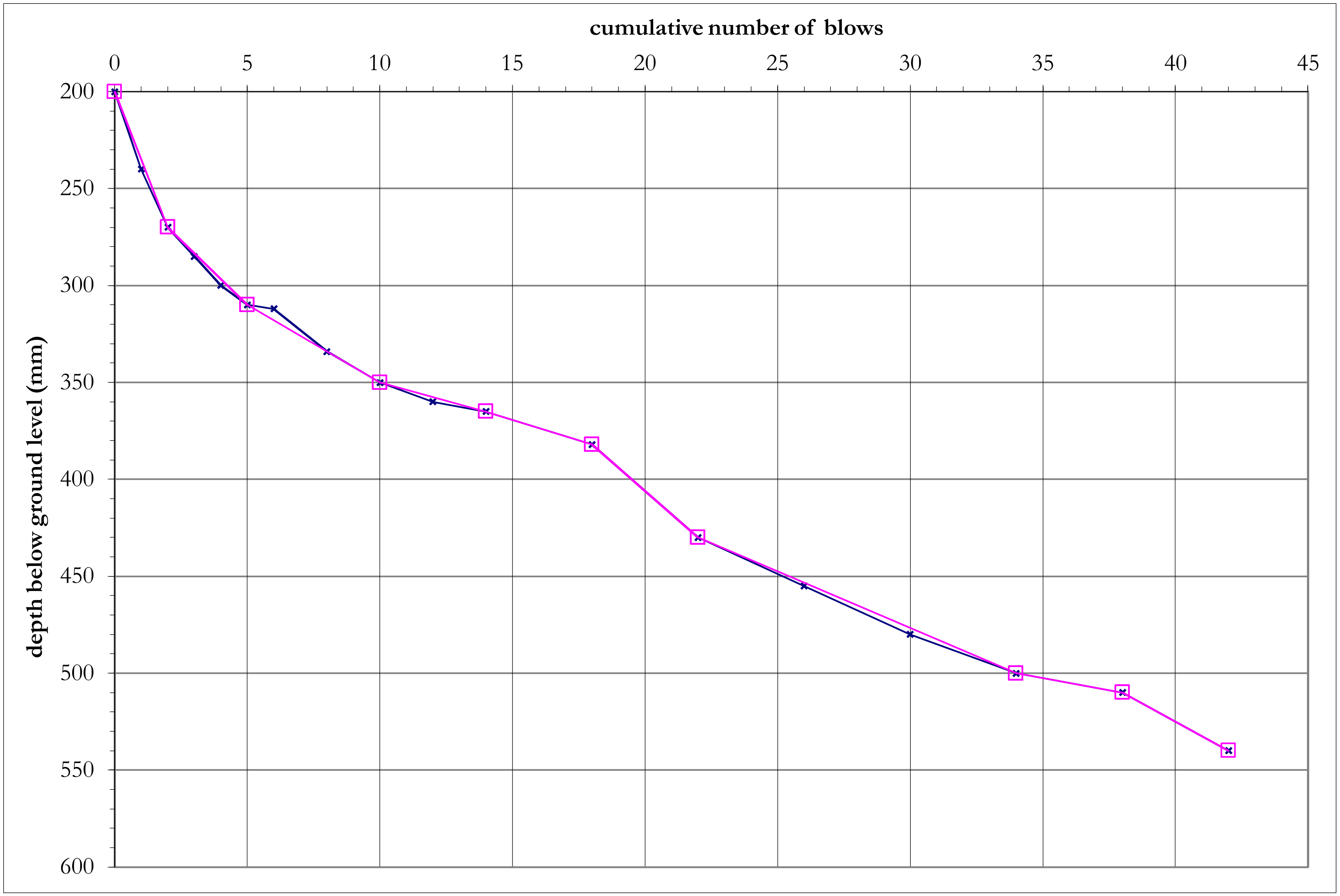
Test Number: **TP04**

CBR estimated using Kleyn & Van Heerden (1983):

Log CBR = 2.632-1.28 Log (mm/blow)

Project No: **17-0439**

Date: **13-Jun-18**



depth from to (mm)	mm/blow	CBR (%)
200 270	35	4.5
270 310	13	16
310 350	8	30
350 365	3.8	79
365 382	4.3	67
382 430	12	18
430 500	5.8	45
500 510	2.5	>100
510 540	7.5	33

Causeway Geotech Ltd

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project: **Coolnabacky 400kV GIS Substation**

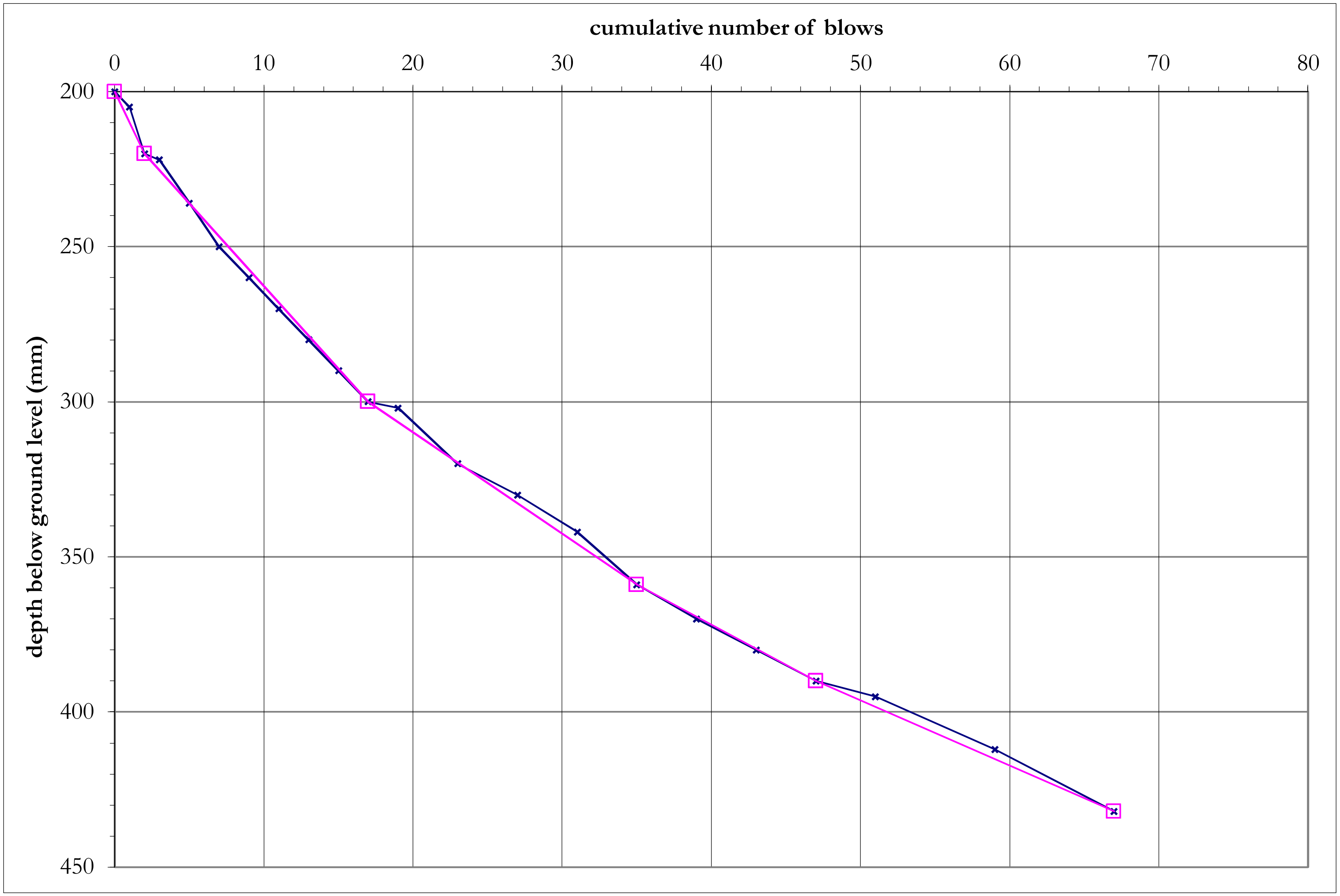
Test Number: **TP05**

CBR estimated using Kleyn & Van Heerden (1983):

Log CBR = 2.632-1.28 Log (mm/blow)

Project No: **17-0439**

Date: **13-Jun-18**



depth from to (mm)	mm/blow	CBR (%)
200 220	10	22
220 300	5.3	50
300 359	3.3	94
359 390	2.6	>100
390 432	2.1	>100

Causeway Geotech Ltd

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project: **Coolnabacky 400kV GIS Substation**

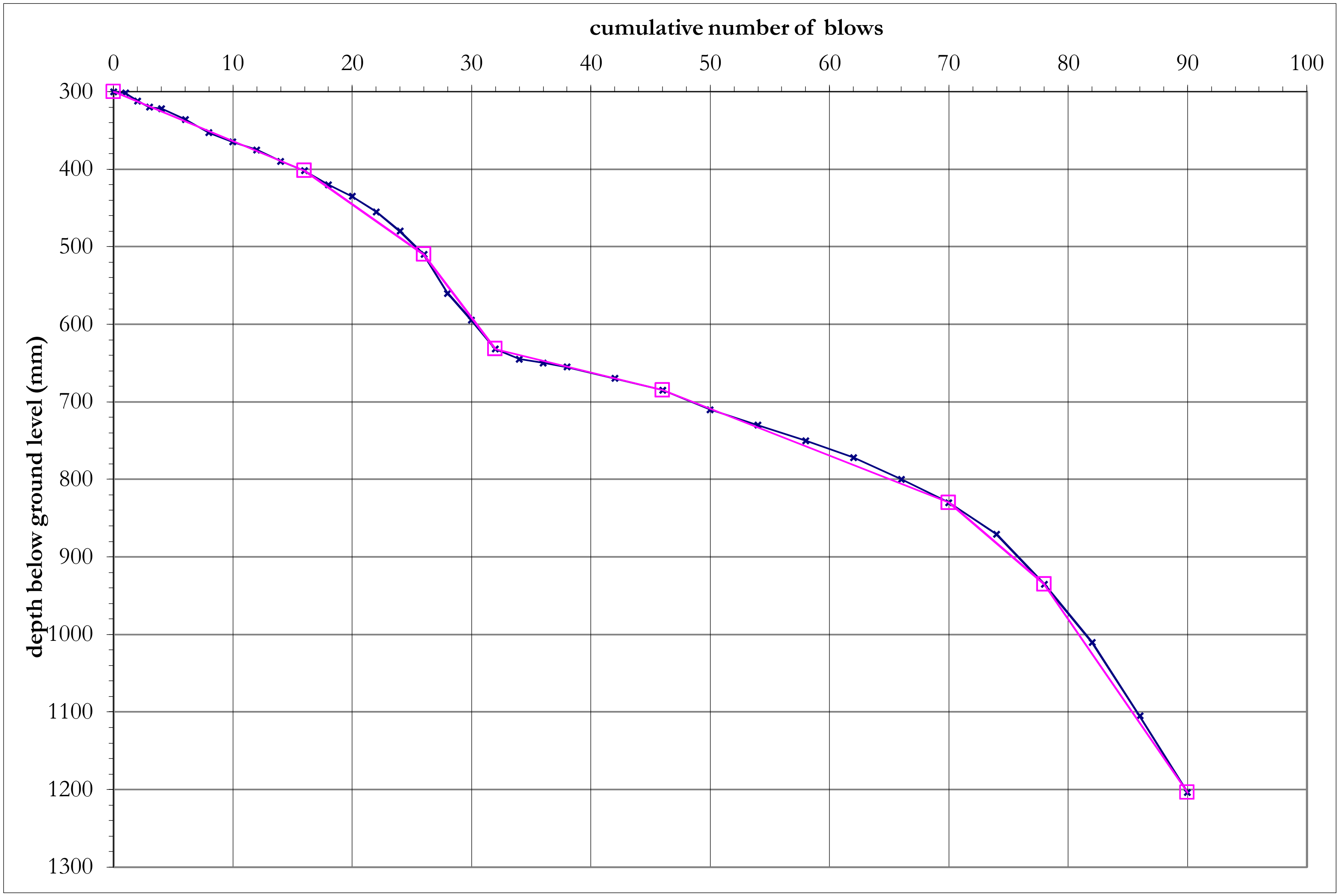
Test Number: **TP06**

CBR estimated using Kleyn & Van Heerden (1983):

Log CBR = 2.632-1.28 Log (mm/blow)

Project No: **17-0439**

Date: **13-Jun-18**



depth from to (mm)	mm/blow	CBR (%)
300 402	6.4	40
402 510	11	20
510 632	20	9.1
632 685	3.8	78
685 830	6	43
830 935	13	16
935 1204	22	8

Causeway Geotech Ltd

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project: **Coolnabacky 400kV GIS Substation**

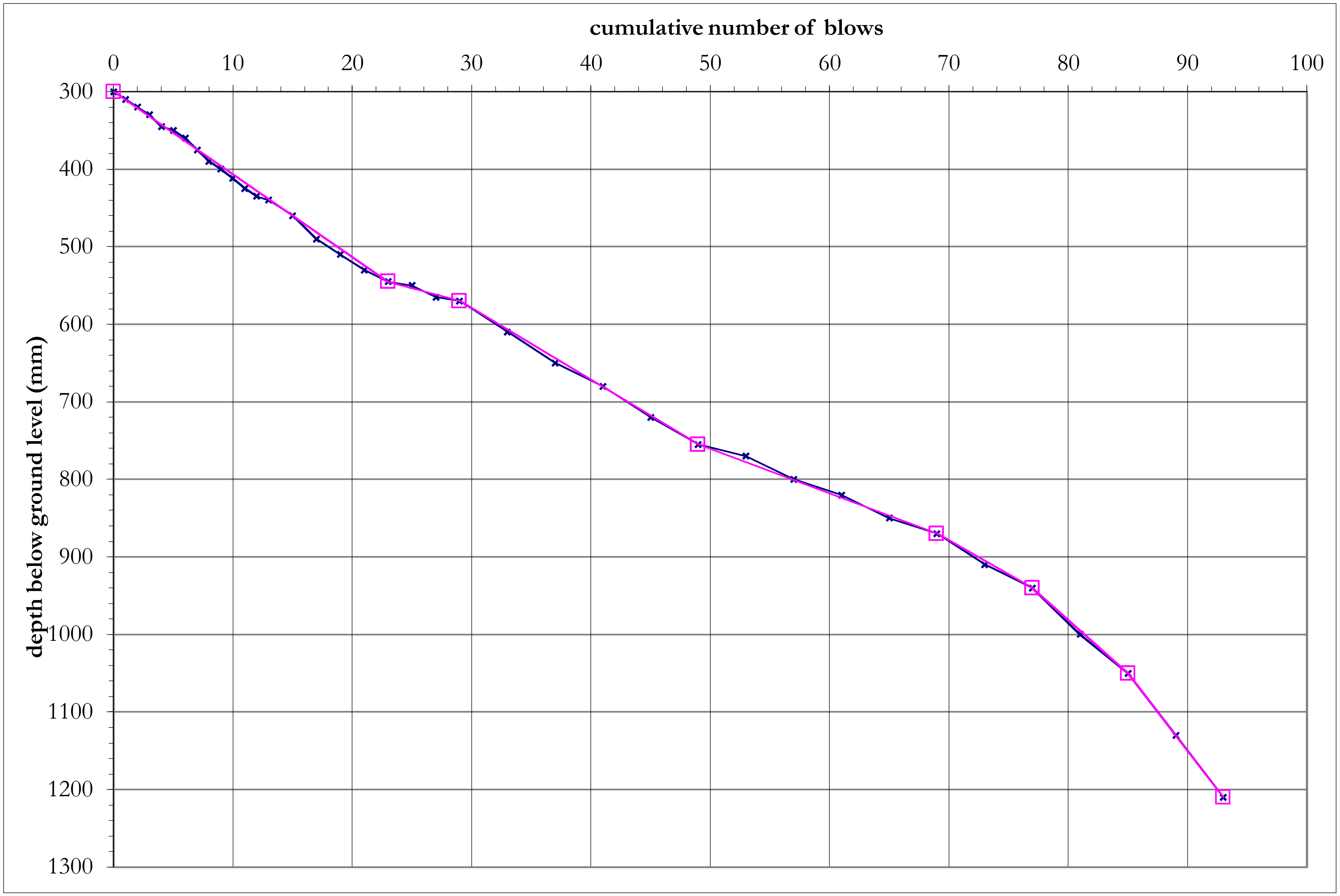
Test Number: **TP07**

CBR estimated using Kleyn & Van Heerden (1983):

Log CBR = 2.632-1.28 Log (mm/blow)

Project No: **17-0439**

Date: **12-Jun-18**



depth from to (mm)	mm/blow	CBR (%)
300 545	11	21
545 570	4.2	69
570 755	9.3	25
755 870	5.8	46
870 940	8.8	27
940 1050	14	15
1050 1210	20	9.3

Causeway Geotech Ltd

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project: **Coolnabacky 400kV GIS Substation**

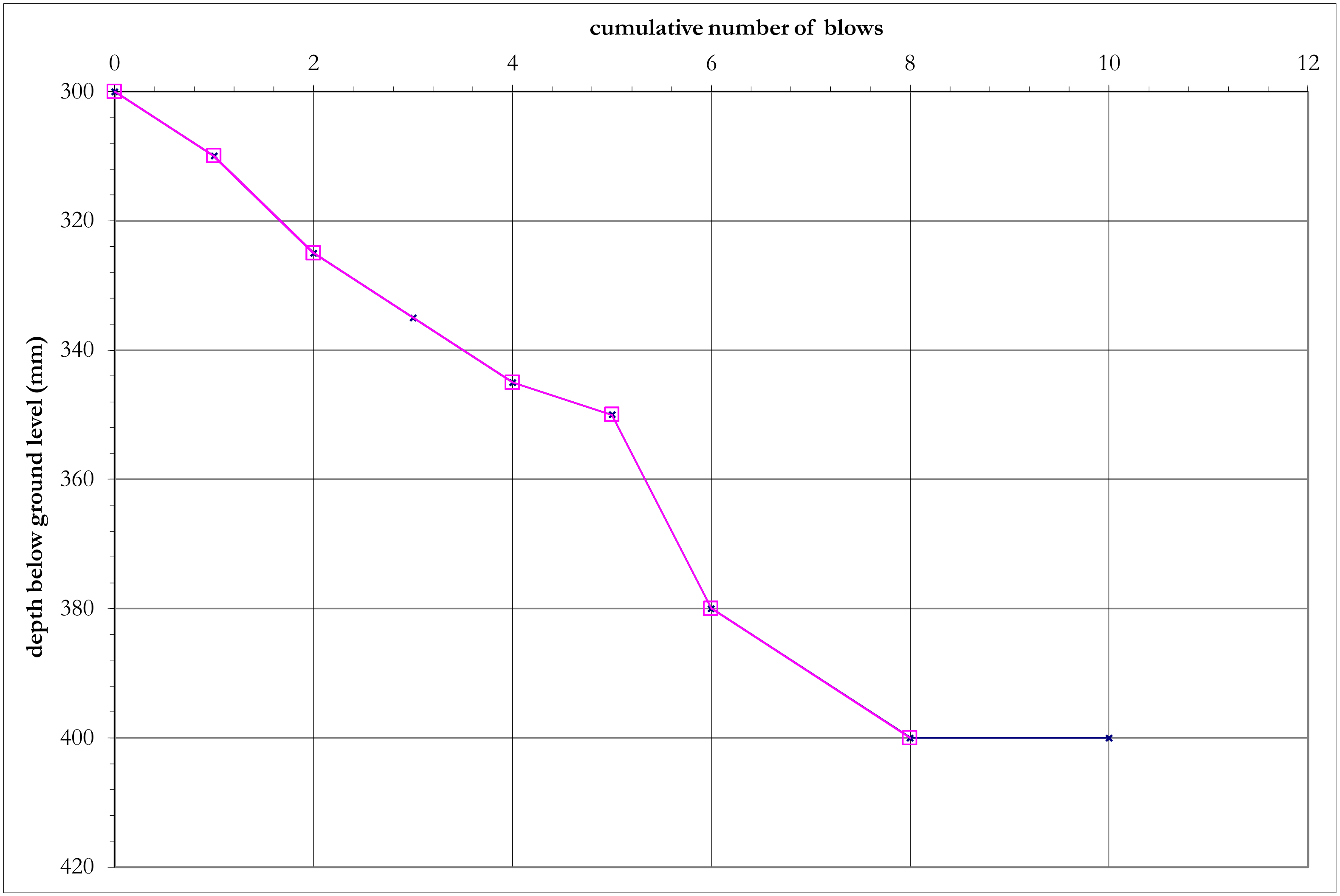
Test Number: **TP09**

CBR estimated using Kleyn & Van Heerden (1983):

Log CBR = 2.632-1.28 Log (mm/blow)

Project No: 17-0439

Date: 12-Jun-18



depth from to (mm)	mm/blow	CBR (%)
300 310	10	22
310 325	15	13
325 345	10	22
345 350	5	55
350 380	30	5.5
380 400	10	22

Causeway Geotech Ltd

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project: **Coolnabacky 400kV GIS Substation**

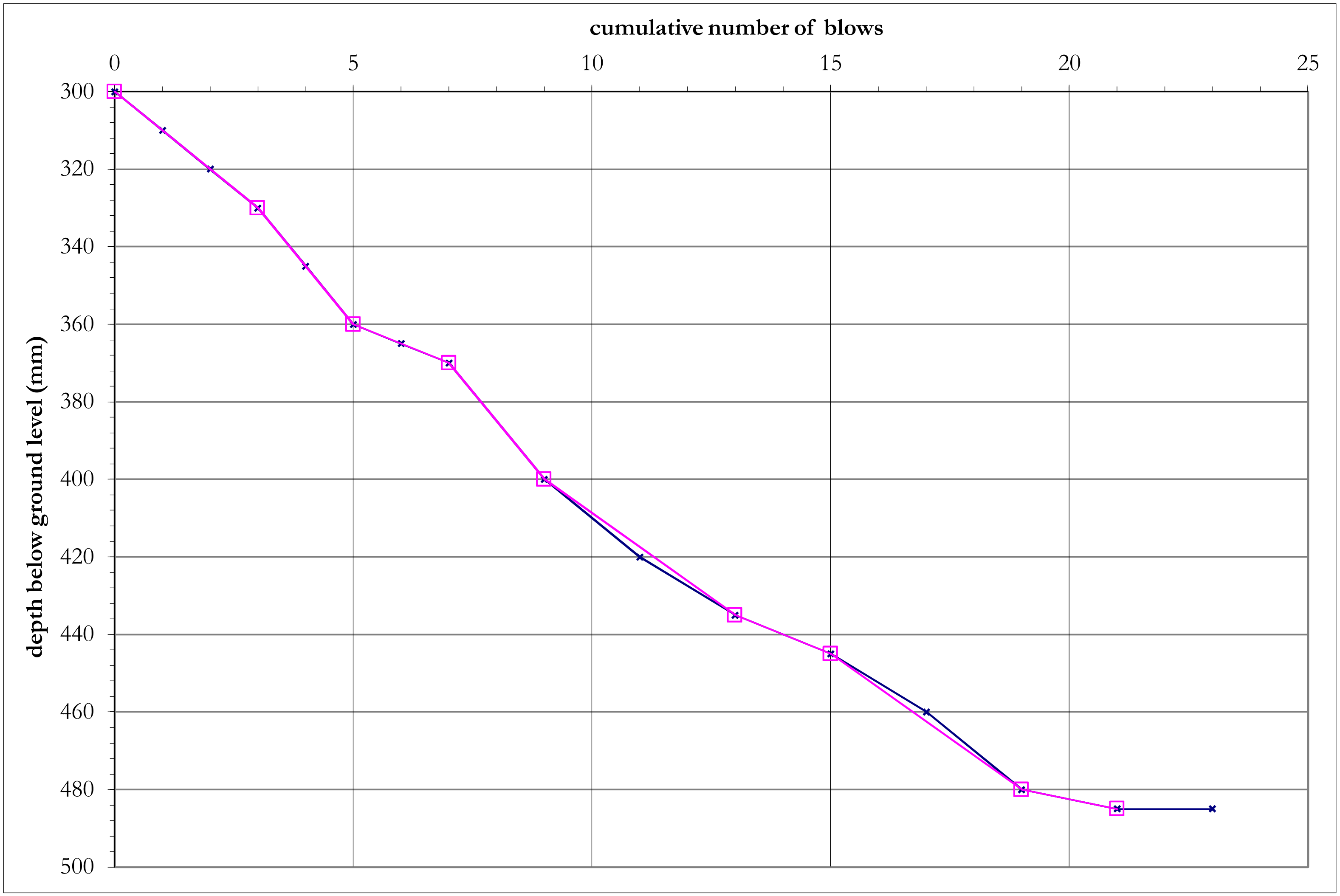
Test Number: **TP10**

CBR estimated using Kleyn & Van Heerden (1983):

Log CBR = 2.632-1.28 Log (mm/blow)

Project No: **17-0439**

Date: **12-Jun-18**



depth from to (mm)	mm/blow	CBR (%)
300	10	22
330		
330	15	13
360		
360	5	55
370		
370	15	13
400		
400	8.8	27
435		
435	5	55
445		
445	8.8	27
480		
480	2.5	>100
485		

Causeway Geotech Ltd

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project: **Coolnabacky 400kV GIS Substation**

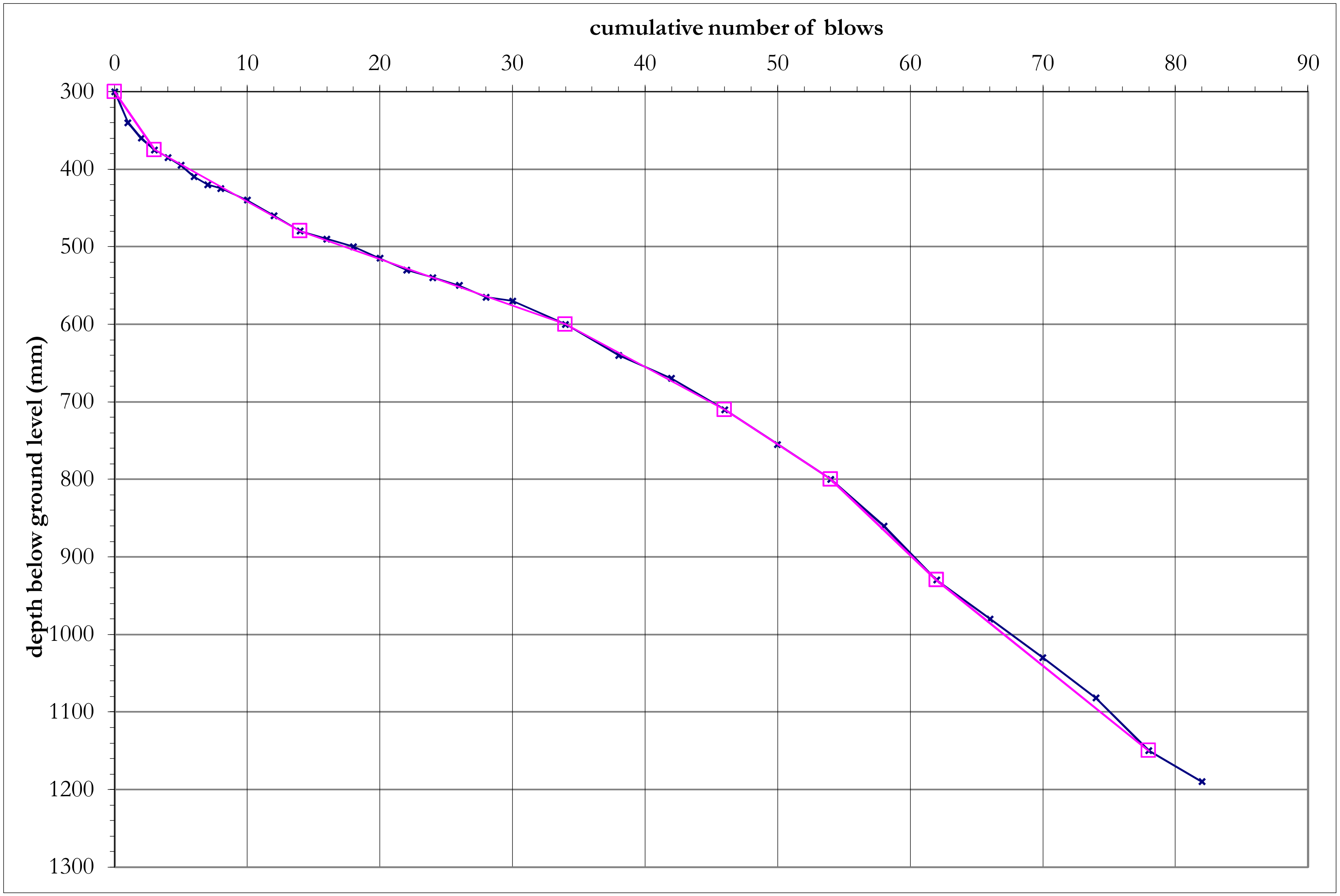
Test Number: **TP11**

CBR estimated using Kleyn & Van Heerden (1983):

Log CBR = 2.632-1.28 Log (mm/blow)

Project No: **17-0439**

Date: **12-Jun-18**



depth from to (mm)	mm/blow	CBR (%)
300 375	25	7
375 480	9.5	24
480 600	6	43
600 710	9.2	25
710 800	11	19
800 930	16	12
930 1150	14	15

Causeway Geotech Ltd

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project: **Coolnabacky 400kV GIS Substation**

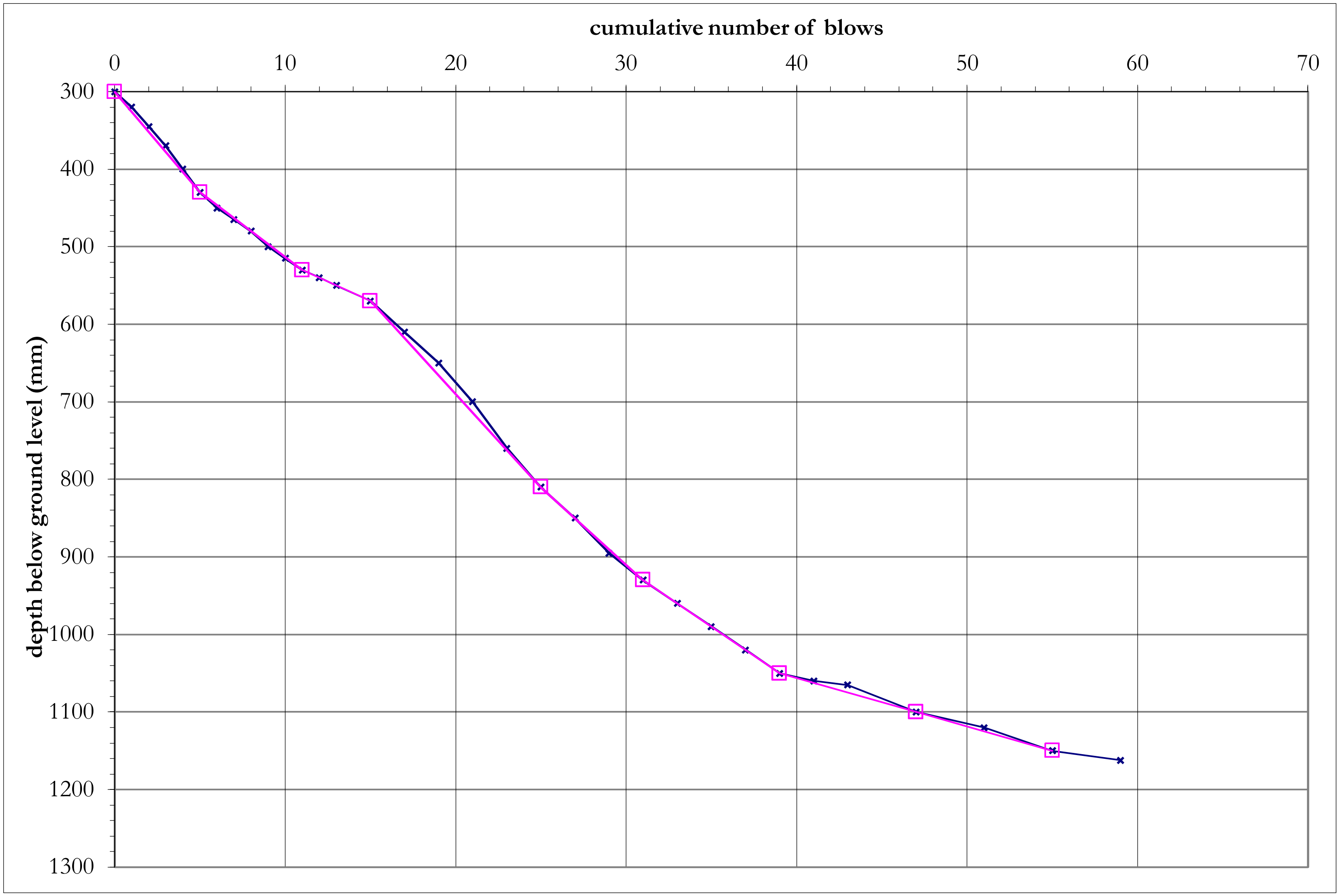
Test Number: **TP12**

CBR estimated using Kleyn & Van Heerden (1983):

Log CBR = 2.632-1.28 Log (mm/blow)

Project No: **17-0439**

Date: **12-Jun-18**



depth from to (mm)	mm/blow	CBR (%)
300 430	26	6.6
430 530	17	12
530 570	10	22
570 810	24	7.3
810 930	20	9.3
930 1050	15	13
1050 1100	6.3	41
1100 1150	6.3	41

Causeway Geotech Ltd

CBR estimated using Kleyn & Van Heerden (1983):

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

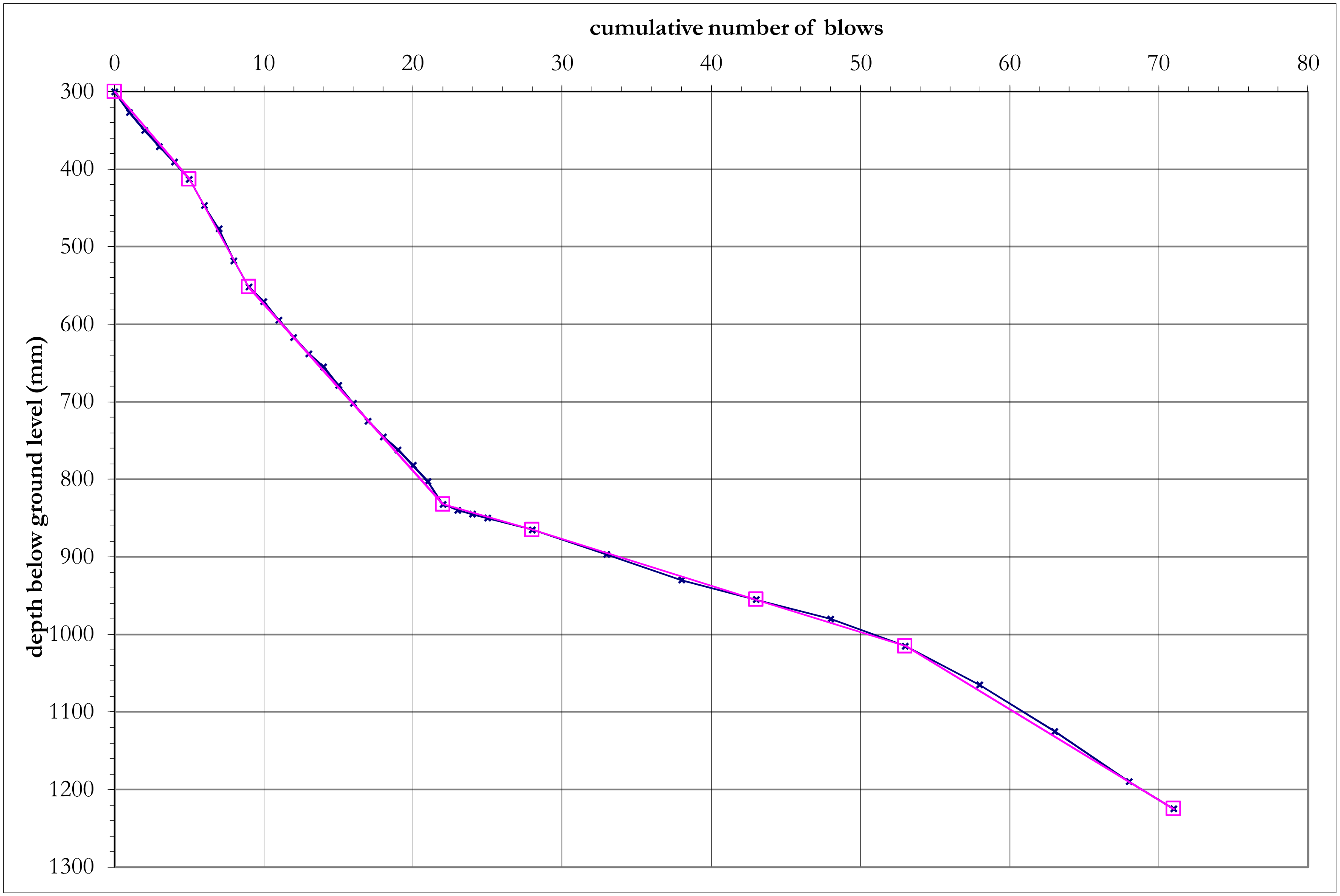
Log CBR = 2.632-1.28 Log (mm/blow)

Project: **Coolnabacky 400kV GIS Substation**

Project No: **17-0439**

Test Number: **TP13**

Date: **11-Jun-18**



depth from to (mm)	mm/blow	CBR (%)
300 413	23	7.9
413 552	35	4.6
552 832	22	8.4
832 865	5.5	48
865 955	6	43
955 1015	6	43
1015 1225	12	18

Causeway Geotech Ltd

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project: **Coolnabacky 400kV GIS Substation**

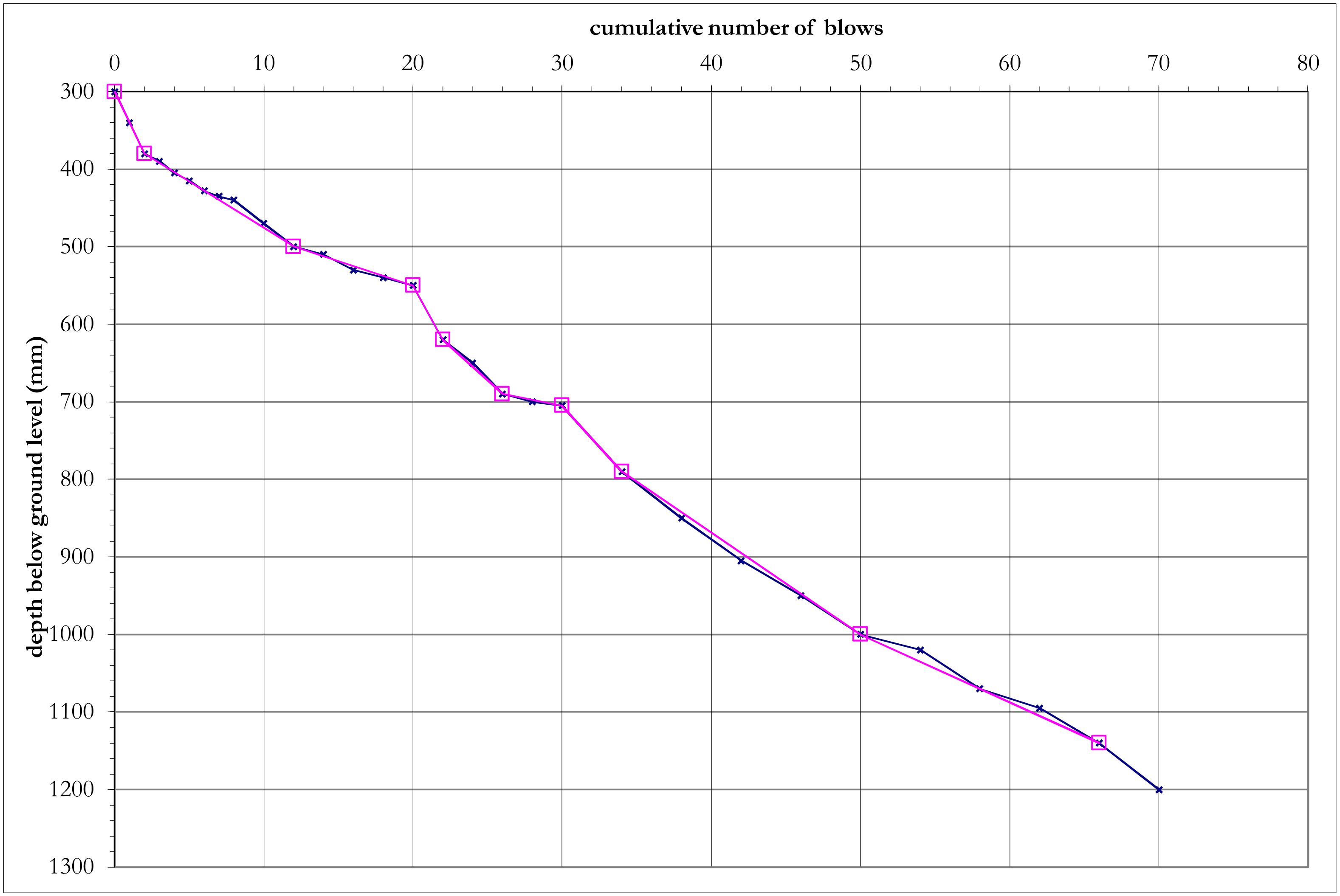
Test Number: **TP14**

CBR estimated using Kleyn & Van Heerden (1983):

Log CBR = 2.632-1.28 Log (mm/blow)

Project No: **17-0439**

Date: **11-Jun-18**



depth from to (mm)	mm/blow	CBR (%)
300	40	3.8
380		
380	12	18
500		
500	6.3	41
550		
550	35	4.5
620		
620	18	11
690		
690	3.8	79
705		
705	21	8.6
790		
790	13	16
1000		
1000	8.8	27
1140		

Causeway Geotech Ltd

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project: **Coolnabacky 400kV GIS Substation**

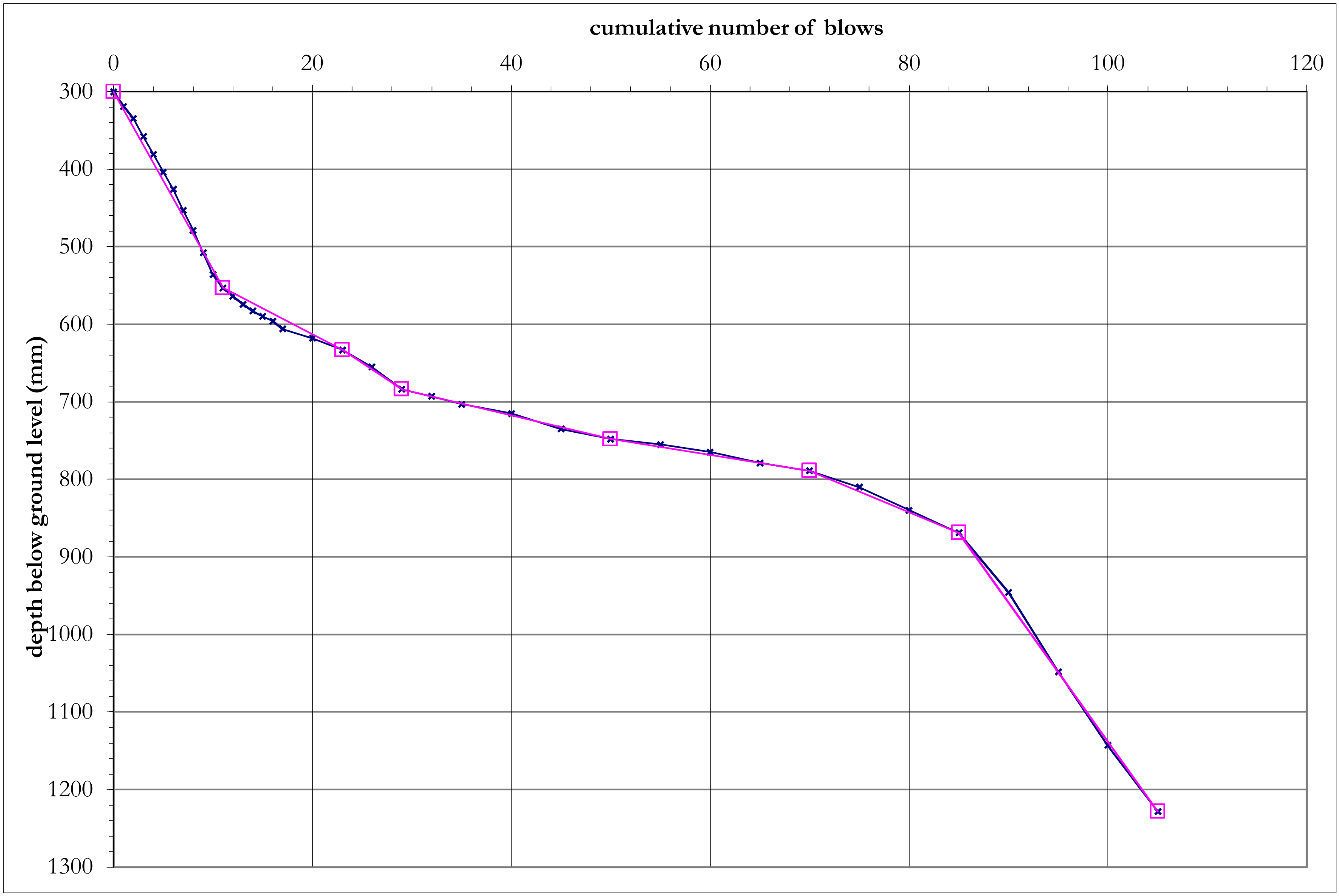
Test Number: **TP15**

CBR estimated using Kleyn & Van Heerden (1983):

Log CBR = 2.632-1.28 Log (mm/blow)

Project No: 17-0439

Date: 11-Jun-18



depth from to (mm)	**mm/blow**	**CBR (%)**
300	23	7.7
553		
553	6.7	38
633		
633	8.5	28
684		
684	3	>100
748		
748	2.1	>100
789		
789	5.3	50
869		
869	18	11
1228		

Causeway Geotech Ltd

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project: **Coolnabacky 400kV GIS Substation**

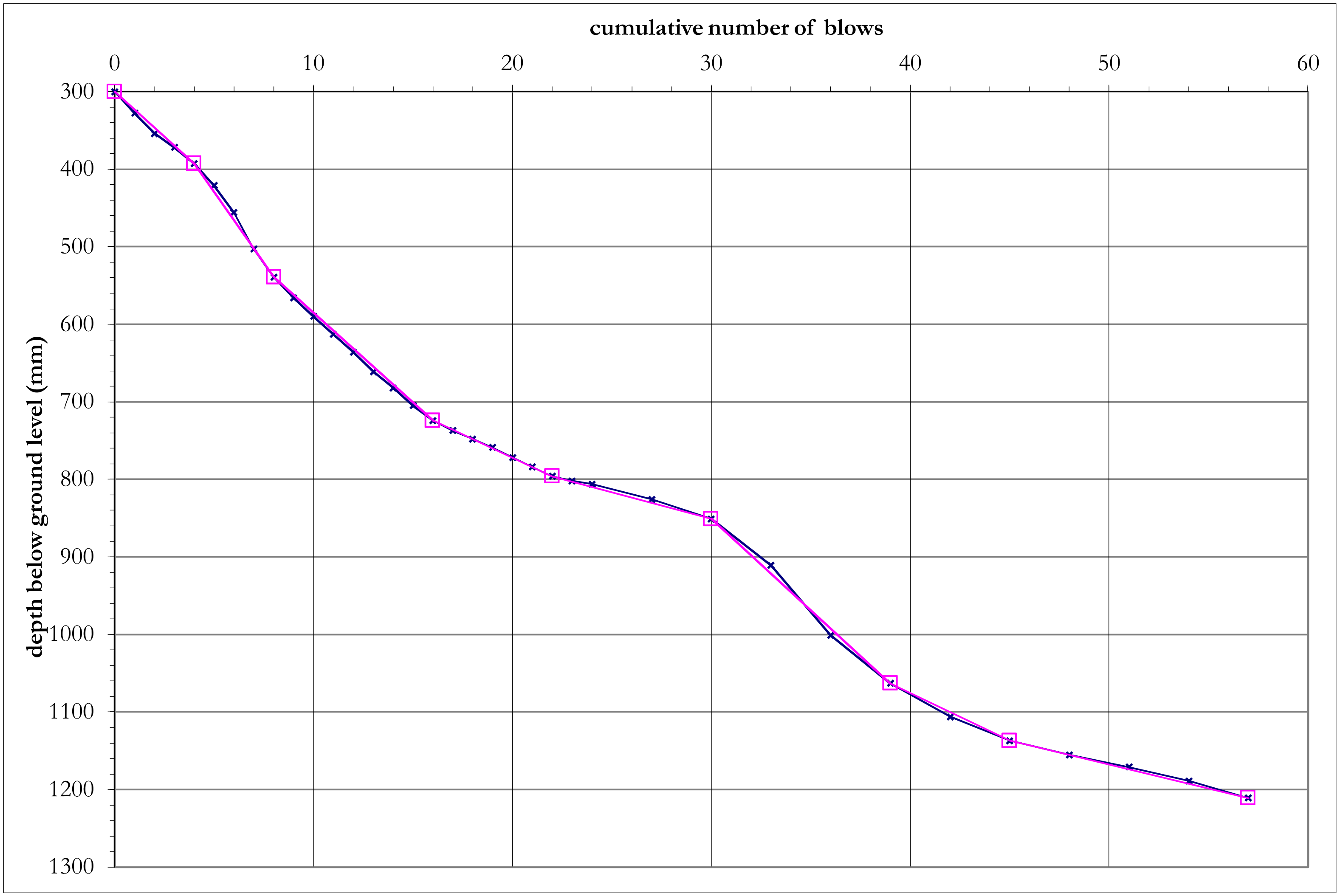
Test Number: **TP16**

CBR estimated using Kleyn & Van Heerden (1983):

Log CBR = 2.632-1.28 Log (mm/blow)

Project No: **17-0439**

Date: **11-Jun-18**



depth from to (mm)	mm/blow	CBR (%)
300	23	7.6
393		
393	37	4.3
539		
539	23	7.7
724		
724	12	18
796		
796	6.9	36
851		
851	24	7.5
1063		
1063	12	17
1137		
1137	6.2	42
1211		

APPENDIX G

Geotechnical laboratory test results

CAUSEWAY GEOTECH

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info@causewaygeotech.com
www.causewaygeotech.com

SOIL AND ROCK SAMPLE ANALYSIS
LABORATORY TEST REPORT

Client:	**Eirgrid/Kileens Civil Engineering Ltd.**
Engineer:	**Kileens Civil Engineering Ltd**
From:	**Stephen Watson** **Laboratory Manager** **Causeway Geotech Ltd**
Tel:	**+44(0)2827666640**
E-mail:	**stephen.watson@causewaygeotech.com**
Date:	**30/07/18**
Ref:	**17-0439**

Coolnabacky 400kV GIS Substation

We are pleased to attach the results of laboratory testing carried out for the above project. This memo and its attachments constitute a report of the results of tests as detailed in the *Contents page(s)*.

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

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

Approved Signatory

Stephen Watson
Laboratory Manager

Causeway Geotech Ltd
8 Drumahiskey Road, Ballymoney
Co. Antrim, N. Ireland, BT53 7QL

Registered in Northern Ireland. Company Number: NI610766
Approved: ISO 9001 • ISO 14001 • OHSAS 18001

Project Name **Coolnabacky 400kV GIS Substation**

Report Reference. **17-0439**

The table below details the tests carried out, the specifications used, and the number of tests included in this report:

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	Number of test results included in the report
SOIL	Moisture Content of Soil	BS1377: Part 2: Clause 3.2: 1990	20
SOIL	Liquid and Plastic Limits of soil -1 point cone penetrometer method	BS1377: Part 2: Clauses 4.4, 5.3 & 5.4 1990	19
SOIL	Particle size distribution - wet sieving	BS1377: Part 2: Clause 9.2: 1990	25
SOIL	Particle size distribution -sedimentation hydrometer method	BS1377: Part 2: Clause 9.5: 1990	20
SOIL – subcontracted to Chemtest Ltd	pH Value of Soil		7
SOIL – subcontracted to Chemtest Ltd	Sulphate Content water extract		7
SOIL – subcontracted to Chemtest Ltd	Water soluble chloride content		7

Summary of Classification Test Results

Project No.
17-0439

Project Name
Coolnabacky 400kV GIS Substation

Hole No.	Sample				Soil Description	Density bulk Mg/m3	Density dry Mg/m3	w %	Passing 425µm %	LL %	PL %	PI %	Particle density Mg/m3	Casagrande Classification
	Ref	Top	Base	Type										
BH01	4	1.00		B	Grey sandy slightly gravelly silty CLAY.			8.5	51	21	14	7		CL
BH01	6	3.00		B	Grey sandy slightly gravelly silty CLAY.			9.3	70	21	17	7		CL
BH02	3	2.00		B	Grey sandy gravelly silty CLAY.			4.8	62	20	12	8		CL
BH03	2	1.00		B	Grey gravelly silty fine to coarse SAND.			12.0	37	26	NP			
BH03	5	4.00		B	Grey sandy gravelly silty CLAY.			7.0	69	24	14	10		CL
BH04	3	2.00		B	Grey sandy gravelly clayey SILT.			8.9	48	35	25	10		ML/MI
BH04	5	4.00		B	Grey sandy gravelly silty CLAY.			8.4	74	23	13	10		CL
BH06	4	3.00		B	Grey sandy gravelly silty CLAY.			11.0	67	20	13	7		CL
BH07	2	1.00		B	Brownish grey silty fine to coarse SAND.			21.0	91	20	17	3		ML
BH07	4	3.00		B	Grey slightly sandy clayey subangular fine to coarse GRAVEL with low cobble content.			12.0	69	23	10	13		CL
BH08	2	1.00		B	Brownish grey sandy gravelly silty CLAY.			12.0						
BH08	4	3.00		B	Grey slightly sandy gravelly silty CLAY with low cobble content.			6.6	58	20	13	7		CL
BH09	2	1.00		B	Brown sandy clayey silty subangular to subrounded fine to coarse GRAVEL.			6.0	48	20	14	6		ML/CL

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

Key

Density test	Liquid Limit	Particle density
Linear measurement unless :	4pt cone unless :	sp - small pyknometer
wd - water displacement	cas - Casagrande method	gj - gas jar
wi - immersion in water	1pt - single point test	

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Summary of Classification Test Results

Project No.
17-0439

Project Name
Coolnabacky 400kV GIS Substation

Hole No.	Sample				Soil Description	Density Mg/m3		*w* %	Passing 425µm %	LL %	PL %	PI %	Particle density Mg/m3	Casagrande Classification
	Ref	Top	Base	Type		bulk	dry							
BH09	5	4.00		B	Grey sandy gravelly silty CLAY.			8.3	65	23	13	10		CL
BH10	2	1.00		B	Grey sandy silty subangular to subrounded fine to coarse GRAVEL.			9.0	35	19	NP			
TP02	2	0.50		B	Brown sandy gravelly clayey SILT.			18.0	61	55	38	17		MH
TP05	1	0.50		B	Brown sandy slightly clayey subangular fine to coarse GRAVEL.			103.0	54	32	22	10		CL
TP09	2	0.50		B	Brown slightly gravelly silty fine to coarse SAND.			15.0	50	33	27	9		ML/CL
TP12	2	0.50		B	Grey gravelly slightly clayey fine to coarse SAND.			7.2	31	21	14	7		CL
TP15	5	1.70		B	Grey sandy gravelly silty CLAY.			7.3	46	20	13	7		CL

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

Key

Density test	Liquid Limit	Particle density
Linear measurement unless :	4pt cone unless :	sp - small pyknometer
wd - water displacement	cas - Casagrande method	gj - gas jar
wi - immersion in water	1pt - single point test	

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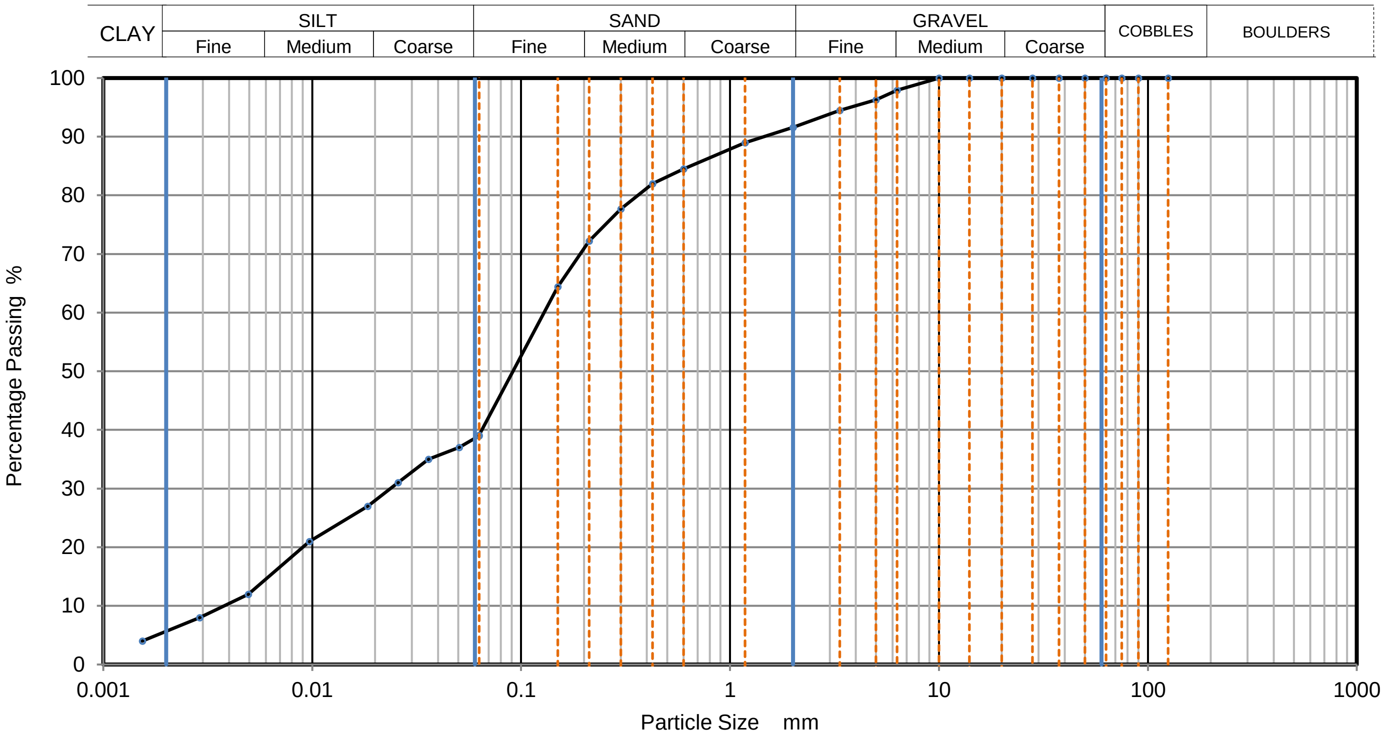
CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**17-0439**
				Borehole/Pit No.	BH01
Site Name	Coolnabacky 400kV GIS Substation			Sample No.	4
Soil Description	Grey sandy slightly gravelly silty CLAY.			Depth, m	1.00
Specimen Reference	6	Specimen Depth	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus201807040



Sieving		**Sedimentation**	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	39
90	100	0.0506	37
75	100	0.0360	35
63	100	0.0258	31
50	100	0.0184	27
37.5	100	0.0097	21
28	100	0.0050	12
20	100	0.0029	8
14	100	0.0015	4
10	100		
6.3	98		
5	96		
3.35	95		
2	92		
1.18	89		
0.6	85	Particle density	(assumed)
0.425	82	2.65	Mg/m3
0.3	78		
0.212	72		
0.15	64		
0.063	39		

Dry Mass of sample, g	873

Sample Proportions	% dry mass
Cobbles	0
Gravel	8
Sand	53
Silt	33
Clay	6

Grading Analysis		
D100	mm	
D60	mm	0.129
D30	mm	0.024
D10	mm	0.00364
Uniformity Coefficient		35
Curvature Coefficient		1.2

Remarks

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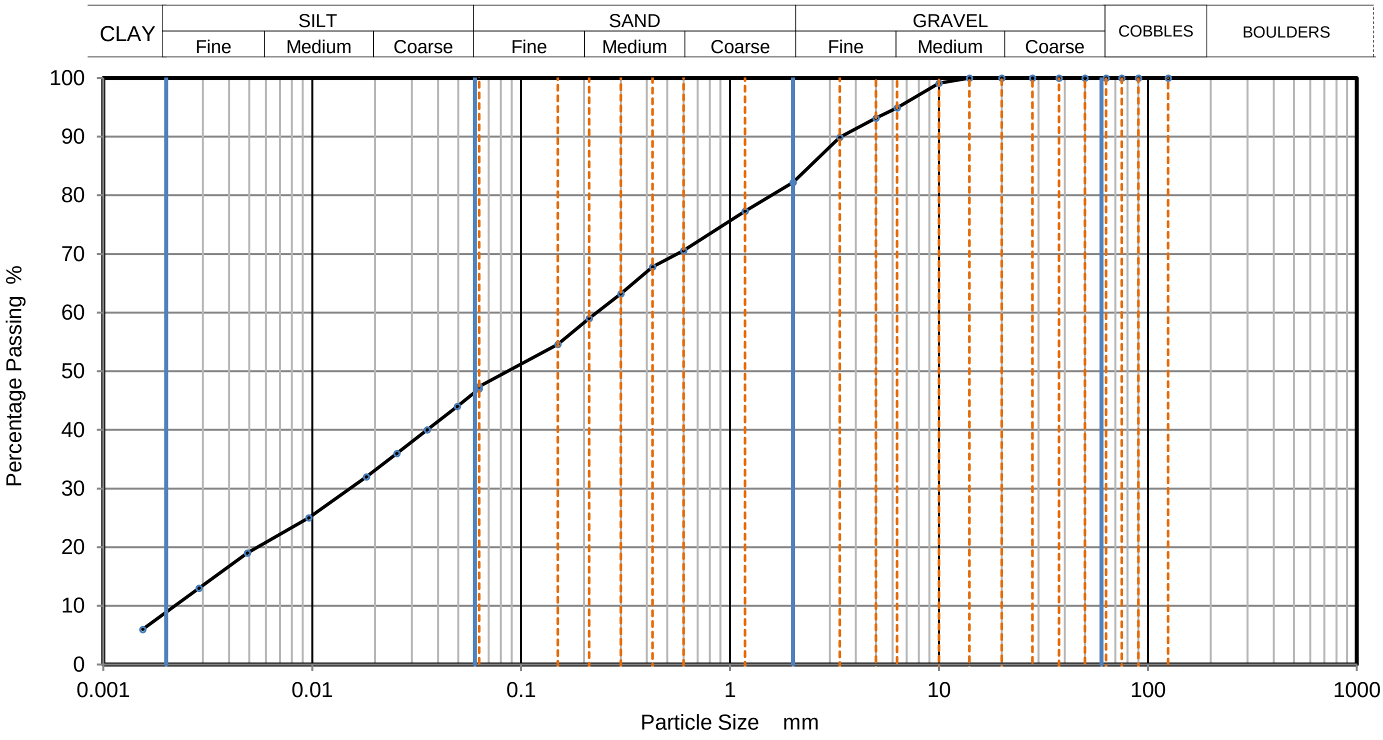
PARTICLE SIZE DISTRIBUTION

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION			Job Ref	**17-0439**
				Borehole/Pit No.	BH01
Site Name	Coolnabacky 400kV GIS Substation			Sample No.	6
Soil Description	Grey sandy slightly gravelly silty CLAY.			Depth, m	3.00
Specimen Reference	6	Specimen Depth	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus201807041



Sieving		**Sedimentation**	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	47
90	100	0.0495	44
75	100	0.0355	40
63	100	0.0254	36
50	100	0.0182	32
37.5	100	0.0096	25
28	100	0.0049	19
20	100	0.0029	13
14	100	0.0015	6
10	99		
6.3	95		
5	93		
3.35	90		
2	82		
1.18	77		
0.6	71	Particle density	(assumed)
0.425	68	2.65	Mg/m3
0.3	63		
0.212	59		
0.15	55		
0.063	47		

Dry Mass of sample, g	1046

Sample Proportions	% dry mass
Cobbles	0
Gravel	18
Sand	35
Silt	39
Clay	9

Grading Analysis		
D100	mm	
D60	mm	0.23
D30	mm	0.0151
D10	mm	0.0022
Uniformity Coefficient		100
Curvature Coefficient		0.45

Remarks

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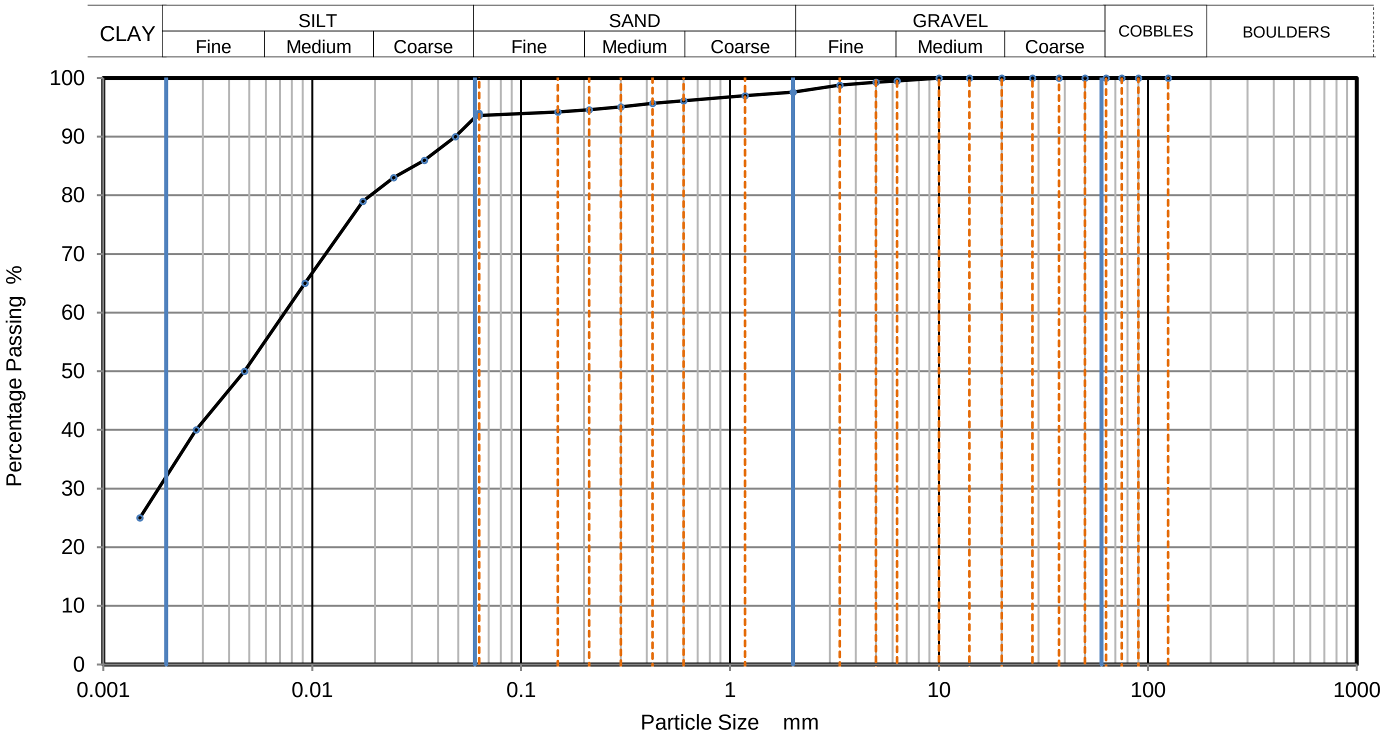
CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**17-0439**
				Borehole/Pit No.	BH02
Site Name	Coolnabacky 400kV GIS Substation			Sample No.	2
Soil Description	Grey slightly sandy silty CLAY.			Depth, m	1.00
Specimen Reference	2	Specimen Depth	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus201807042



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	94
90	100	0.0484	90
75	100	0.0345	86
63	100	0.0245	83
50	100	0.0175	79
37.5	100	0.0092	65
28	100	0.0047	50
20	100	0.0028	40
14	100	0.0015	25
10	100		
6.3	100		
5	99		
3.35	99		
2	98		
1.18	97		
0.6	96	Particle density	(assumed)
0.425	96	2.65	Mg/m3
0.3	95		
0.212	95		
0.15	94		
0.063	94		

Dry Mass of sample, g	980

Sample Proportions	% dry mass
Cobbles	0
Gravel	2
Sand	4
Silt	62
Clay	32

Grading Analysis		
D100	mm	
D60	mm	0.0074
D30	mm	0.00184
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

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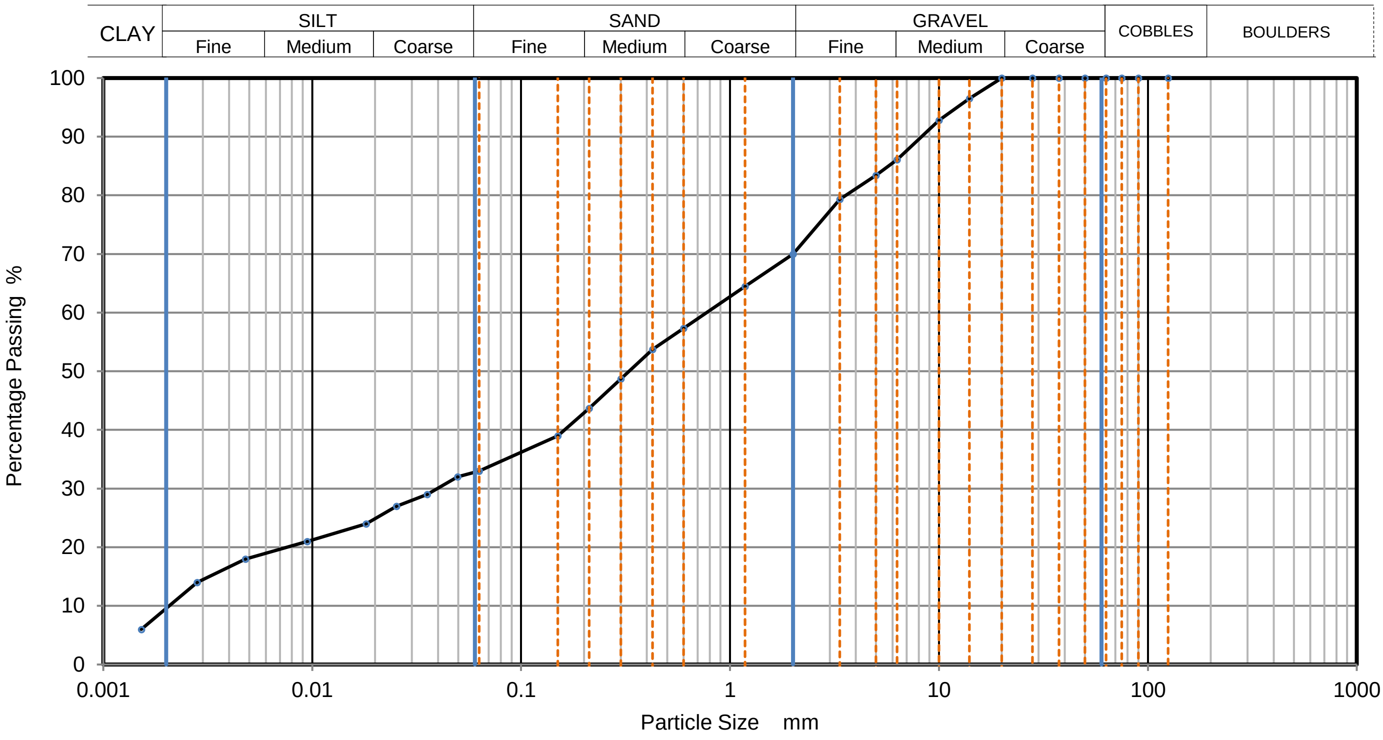
CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**	Job Ref	**17-0439**
		Borehole/Pit No.	BH02
Site Name	Coolnabacky 400kV GIS Substation	Sample No.	3
Soil Description	Grey sandy gravelly silty CLAY.	Depth, m	2.00
Specimen Reference	6 Specimen Depth m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5	KeyLAB ID	Caus201807043



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	33
90	100	0.0497	32
75	100	0.0356	29
63	100	0.0253	27
50	100	0.0181	24
37.5	100	0.0095	21
28	100	0.0048	18
20	100	0.0028	14
14	97	0.0015	6
10	93		
6.3	86		
5	83		
3.35	79		
2	70		
1.18	65		
0.6	57	Particle density	(assumed)
0.425	54	2.65	Mg/m3
0.3	49		
0.212	44		
0.15	39		
0.063	33		

Dry Mass of sample, g	1220

Sample Proportions	% dry mass
Cobbles	0
Gravel	30
Sand	37
Silt	24
Clay	9

Grading Analysis		
D100	mm	
D60	mm	0.773
D30	mm	0.042
D10	mm	0.00211
Uniformity Coefficient		370
Curvature Coefficient		1.1

Remarks

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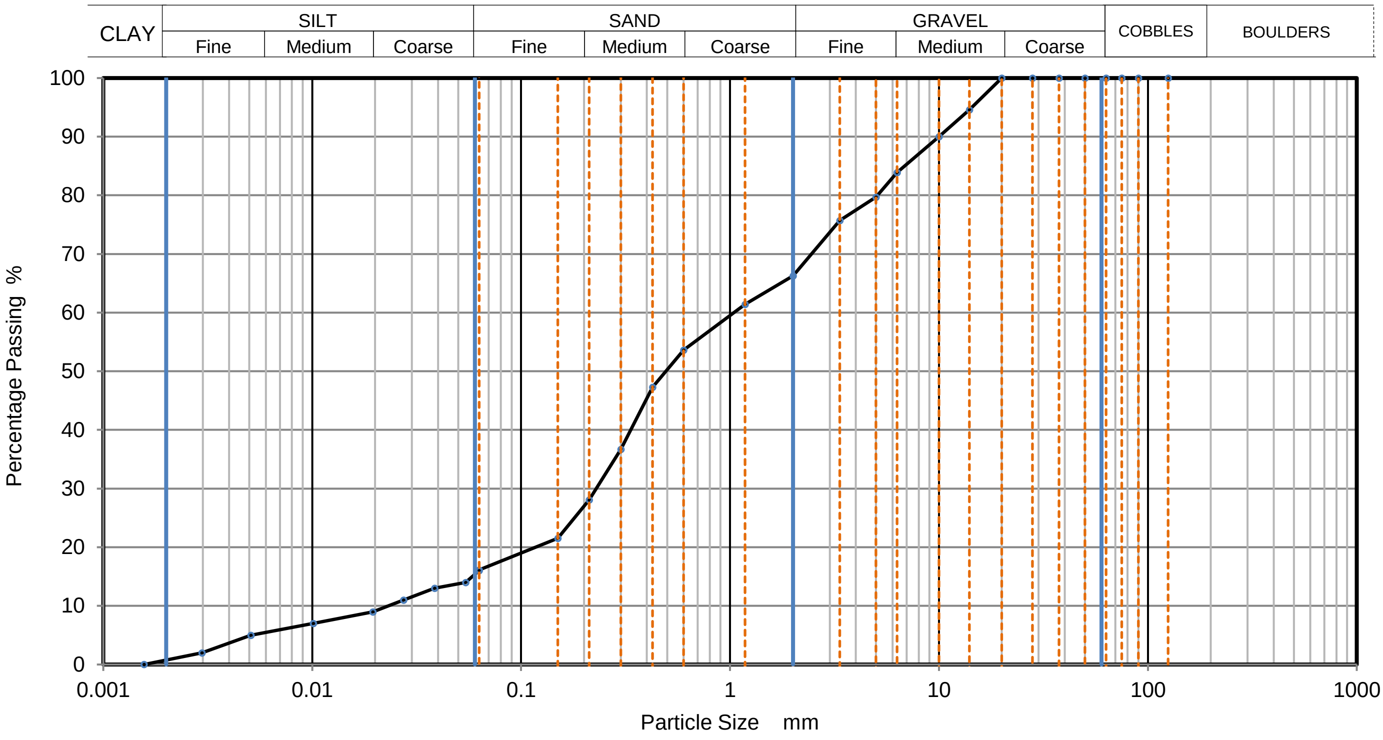
PARTICLE SIZE DISTRIBUTION

CAUSEWAY GEOTECH		Job Ref	**17-0439**
		Borehole/Pit No.	BH03
Site Name	Coolnabacky 400kV GIS Substation	Sample No.	2
Soil Description	Grey gravelly silty fine to coarse SAND.	Depth, m	1.00
Specimen Reference	6 Specimen Depth m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5	KeyLAB ID	Caus201807044



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	16
90	100	0.0542	14
75	100	0.0385	13
63	100	0.0274	11
50	100	0.0195	9
37.5	100	0.0101	7
28	100	0.0051	5
20	100	0.0030	2
14	95	0.0016	0
10	90		
6.3	84		
5	80		
3.35	76		
2	66		
1.18	61		
0.6	54	Particle density	(assumed)
0.425	47	2.65	Mg/m3
0.3	37		
0.212	28		
0.15	22		
0.063	16		

Dry Mass of sample, g	1011

Sample Proportions	% dry mass
Cobbles	0
Gravel	34
Sand	50
Silt	15
Clay	1

Grading Analysis		
D100	mm	
D60	mm	1.04
D30	mm	0.228
D10	mm	0.0238
Uniformity Coefficient		44
Curvature Coefficient		2.1

Remarks

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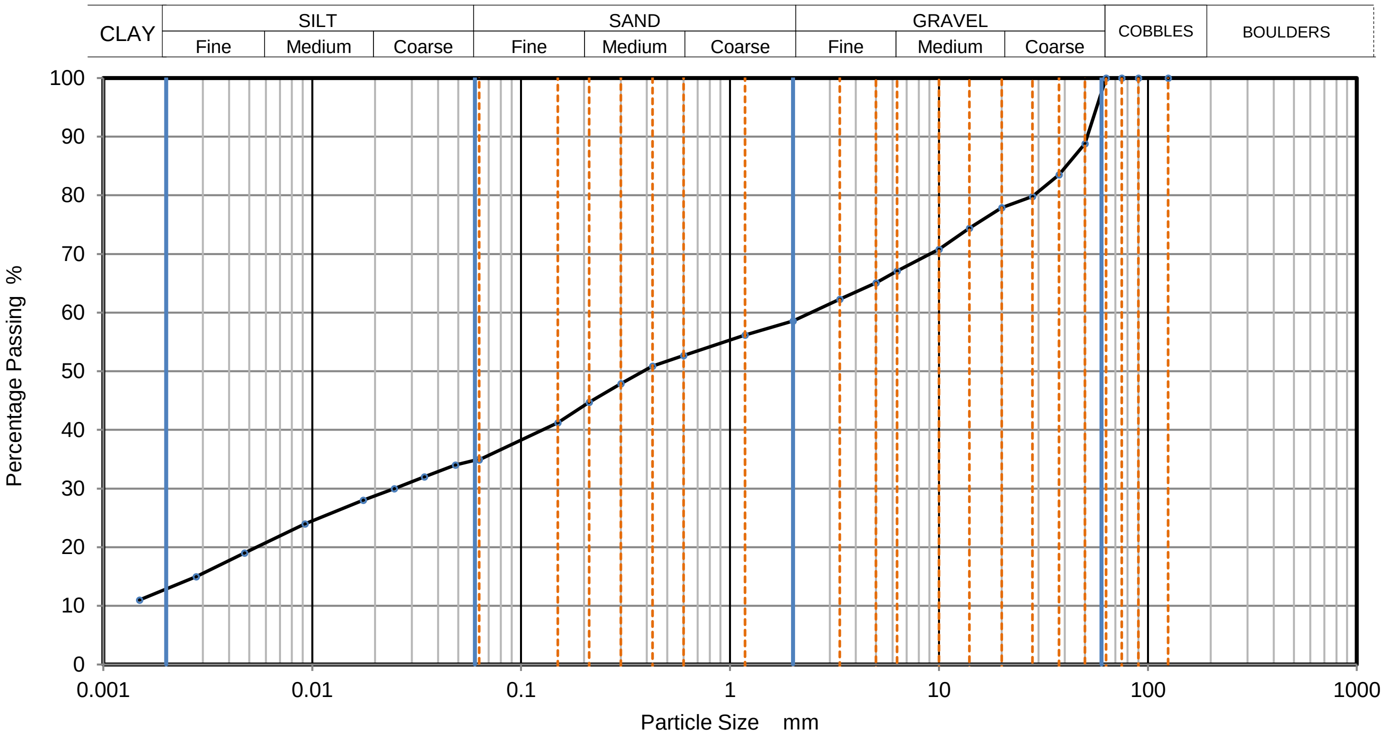
CAUSEWAY GEOTECH

PARTICLE SIZE DISTRIBUTION

				Job Ref	**17-0439**
				Borehole/Pit No.	BH03
Site Name	Coolnabacky 400kV GIS Substation			Sample No.	5
Soil Description	Grey sandy gravelly silty CLAY.			Depth, m	4.00
Specimen Reference	6	Specimen Depth	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus201807045



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	35
90	100	0.0484	34
75	100	0.0345	32
63	100	0.0247	30
50	89	0.0176	28
37.5	84	0.0092	24
28	80	0.0047	19
20	78	0.0028	15
14	74	0.0015	11
10	71		
6.3	67		
5	65		
3.35	62		
2	59		
1.18	56		
0.6	53	Particle density	(assumed)
0.425	51	2.65	Mg/m3
0.3	48		
0.212	45		
0.15	41		
0.063	35		

Dry Mass of sample, g	4461

Sample Proportions	% dry mass
Cobbles	0
Gravel	41
Sand	24
Silt	22
Clay	13

Grading Analysis		
D100	mm	
D60	mm	2.43
D30	mm	0.0262
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

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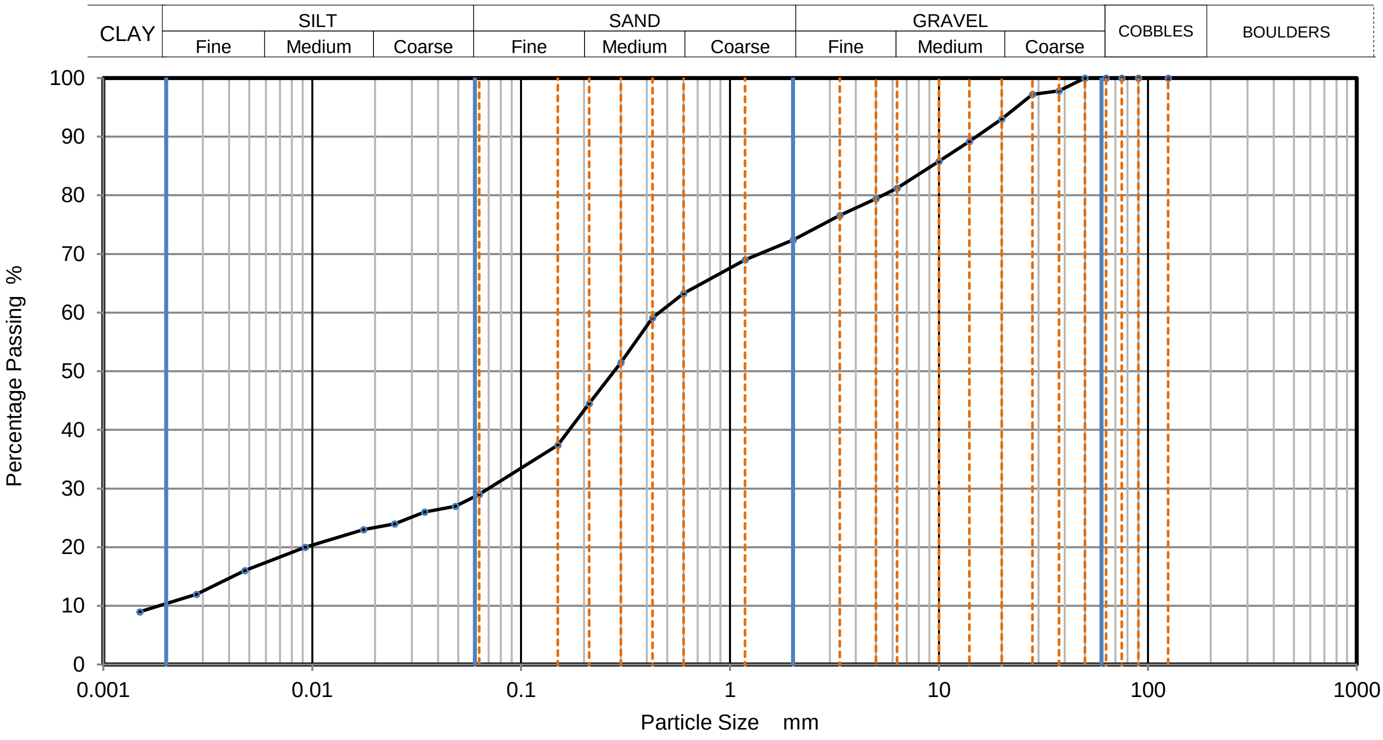
CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**	Job Ref	**17-0439**
		Borehole/Pit No.	BH04
Site Name	Coolnabacky 400kV GIS Substation	Sample No.	3
Soil Description	Grey sandy gravelly clayey SILT.	Depth, m	2.00
Specimen Reference	6 Specimen Depth m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5	KeyLAB ID	Caus201807046



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	29
90	100	0.0485	27
75	100	0.0346	26
63	100	0.0248	24
50	100	0.0176	23
37.5	98	0.0093	20
28	97	0.0048	16
20	93	0.0028	12
14	89	0.0015	9
10	86		
6.3	81		
5	79		
3.35	77		
2	72		
1.18	69		
0.6	63	Particle density	(assumed)
0.425	59	2.65	Mg/m3
0.3	52		
0.212	45		
0.15	37		
0.063	29		

Dry Mass of sample, g	5306

Sample Proportions	% dry mass
Cobbles	0
Gravel	28
Sand	43
Silt	18
Clay	11

Grading Analysis	
D100 mm	
D60 mm	0.459
D30 mm	0.0701
D10 mm	0.00171
Uniformity Coefficient	270
Curvature Coefficient	6.3

Remarks

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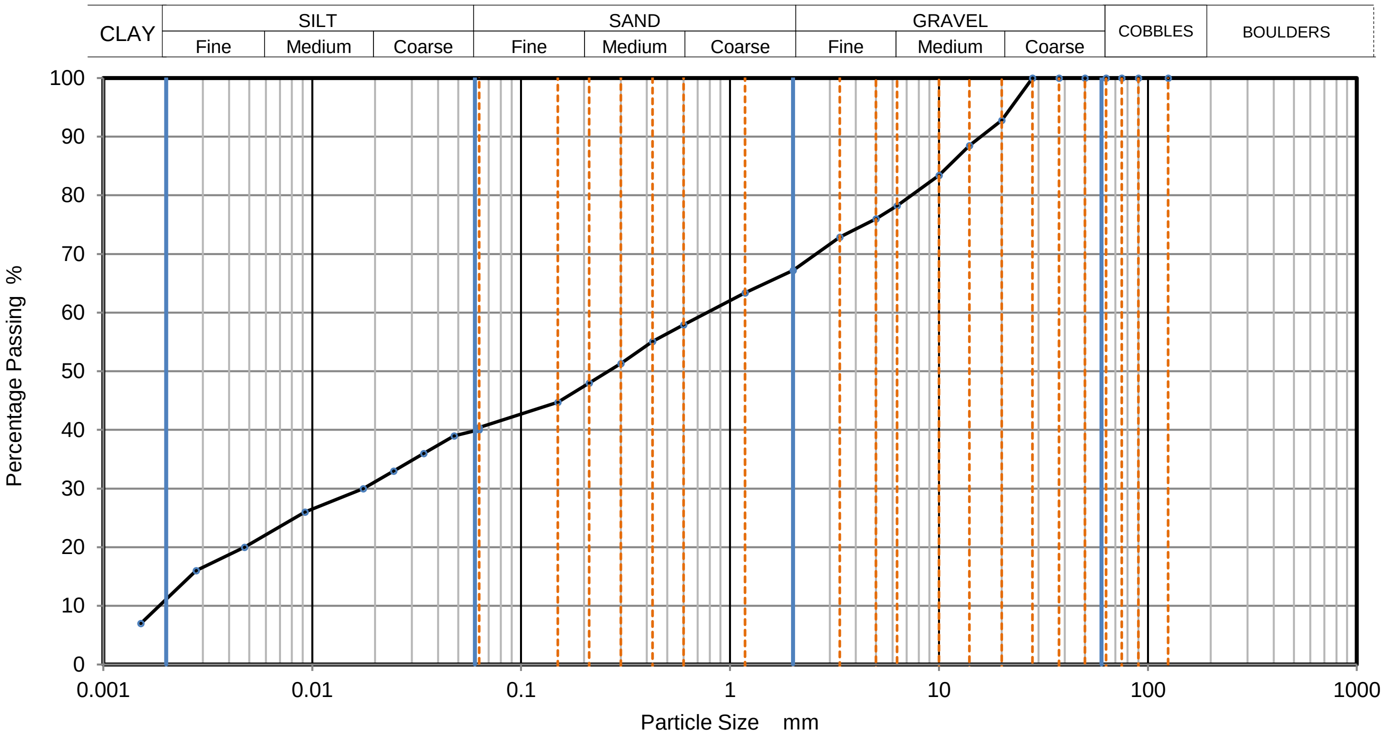
CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**	Job Ref	**17-0439**
		Borehole/Pit No.	BH04
Site Name	Coolnabacky 400kV GIS Substation	Sample No.	5
Soil Description	Grey sandy gravelly silty CLAY.	Depth, m	4.00
Specimen Reference	6 / Specimen Depth / m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5	KeyLAB ID	Caus201807047



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	40
90	100	0.0478	39
75	100	0.0342	36
63	100	0.0245	33
50	100	0.0176	30
37.5	100	0.0092	26
28	100	0.0047	20
20	93	0.0028	16
14	89	0.0015	7
10	83		
6.3	78		
5	76		
3.35	73		
2	67		
1.18	63		
0.6	58	Particle density	(assumed)
0.425	55	2.65	Mg/m3
0.3	51		
0.212	48		
0.15	45		
0.063	40		

Dry Mass of sample, g	2221

Sample Proportions	% dry mass
Cobbles	0
Gravel	33
Sand	27
Silt	29
Clay	11

Grading Analysis		
D100	mm	
D60	mm	0.775
D30	mm	0.0168
D10	mm	0.00184
Uniformity Coefficient		420
Curvature Coefficient		0.2

Remarks

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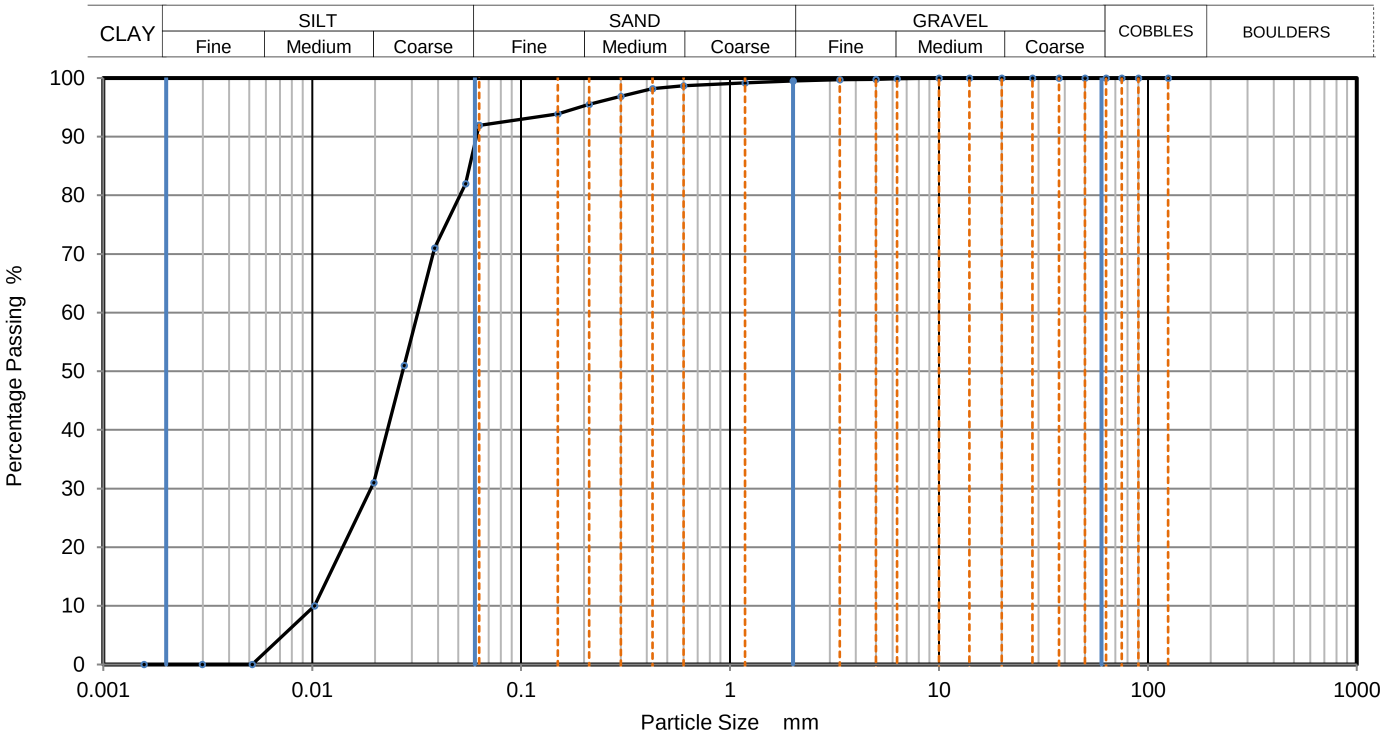
PARTICLE SIZE DISTRIBUTION

CAUSEWAY GEOTECH				Job Ref	**17-0439**
				Borehole/Pit No.	BH06
Site Name	Coolnabacky 400kV GIS Substation			Sample No.	2
Soil Description	Grey slightly sandy clayey SILT.			Depth, m	1.00
Specimen Reference	2	Specimen Depth	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus201807048



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	92
90	100	0.0542	82
75	100	0.0385	71
63	100	0.0275	51
50	100	0.0197	31
37.5	100	0.0103	10
28	100	0.0052	0
20	100	0.0030	0
14	100	0.0016	0
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	99		
0.6	99	Particle density	(assumed)
0.425	98	2.65	Mg/m3
0.3	97		
0.212	96		
0.15	94		
0.063	92		

Dry Mass of sample, g	1135

Sample Proportions	% dry mass
Cobbles	0
Gravel	1
Sand	8
Silt	92
Clay	0

Grading Analysis		
D100	mm	
D60	mm	0.0319
D30	mm	0.0193
D10	mm	0.0101
Uniformity Coefficient		3.2
Curvature Coefficient		1.2

Remarks

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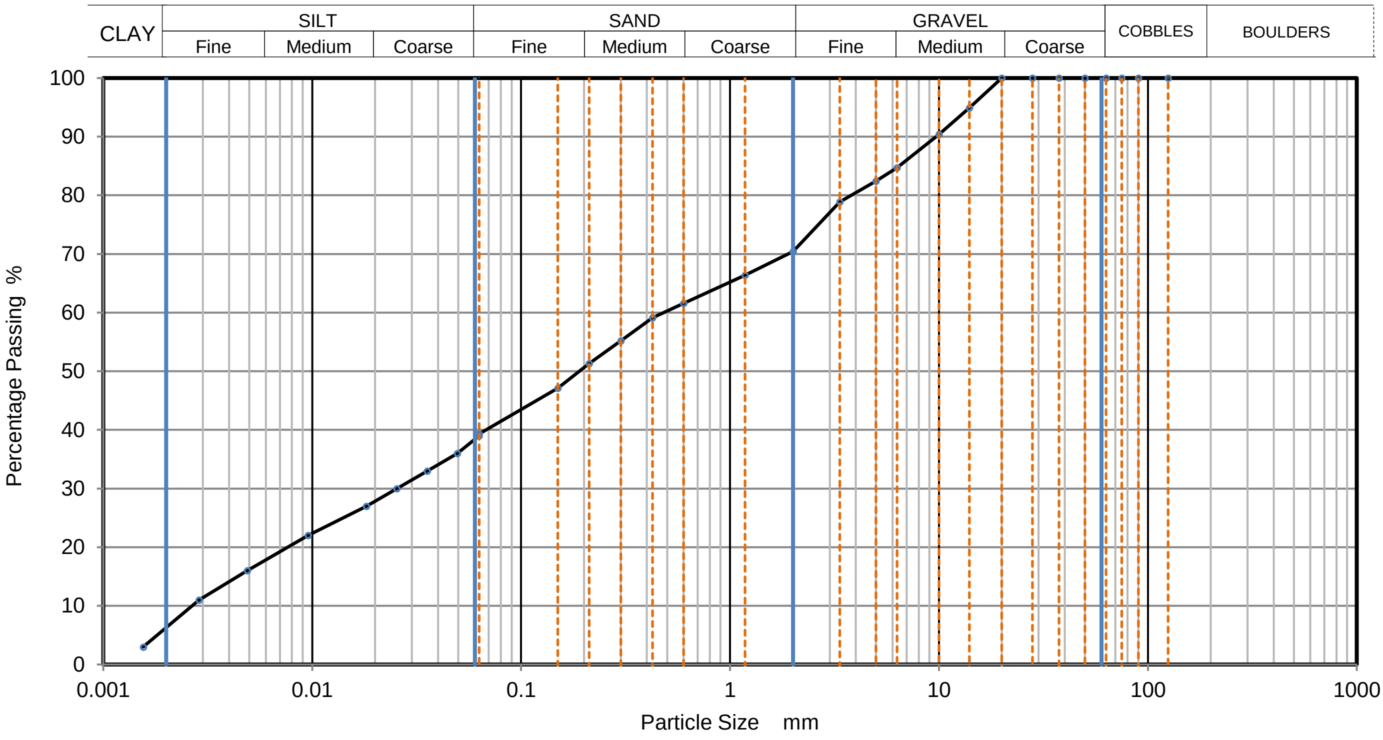
	PARTICLE SIZE DISTRIBUTION	Job Ref	**17-0439**
		Borehole/Pit No.	BH06
Site Name	Coolnabacky 400kV GIS Substation	Sample No.	4
Soil Description	Grey sandy gravelly silty CLAY.	Depth, m	3.00
Specimen Reference	6 Specimen Depth m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5	KeyLAB ID	Caus201807049



Sieving		**Sedimentation**	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	39
90	100	0.0495	36
75	100	0.0355	33
63	100	0.0254	30
50	100	0.0182	27
37.5	100	0.0096	22
28	100	0.0049	16
20	100	0.0029	11
14	95	0.0016	3
10	90		
6.3	85		
5	82		
3.35	79		
2	70		
1.18	66		
0.6	62	Particle density	(assumed)
0.425	59	2.65	Mg/m3
0.3	55		
0.212	51		
0.15	47		
0.063	39		

Dry Mass of sample, g	2437

Sample Proportions	% dry mass
Cobbles	0
Gravel	30
Sand	31
Silt	33
Clay	6

Grading Analysis		
D100	mm	
D60	mm	0.482
D30	mm	0.0258
D10	mm	0.00265
Uniformity Coefficient		180
Curvature Coefficient		0.52

Remarks

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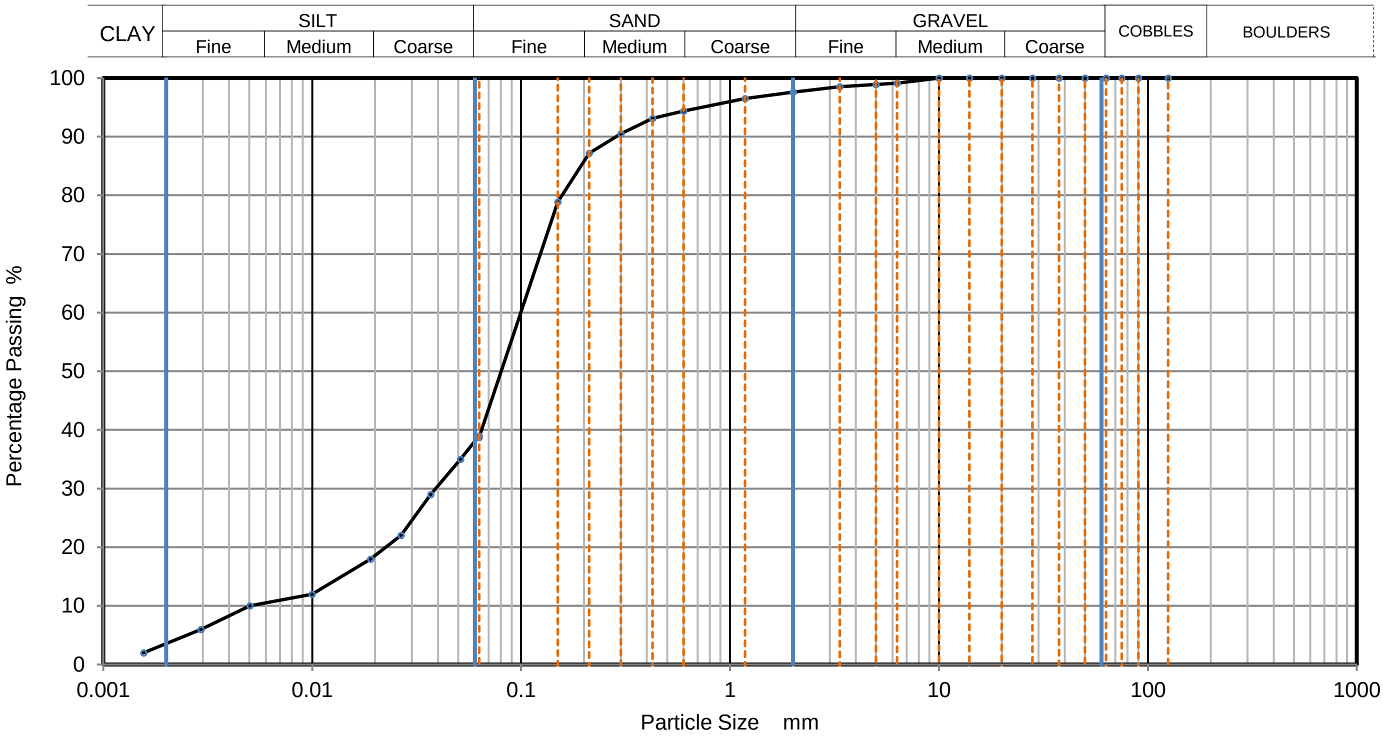
PARTICLE SIZE DISTRIBUTION

		Job Ref	**17-0439**
		Borehole/Pit No.	BH07
Site Name	Coolnabacky 400kV GIS Substation	Sample No.	2
Soil Description	Brownish grey silty fine to coarse SAND.	Depth, m	1.00
Specimen Reference	6 Specimen Depth m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5	KeyLAB ID	Caus2018070410



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	39
90	100	0.0513	35
75	100	0.0369	29
63	100	0.0266	22
50	100	0.0190	18
37.5	100	0.0100	12
28	100	0.0050	10
20	100	0.0029	6
14	100	0.0016	2
10	100		
6.3	99		
5	99		
3.35	99		
2	98		
1.18	97		
0.6	94	Particle density	(assumed)
0.425	93	2.65	Mg/m3
0.3	91		
0.212	87		
0.15	79		
0.063	39		

Dry Mass of sample, g	442

Sample Proportions	% dry mass
Cobbles	0
Gravel	2
Sand	59
Silt	35
Clay	4

Grading Analysis		
D100	mm	
D60	mm	0.0998
D30	mm	0.04
D10	mm	0.0049
Uniformity Coefficient		20
Curvature Coefficient		3.3

Remarks

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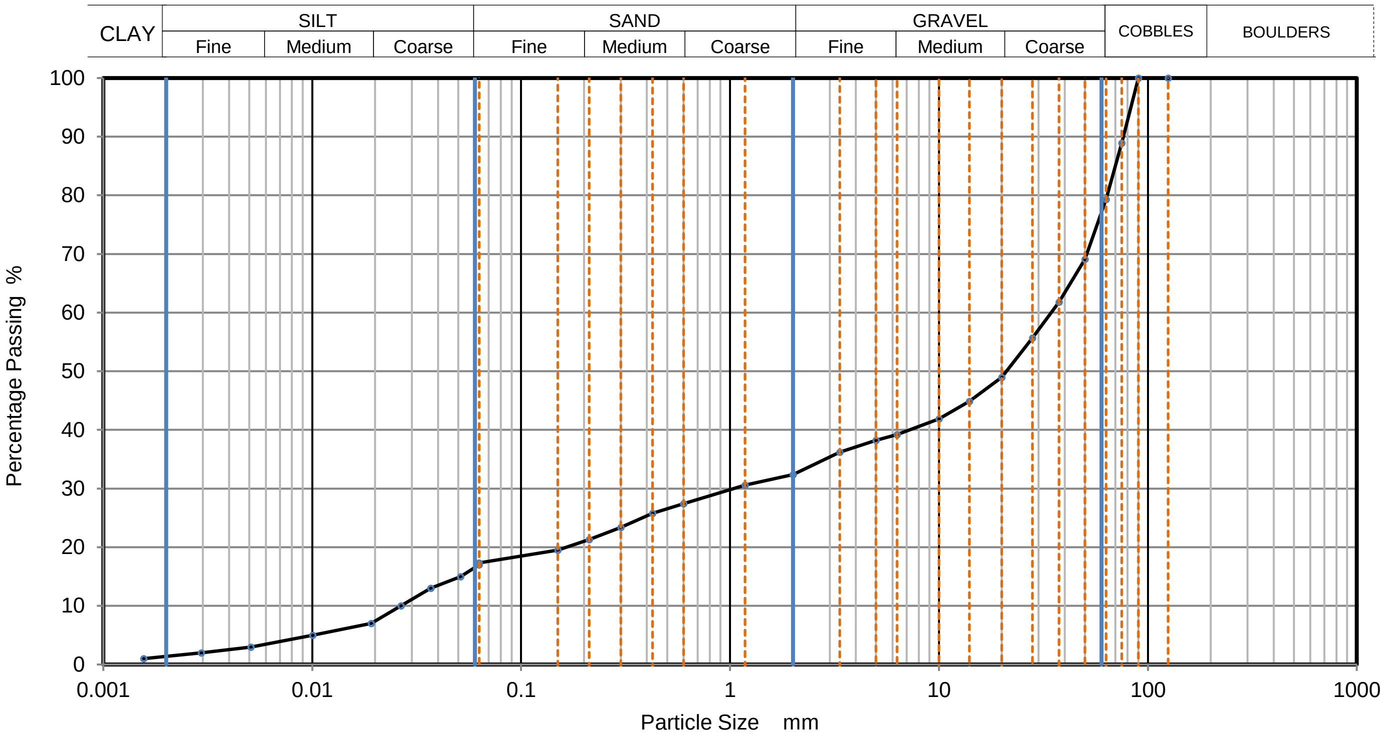
CAUSEWAY GEOTECH

PARTICLE SIZE DISTRIBUTION

				Job Ref	**17-0439**
				Borehole/Pit No.	BH07
Site Name	Coolnabacky 400kV GIS Substation			Sample No.	4
Soil Description	Grey slightly sandy clayey subangular fine to coarse GRAVEL with low cobble content.			Depth, m	3.00
Specimen Reference	6	Specimen Depth	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2018070411



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	17
90	100	0.0513	15
75	89	0.0369	13
63	79	0.0266	10
50	69	0.0191	7
37.5	62	0.0100	5
28	56	0.0051	3
20	49	0.0029	2
14	45	0.0016	1
10	42		
6.3	39		
5	38		
3.35	36		
2	32		
1.18	31		
0.6	27	Particle density	(assumed)
0.425	26	2.65	Mg/m3
0.3	23		
0.212	21		
0.15	20		
0.063	17		

Dry Mass of sample, g	14350

Sample Proportions	% dry mass
Cobbles	21
Gravel	47
Sand	15
Silt	16
Clay	1

Grading Analysis		
D100	mm	
D60	mm	34.4
D30	mm	1.04
D10	mm	0.0265
Uniformity Coefficient		1300
Curvature Coefficient		1.2

Remarks

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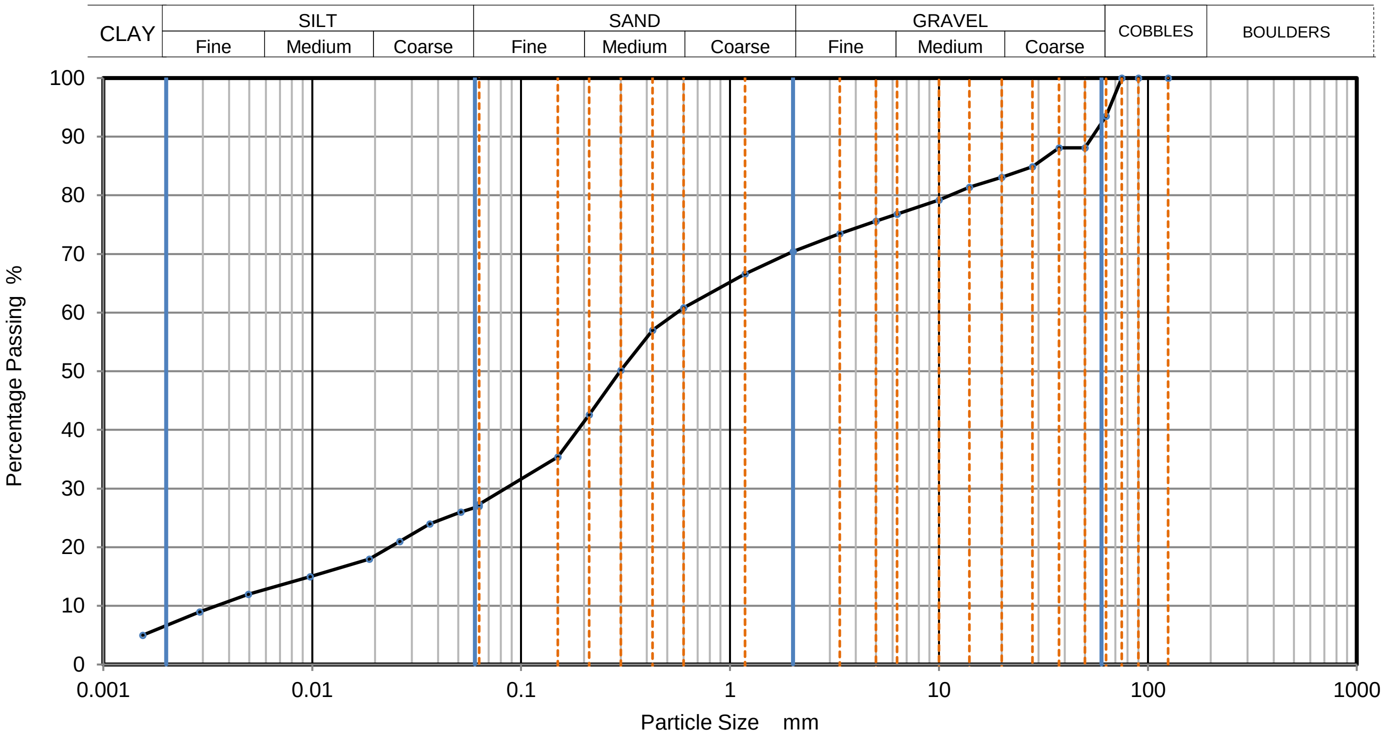
PARTICLE SIZE DISTRIBUTION

		Job Ref	**17-0439**
		Borehole/Pit No.	BH08
Site Name	Coolnabacky 400kV GIS Substation	Sample No.	2
Soil Description	Brownish grey sandy gravelly silty CLAY.	Depth, m	1.00
Specimen Reference	4 Specimen Depth m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5	KeyLAB ID	Caus2018070412



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	27
90	100	0.0514	26
75	100	0.0366	24
63	94	0.0262	21
50	88	0.0187	18
37.5	88	0.0098	15
28	85	0.0049	12
20	83	0.0029	9
14	81	0.0015	5
10	79		
6.3	77		
5	76		
3.35	74		
2	70		
1.18	67		
0.6	61	Particle density	(assumed)
0.425	57	2.65	Mg/m3
0.3	50		
0.212	43		
0.15	35		
0.063	27		

Dry Mass of sample, g	10924

Sample Proportions	% dry mass
Cobbles	7
Gravel	23
Sand	43
Silt	21
Clay	6

Grading Analysis		
D100	mm	
D60	mm	0.556
D30	mm	0.0843
D10	mm	0.00339
Uniformity Coefficient		160
Curvature Coefficient		3.8

Remarks

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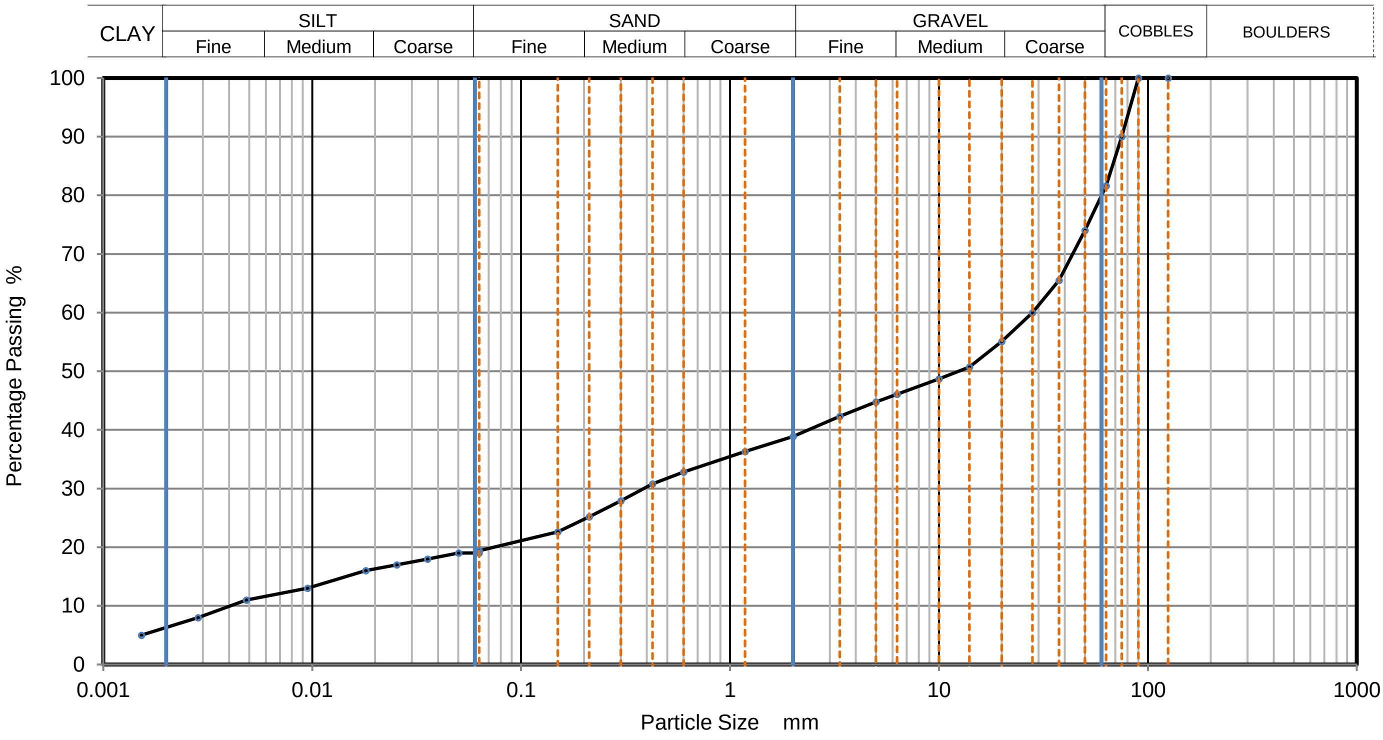
CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**	Job Ref	**17-0439**
		Borehole/Pit No.	BH08
Site Name	Coolnabacky 400kV GIS Substation	Sample No.	4
Soil Description	Grey slightly sandy gravelly silty CLAY with low cobble content.	Depth, m	3.00
Specimen Reference	6 Specimen Depth m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5	KeyLAB ID	Caus2018070413



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	19
90	100	0.0502	19
75	90	0.0357	18
63	82	0.0254	17
50	74	0.0181	16
37.5	66	0.0095	13
28	60	0.0048	11
20	55	0.0028	8
14	51	0.0015	5
10	49		
6.3	46		
5	45		
3.35	42		
2	39		
1.18	36		
0.6	33	Particle density	(assumed)
0.425	31	2.65	Mg/m3
0.3	28		
0.212	25		
0.15	23		
0.063	19		

Dry Mass of sample, g: 15788

Sample Proportions	% dry mass
Cobbles	18
Gravel	43
Sand	19
Silt	13
Clay	7

Grading Analysis		
D100	mm	
D60	mm	27.9
D30	mm	0.385
D10	mm	0.0043
Uniformity Coefficient		6500
Curvature Coefficient		1.2

Remarks

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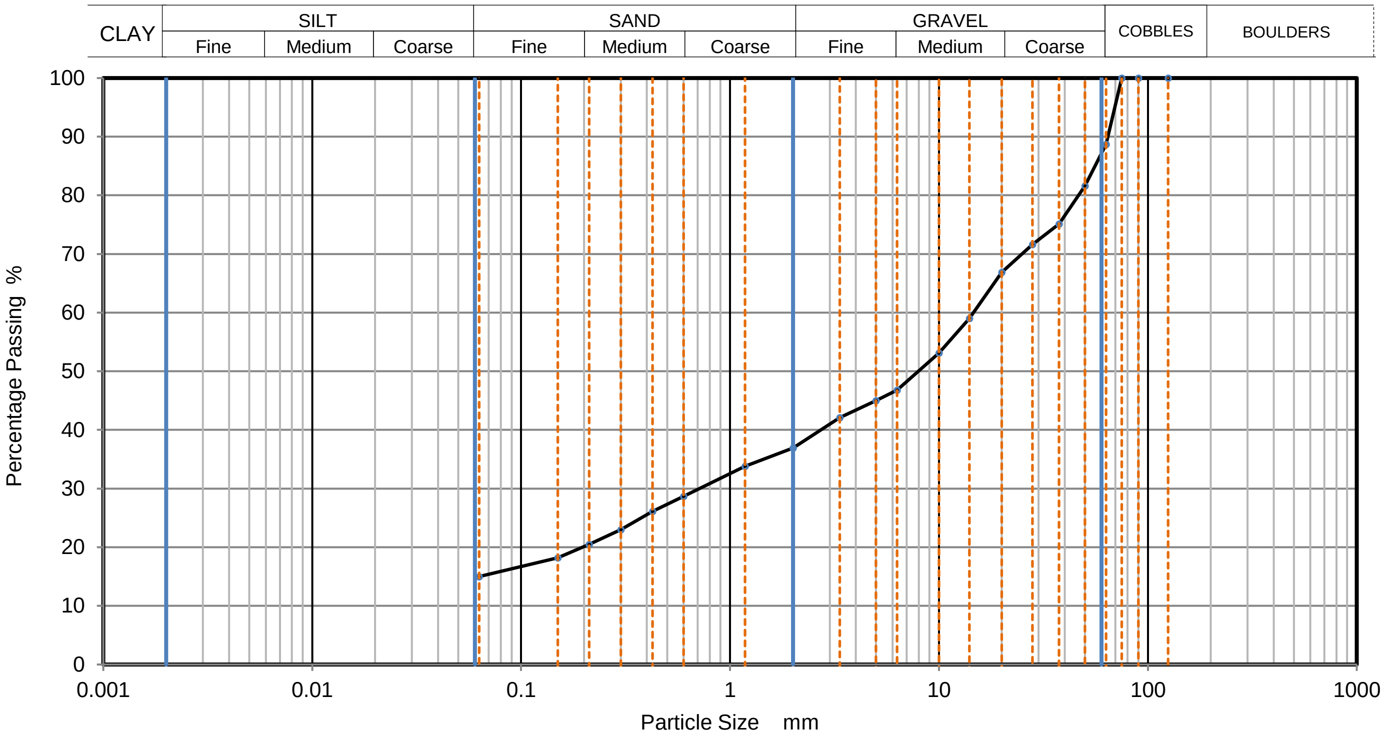
	PARTICLE SIZE DISTRIBUTION	Job Ref	**17-0439**
		Borehole/Pit No.	BH09
Site Name	Coolnabacky 400kV GIS Substation	Sample No.	2
Soil Description	Brown sandy clayey silty subangular to subrounded fine to coarse GRAVEL.	Depth, m	1.00
Specimen Reference	6 | Specimen Depth | m	Sample Type	B
Test Method	BS1377:Part 2:1990, clause 9.2	KeyLAB ID	Caus2018070414



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	89		
50	82		
37.5	75		
28	72		
20	67		
14	59		
10	53		
6.3	47		
5	45		
3.35	42		
2	37		
1.18	34		
0.6	29		
0.425	26		
0.3	23		
0.212	21		
0.15	18		
0.063	15		

Dry Mass of sample, g	12798

Sample Proportions	% dry mass
Cobbles	11
Gravel	52
Sand	22
Fines <0.063mm	15

Grading Analysis		
D100	mm	
D60	mm	14.6
D30	mm	0.711
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

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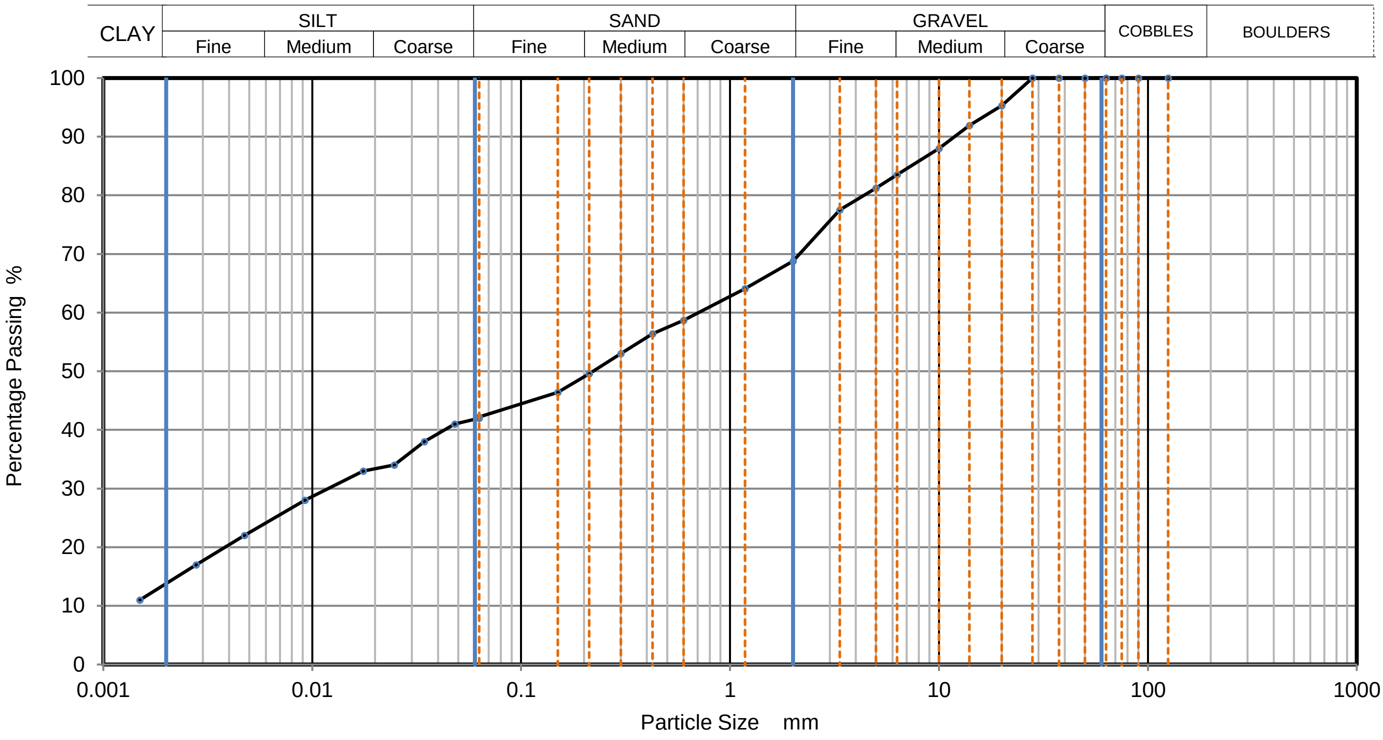
CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**17-0439**
				Borehole/Pit No.	BH09
Site Name	Coolnabacky 400kV GIS Substation			Sample No.	5
Soil Description	Grey sandy gravelly silty CLAY.			Depth, m	4.00
Specimen Reference	6	Specimen Depth	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2018070415



Sieving	
Particle Size mm	% Passing
125	100
90	100
75	100
63	100
50	100
37.5	100
28	100
20	95
14	92
10	88
6.3	84
5	81
3.35	78
2	69
1.18	64
0.6	59
0.425	56
0.3	53
0.212	50
0.15	46
0.063	42

Sedimentation	
Particle Size mm	% Passing
0.0630	42
0.0481	41
0.0345	38
0.0247	34
0.0176	33
0.0092	28
0.0047	22
0.0028	17
0.0015	11
Particle density	(assumed)
2.65	Mg/m3

Dry Mass of sample, g	3094

Sample Proportions	% dry mass
Cobbles	0
Gravel	31
Sand	27
Silt	28
Clay	14

Grading Analysis		
D100	mm	
D60	mm	0.709
D30	mm	0.0119
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

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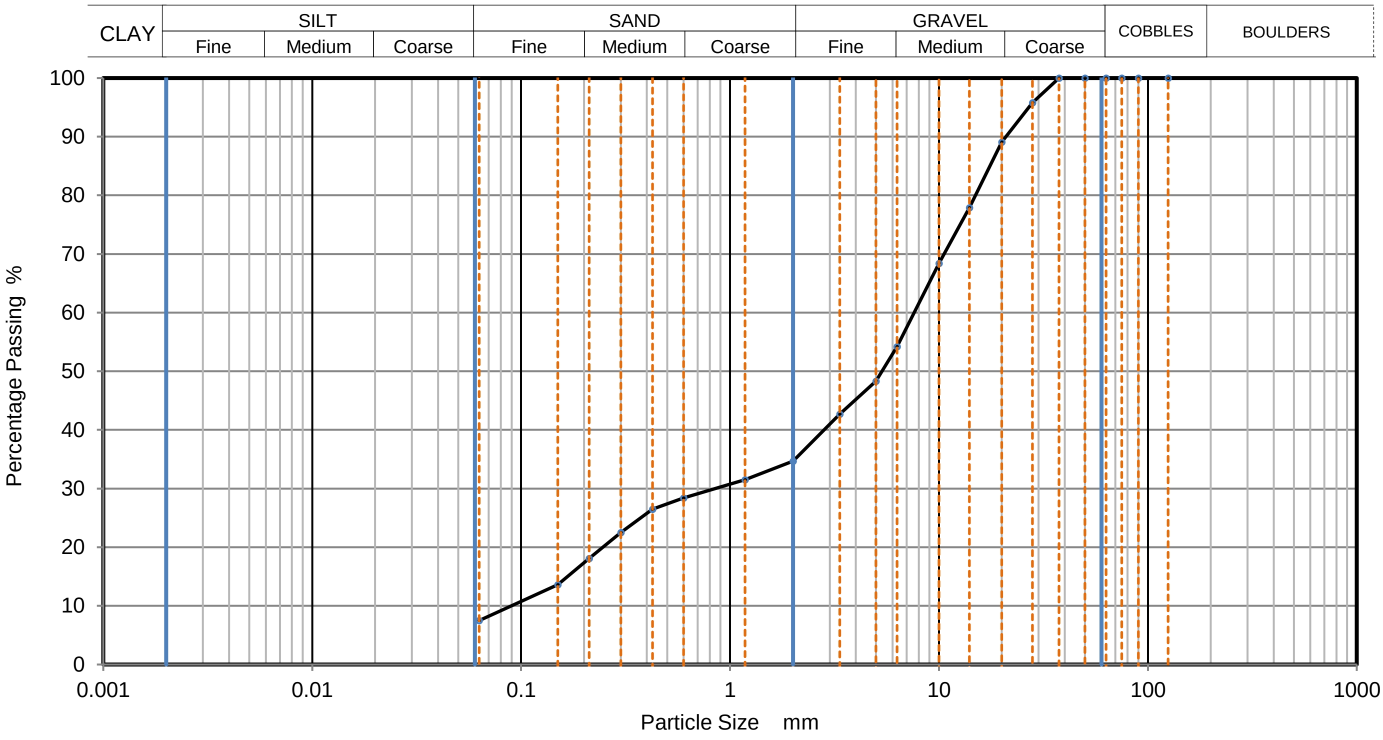
PARTICLE SIZE DISTRIBUTION

				Job Ref	**17-0439**
				Borehole/Pit No.	BH10
Site Name	Coolnabacky 400kV GIS Substation			Sample No.	2
Soil Description	Grey sandy silty subangular to subrounded fine to coarse GRAVEL.			Depth, m	1.00
Specimen Reference	6	Specimen Depth	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus2018070416



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	96		
20	89		
14	78		
10	68		
6.3	54		
5	48		
3.35	43		
2	35		
1.18	32		
0.6	28		
0.425	27		
0.3	23		
0.212	18		
0.15	14		
0.063	8		

Dry Mass of sample, g	2522

Sample Proportions	% dry mass
Cobbles	0
Gravel	65
Sand	27
Fines <0.063mm	8

Grading Analysis		
D100	mm	
D60	mm	7.62
D30	mm	0.847
D10	mm	0.0897
Uniformity Coefficient		85
Curvature Coefficient		1

Remarks

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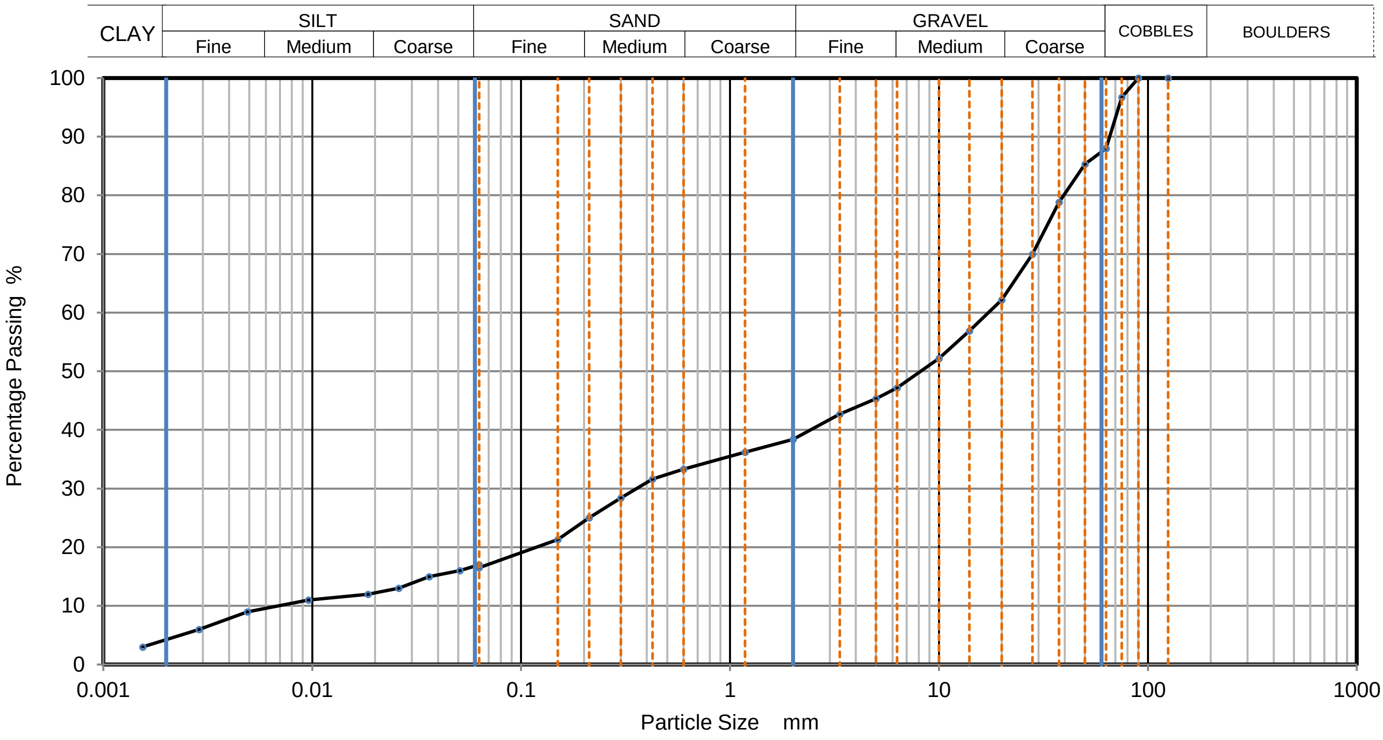
CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**17-0439**
				Borehole/Pit No.	TP01
Site Name	Coolnabacky 400kV GIS Substation			Sample No.	2
Soil Description	Brown sandy clayey rounded fine to coarse GRAVEL.			Depth, m	0.50
Specimen Reference	2	Specimen Depth	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2018070418



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	17
90	100	0.0510	16
75	97	0.0363	15
63	88	0.0260	13
50	85	0.0185	12
37.5	79	0.0096	11
28	70	0.0049	9
20	62	0.0029	6
14	57	0.0015	3
10	52		
6.3	47		
5	45		
3.35	43		
2	38		
1.18	36		
0.6	33	Particle density	(assumed)
0.425	32	2.65	Mg/m3
0.3	28		
0.212	25		
0.15	21		
0.063	17		

Dry Mass of sample, g	18038

Sample Proportions	% dry mass
Cobbles	12
Gravel	50
Sand	22
Silt	13
Clay	4

Grading Analysis		
D100	mm	
D60	mm	17.3
D30	mm	0.358
D10	mm	0.00687
Uniformity Coefficient		2500
Curvature Coefficient		1.1

Remarks

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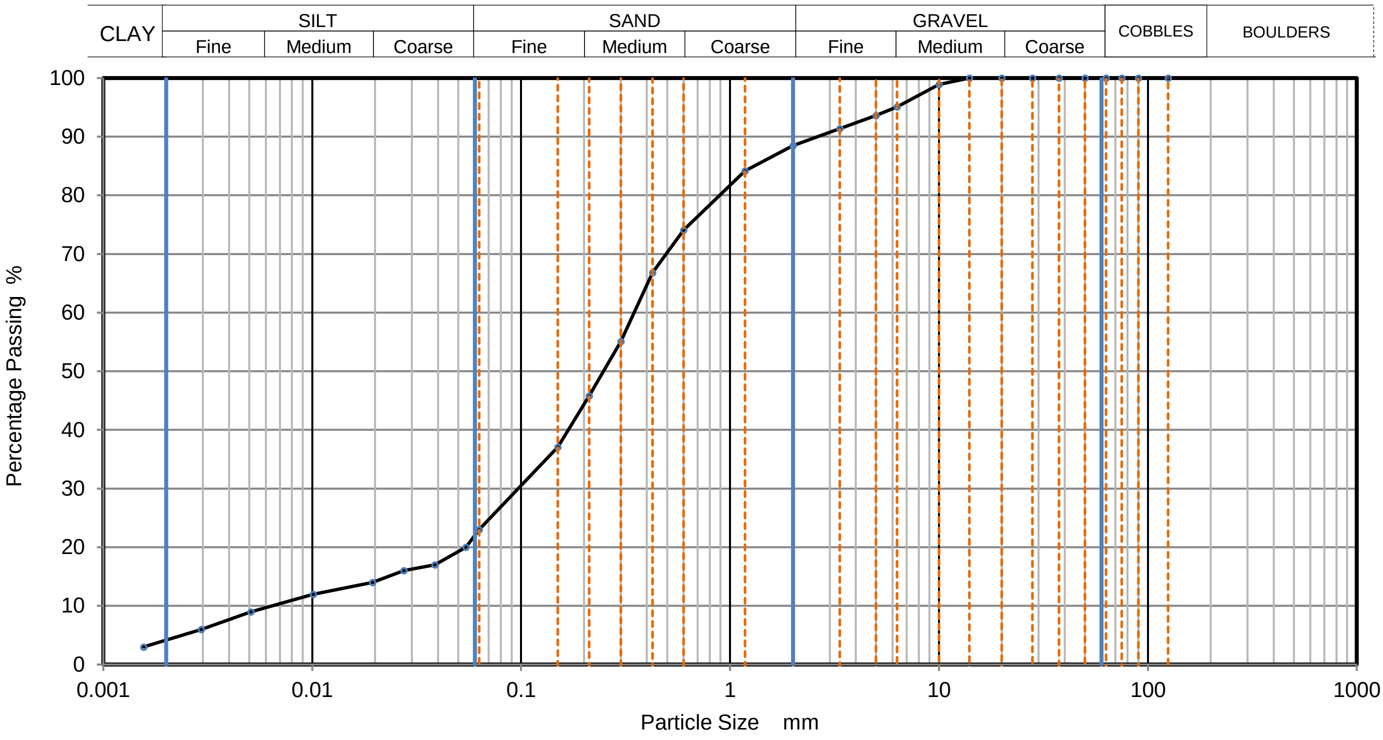
CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION		Job Ref	**17-0439**
			Borehole/Pit No.	TP03
Site Name	Coolnabacky 400kV GIS Substation		Sample No.	1
Soil Description	Brown slightly gravelly silty fine to coarse SAND.		Depth, m	0.50
Specimen Reference	2	Specimen Depth m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2018070420



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	23
90	100	0.0544	20
75	100	0.0387	17
63	100	0.0274	16
50	100	0.0195	14
37.5	100	0.0101	12
28	100	0.0051	9
20	100	0.0029	6
14	100	0.0016	3
10	99		
6.3	95		
5	94		
3.35	91		
2	89		
1.18	84		
0.6	74	Particle density	(assumed)
0.425	67	2.65	Mg/m3
0.3	55		
0.212	46		
0.15	37		
0.063	23		

Dry Mass of sample, g	1027

Sample Proportions	% dry mass
Cobbles	0
Gravel	12
Sand	66
Silt	19
Clay	4

Grading Analysis		
D100	mm	
D60	mm	0.347
D30	mm	0.0969
D10	mm	0.00706
Uniformity Coefficient		49
Curvature Coefficient		3.8

Remarks

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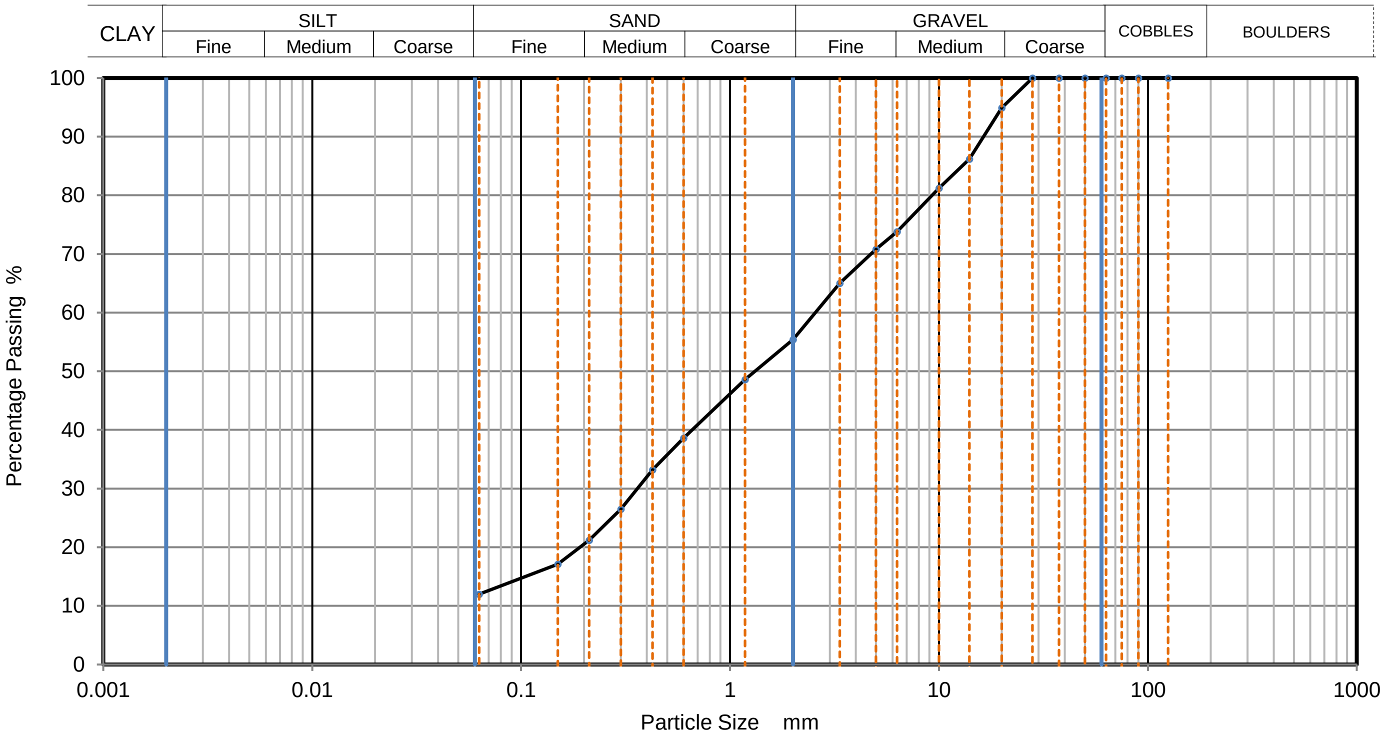
CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**17-0439**
				Borehole/Pit No.	TP05
Site Name	Coolnabacky 400kV GIS Substation			Sample No.	1
Soil Description	Brown sandy slightly clayey subangular fine to coarse GRAVEL.			Depth, m	0.50
Specimen Reference	6	Specimen Depth	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus2018070421



Sieving		**Sedimentation**	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	95		
14	86		
10	81		
6.3	74		
5	71		
3.35	65		
2	55		
1.18	49		
0.6	39		
0.425	33		
0.3	27		
0.212	21		
0.15	17		
0.063	12		

Dry Mass of sample, g	2144

Sample Proportions	% dry mass
Cobbles	0
Gravel	45
Sand	43
Fines <0.063mm	12

Grading Analysis		
D100	mm	
D60	mm	2.56
D30	mm	0.36
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

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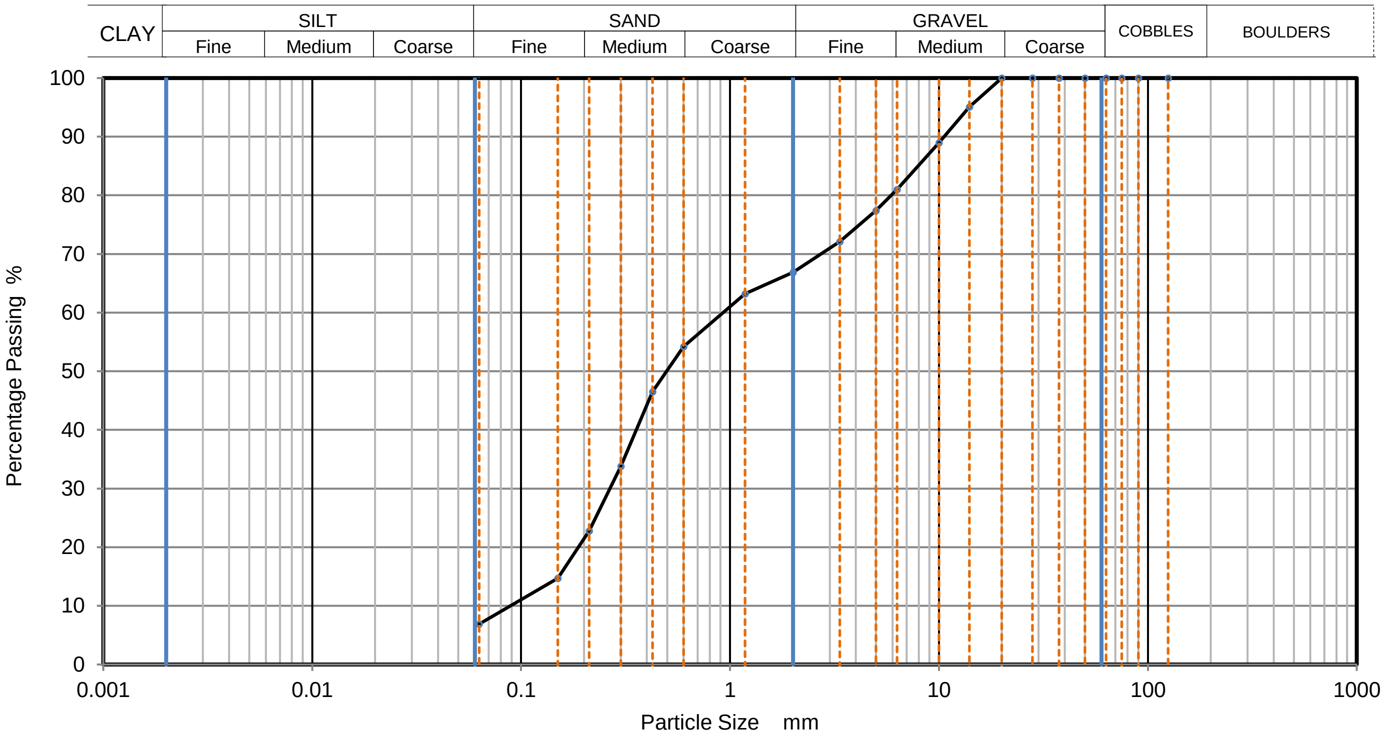
PARTICLE SIZE DISTRIBUTION

				Job Ref	**17-0439**
				Borehole/Pit No.	TP07
Site Name	Coolnabacky 400kV GIS Substation			Sample No.	2
Soil Description	Brown gravelly fine to coarse SAND.			Depth, m	0.50
Specimen Reference	2	Specimen Depth	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus2018070422



Sieving		**Sedimentation**	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	95		
10	89		
6.3	81		
5	77		
3.35	72		
2	67		
1.18	63		
0.6	54		
0.425	47		
0.3	34		
0.212	23		
0.15	15		
0.063	7		

Dry Mass of sample, g	1046

Sample Proportions	% dry mass
Cobbles	0
Gravel	33
Sand	60
Fines <0.063mm	7

Grading Analysis		
D100	mm	
D60	mm	0.93
D30	mm	0.266
D10	mm	0.0886
Uniformity Coefficient		10
Curvature Coefficient		0.86

Remarks

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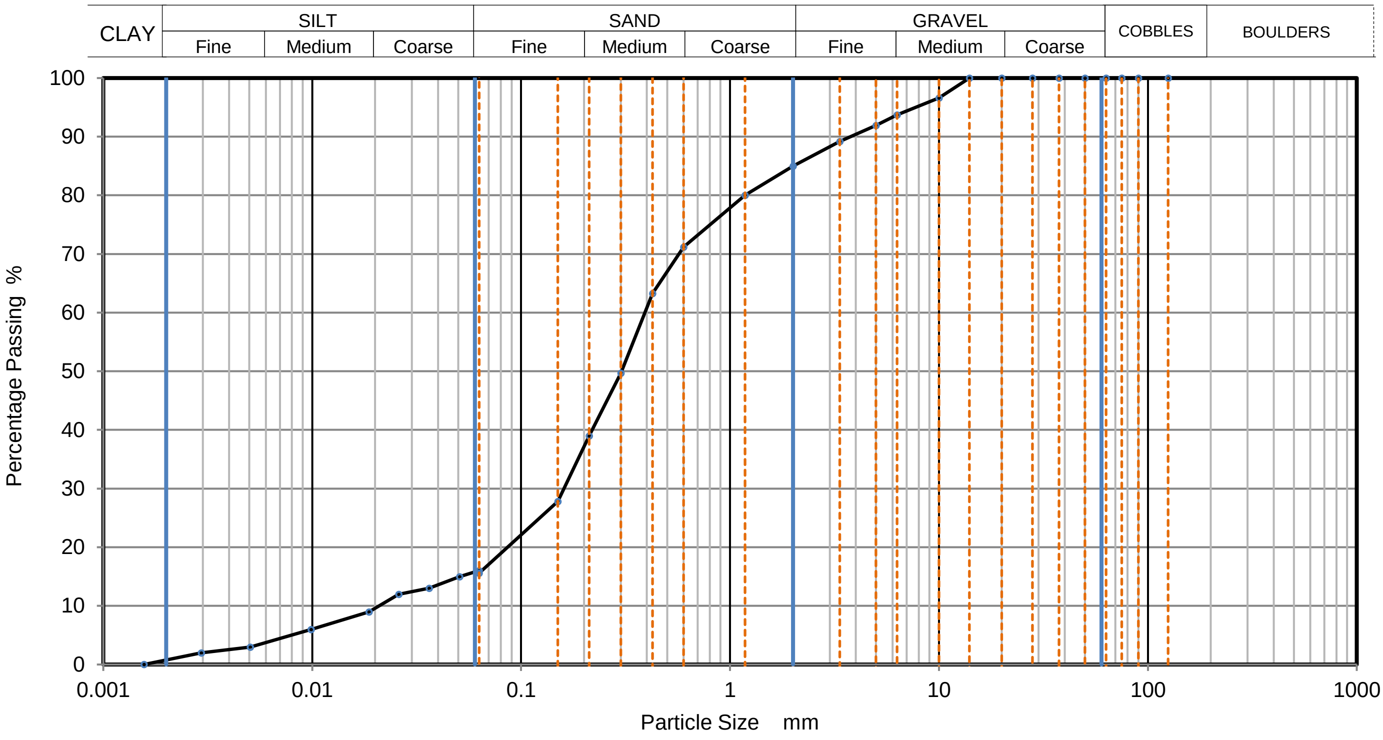
CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**17-0439**
				Borehole/Pit No.	TP09
Site Name	Coolnabacky 400kV GIS Substation			Sample No.	2
Soil Description	Brown slightly gravelly silty fine to coarse SAND.			Depth, m	0.50
Specimen Reference	6	Specimen Depth	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2018070423



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	16
90	100	0.0507	15
75	100	0.0363	13
63	100	0.0260	12
50	100	0.0187	9
37.5	100	0.0099	6
28	100	0.0050	3
20	100	0.0029	2
14	100	0.0016	0
10	97		
6.3	94		
5	92		
3.35	89		
2	85		
1.18	80		
0.6	71	Particle density	(assumed)
0.425	63	2.65	Mg/m3
0.3	50		
0.212	39		
0.15	28		
0.063	16		

Dry Mass of sample, g	1320

Sample Proportions	% dry mass
Cobbles	0
Gravel	15
Sand	69
Silt	15
Clay	1

Grading Analysis		
D100	mm	
D60	mm	0.391
D30	mm	0.161
D10	mm	0.0201
Uniformity Coefficient		19
Curvature Coefficient		3.3

Remarks

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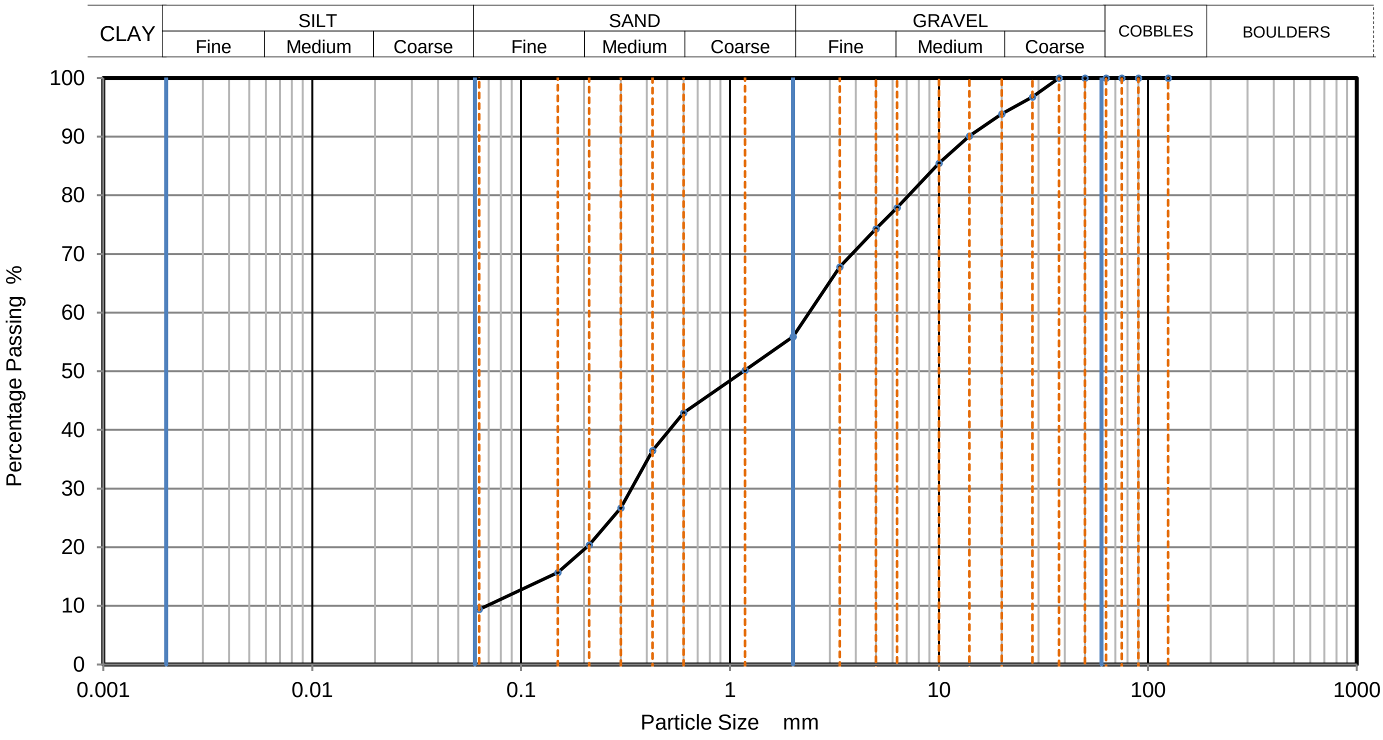
	PARTICLE SIZE DISTRIBUTION		Job Ref	**17-0439**
			Borehole/Pit No.	TP12
Site Name	Coolnabacky 400kV GIS Substation		Sample No.	2
Soil Description	Grey gravelly slightly clayey fine to coarse SAND.		Depth, m	0.50
Specimen Reference	6	Specimen Depth m	Sample Type	B
Test Method	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus2018070424



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	97		
20	94		
14	90		
10	86		
6.3	78		
5	74		
3.35	68		
2	56		
1.18	50		
0.6	43		
0.425	37		
0.3	27		
0.212	20		
0.15	16		
0.063	9		

Dry Mass of sample, g	2034

Sample Proportions	% dry mass
Cobbles	0
Gravel	44
Sand	46
Fines <0.063mm	9

Grading Analysis		
D100	mm	
D60	mm	2.39
D30	mm	0.338
D10	mm	0.068
Uniformity Coefficient		35
Curvature Coefficient		0.7

Remarks

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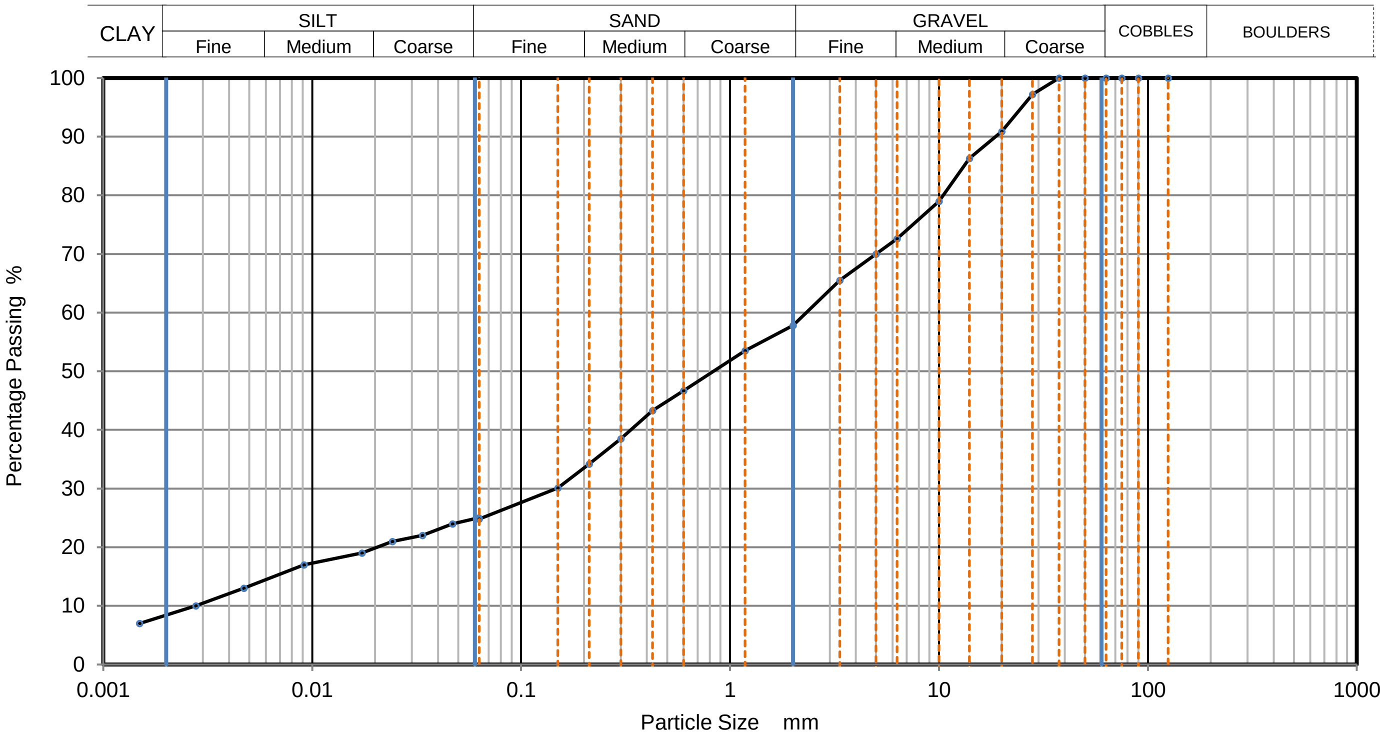
CAUSEWAY GEOTECH	# PARTICLE SIZE DISTRIBUTION			Job Ref	**17-0439**
				Borehole/Pit No.	TP14
Site Name	Coolnabacky 400kV GIS Substation			Sample No.	4
Soil Description	Brown sandy gravelly silty CLAY.			Depth, m	1.50
Specimen Reference	2	Specimen Depth	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2018070425



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0626	25
90	100	0.0469	24
75	100	0.0337	22
63	100	0.0241	21
50	100	0.0173	19
37.5	100	0.0091	17
28	97	0.0047	13
20	91	0.0028	10
14	86	0.0015	7
10	79		
6.3	73		
5	70		
3.35	66		
2	58		
1.18	54		
0.6	47	Particle density	(assumed)
0.425	43	2.65	Mg/m3
0.3	39		
0.212	34		
0.15	30		
0.063	25		

Dry Mass of sample, g	3957

Sample Proportions	% dry mass
Cobbles	0
Gravel	42
Sand	33
Silt	16
Clay	9

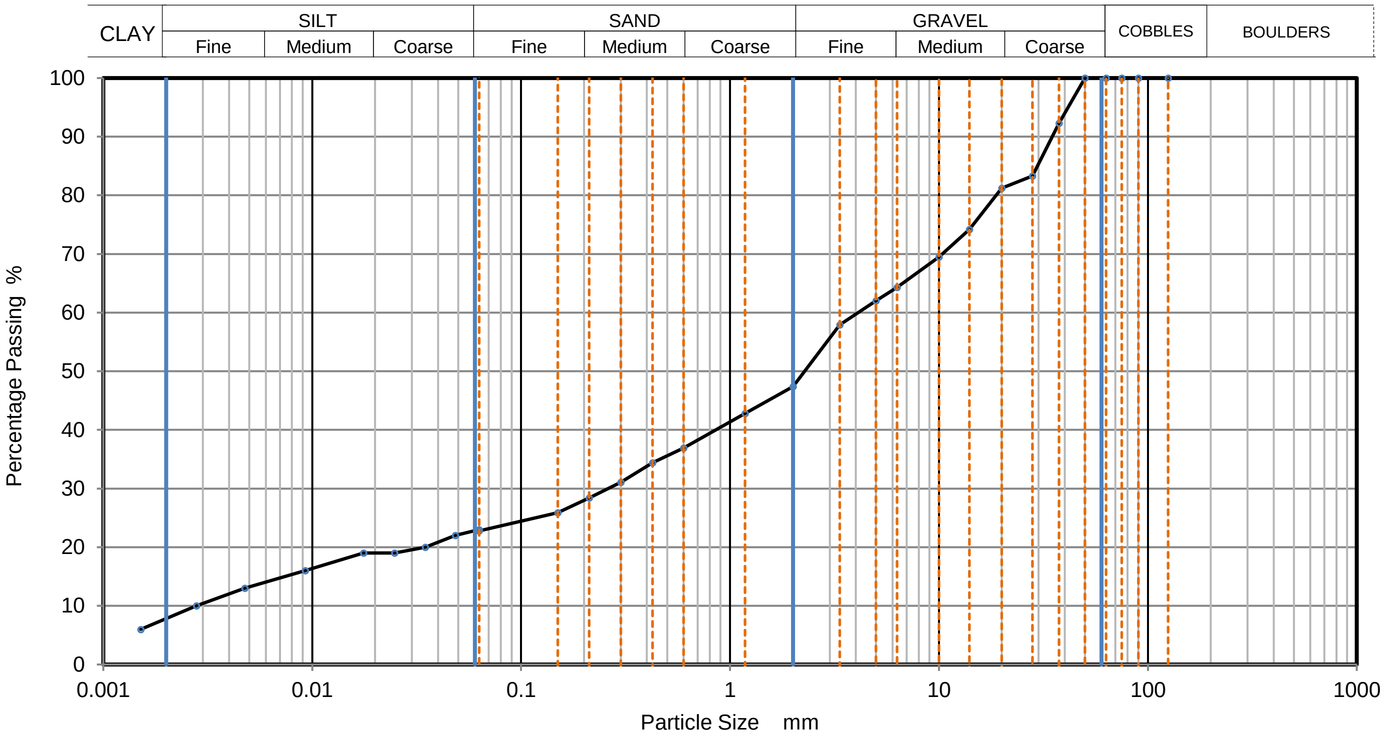
Grading Analysis		
D100	mm	
D60	mm	2.32
D30	mm	0.148
D10	mm	0.00256
Uniformity Coefficient		910
Curvature Coefficient		3.7

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved	Sheet printed	**Fig 1**
Stephen.Watson	30/07/2018 12:11	Sheet

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION			Job Ref	**17-0439**
				Borehole/Pit No.	TP15
Site Name	Coolnabacky 400kV GIS Substation			Sample No.	5
Soil Description	Grey sandy gravelly silty CLAY.			Depth, m	1.70
Specimen Reference	6	Specimen Depth	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2018070426



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	23
90	100	0.0485	22
75	100	0.0348	20
63	100	0.0248	19
50	100	0.0176	19
37.5	92	0.0093	16
28	83	0.0048	13
20	81	0.0028	10
14	74	0.0015	6
10	70		
6.3	64		
5	62		
3.35	58		
2	47		
1.18	43		
0.6	37	Particle density	(assumed)
0.425	34	2.65	Mg/m3
0.3	31		
0.212	28		
0.15	26		
0.063	23		

Dry Mass of sample, g	4983

Sample Proportions	% dry mass
Cobbles	0
Gravel	53
Sand	25
Silt	15
Clay	8

Grading Analysis		
D100	mm	
D60	mm	4.11
D30	mm	0.26
D10	mm	0.00274
Uniformity Coefficient		1500
Curvature Coefficient		6

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved	Sheet printed	Fig 1
Stephen.Watson	30/07/2018 12:11	Sheet

UKAS TESTING
2183

Chemtest
The right chemistry to deliver results
Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.co.uk

Final Report

Report No.:	18-21719-1		
Initial Date of Issue:	25-Jul-2018		
Client	Causeway Geotech Ltd		
Client Address:	8 Drumahiskey Road Balnamore Ballymoney County Antrim BT53 7QL		
Contact(s):	Aisling O'Kane Colm Hurley Darren O'Mahony Gabriella Horan John Cameron Lucy Newland Matthew Gilbert Neil Haggan Paul Dunlop Paul McNamara Stephen Franey Stephen Watson		
Project	17-0439 ESB Site in Collnabacky, Co. Laois		
Quotation No.:		**Date Received:**	23-Jul-2018
Order No.:		**Date Instructed:**	23-Jul-2018
No. of Samples:	7		
Turnaround (Wkdays):	3	**Results Due:**	25-Jul-2018
Date Approved:	25-Jul-2018		
Approved By:			
Details:	Robert Monk, Technical Manager		

Results - Soil

Project: 17-0439 ESB Site in Collnabacky, Co. Laois

Client: Causeway Geotech Ltd				**Chemtest Job No.:**	18-21719	18-21719	18-21719	18-21719	18-21719	18-21719	18-21719
Quotation No.:				**Chemtest Sample ID.:**	658257	658258	658259	658260	658261	658262	658263
Order No.:				Client Location ID.:	BH01	BH02	BH03	BH07	BH09	TP02	TP09
				Client Sample Ref.:	2	2	4	3	5	2	2
				Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
				Top Depth (m):	1.00	2.00	4.00	1.00	1.00	0.50	0.50
				Date Sampled:	20-Jul-2018	20-Jul-2018	20-Jul-2018	20-Jul-2018	20-Jul-2018	20-Jul-2018	20-Jul-2018
Determinand	**Accred.**	**SOP**	**Units**	**LOD**							
Moisture	N	2030	%	0.020	5.6	8.3	2.7	16	7.8	13	9.9
pH	U	2010		N/A	8.2	8.5	8.5	8.5	8.6	8.0	8.2
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Chloride (Water Soluble)	U	2220	g/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010

Report Information

Key

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

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

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

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

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

LABORATORY RESTRICTION REPORT

Project Reference	17-0439	To	Colm Hurley
		Position	Project Manager
Project Name	Coolnabacky, Co. Laois	From	Stephen Watson
TR reference	17-0439 / 1	Position	Laboratory Manager

The following sample(s) and test(s) are restricted as detailed below. Could you please complete the "Required Action" column and return the completed form to the laboratory.

Hole Number	Sample			Test Type	Reason for Restriction	Required Action
	Number	Depth (m)	Type			
BH10	4	3	B	Moisture Content Atterberg limits PSD	Sample damaged in transit to laboratory	Cancel

For electronic reporting a form of electronic signature or printed name is acceptable

Laboratory Signature	Project Manager Signature
Stephen Watson	Colm Hurley
Date 19 July 2018	Date 19 July 2018

APPENDIX H

SPT hammer energy measurement report

Southern Testing
Environmental & Geotechnical

SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

Neil Burrows
Southern Testing Laboratories
Unit 11
Charlwoods Road
East Grinstead
RH19 2HU

SPT Hammer Ref:	NT5.
Test Date:	14/04/2018
Report Date:	15/04/2018
File Name:	NT5..spt
Test Operator:	CAUSEWAY

Instrumented Rod Data

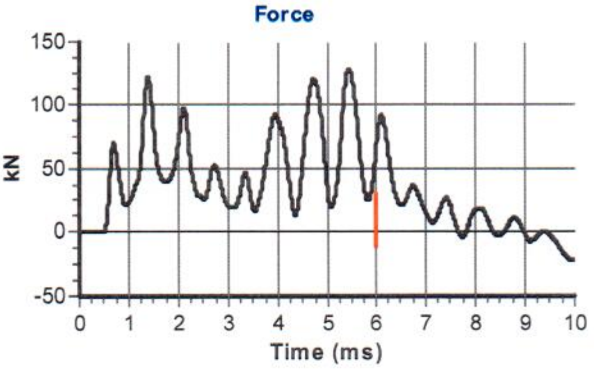
Diameter d_r (mm):	54
Wall Thickness t_r (mm):	6.0
Assumed Modulus E_a (GPa):	200
Accelerometer No.1:	6458
Accelerometer No.2:	9607

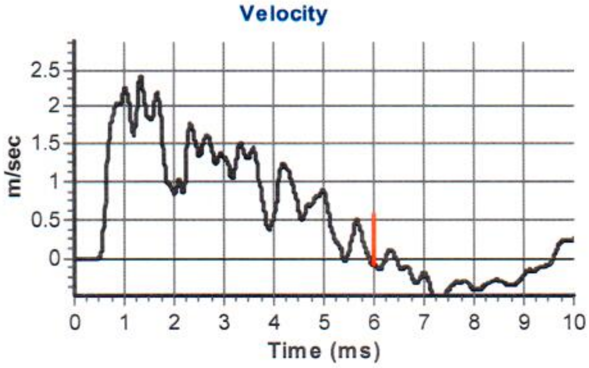
SPT Hammer Information

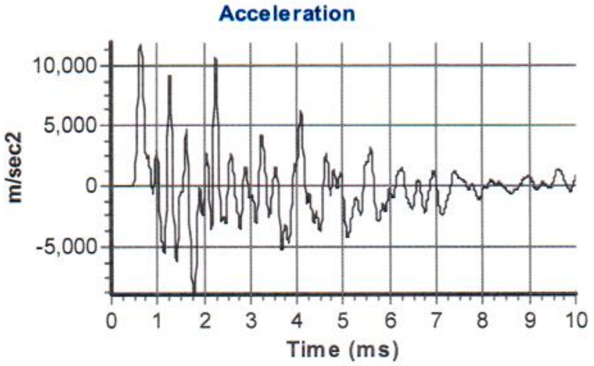
Hammer Mass m (kg):	63.5
Falling Height h (mm):	760
SPT String Length L (m):	10.5

Comments / Location

Causeway Yard







Calculations

Area of Rod A (mm2):	905
Theoretical Energy E_{theor} (J):	473
Measured Energy E_{meas} (J):	299

Energy Ratio E_r (%): **63**

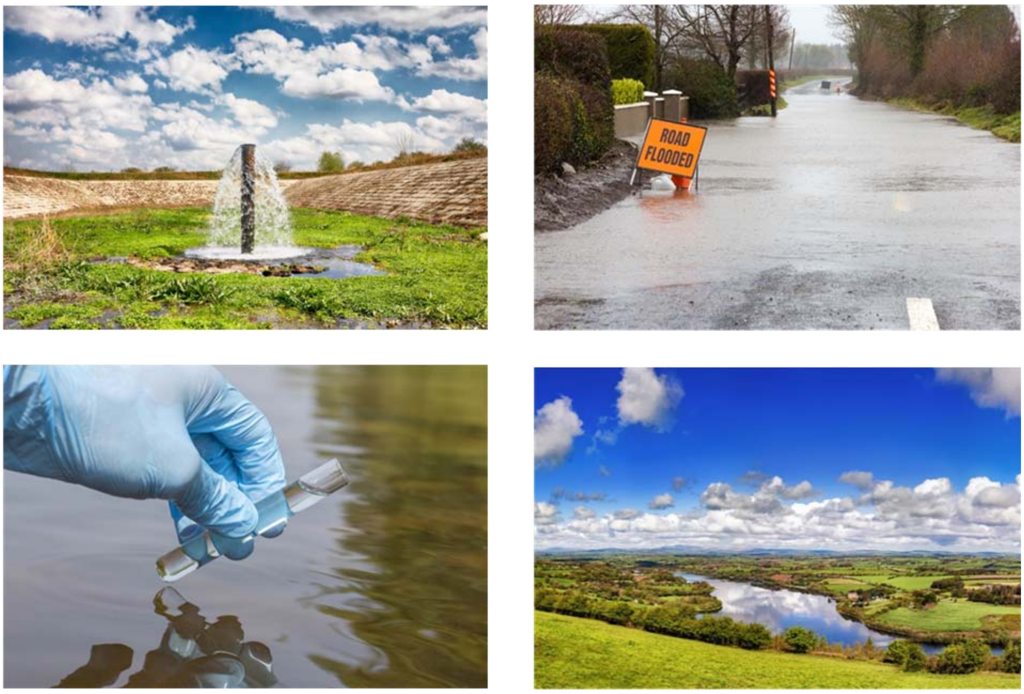
NPBurrows

Signed: N P Burrows
Title: Field Operations Manager

The recommended calibration interval is 12 months

Hydrogeological and Hydrological Review

Proposed Coolnabacky Sub-station site Timahoe



February 2021

IE CONSULTING
WATER-ENVIRONMENTAL-CIVIL

Hydrogeological and Hydrological Review

Location: Proposed Coolnabacky Sub-station site, Timahoe

Date: 16th February 2021

Document Control

PROJECT NUMBER: IE2219		DOCUMENT REF: IE2219_Report_4840			
3.0	Issue	JK			16/02/2021
2.0	Issue	JK			11/01/2021
1.0	Draft	JK			21/12/2020
Revision	Purpose Description	Originated	Checked	Reviewed	Date

Contents

Table of Contents

1. INTRODUCTION

IE Consulting were engaged to conduct an independent audit of the process undertaken (during planning) to assess the potential impact on the hydrological and hydrogeological environment from the proposed construction of a substation at Coolnabacky, near Timahoe, Co. Laois. The Substation is an element of an overall network improvement scheme for the Laois-Kilkenny Area.

IE Consulting were invited by Irish Rural Link to submit a Tender for the following brief

The scope for the independent review for Coolnabacky (also known as Laois-Kilkenny) would broadly involve reviewing the planning documentation, in particular:

- *To review scheme as planned from a hydrological/ hydrogeologic risk point of view*
- *Review of relevant planning information*
- *Recommendations on any gaps in the scheme as planned (e.g. Bunding arrangements, dealing with contaminated runoff, flooding risk etc.)*
- *Comment on whether the scheme is in line with best international practice*
- *Assessment of risk to aquifer*
- *Additional areas to focus on or any further pre-construction site investigations etc.*
- *Provide information of site specific mitigation measures for construction stage*

The main issues of concern are the potential risks to the groundwater water supply.

Irish Rural Link, requested that IE Consulting confirm that they had not undertaken work for Eirgrid or ESB in the recent past or in any way connected to the proposed scheme. This we were happy to confirm.

Irish Rural Link also stressed that IE should confirm that the audit was independent and not influenced in any way by Eirgrid or ESB. This we are happy to confirm.

2. APPROACH TO STUDY

This report is based on a review of the following;

- Documents at the public link: http://eirgridlaoiskilkenny.ie/environmental.html
- A review of the information provided on the An Bord Pleanala website, when a search for VA0015 was made http://www.pleanala.ie/search/index.php?q=va0015&case_scope=all&include_reports_etc=0
- Eirgrid and ESB reports and drawings-provided on request.
- Assessment reports By SLR and Tobins associated with the unauthorised development in
- 2017 Tobins report (Report to assess the impact of the unauthorized development on the Aquifer at Coolnabacky Construction site) 2017
- 2018 SLR Hydrogeological assessment of excavations for the construction of a substation prepared for: Eirgrid SLR Ref: 180720 00357 00004
- GSI 2000- Kyle & Orchard Springs Source Protection report
- GSI 2018 assessment and response to RTS presentation to Minister Naughten
- GSI public viewer maps
- Site walk-over visit under taken by J Keohane on 18th December 2020
- Lyons & Kelly 2016 Monitoring Guidelines for the Assessment of Petrifying Springs in Ireland. Irish Wildlife Manual No. 94 NPWS
- ESBI site drainage report PE687-F0261-R261-016 which included Traynor Environmental Site suitability assessment 2012
- 2012 Soil Mechanics Report No Y2012-12A factual report on ground investigation.

3. TOPOGRAPHY AND SURFACE WATER DRAINAGE

The site lies in a low lying, mostly flat area which extends to the east and north of the site. The surrounding land to the south and west becomes hummocky within 150m to 200m of the site. The geomorphology appears to be glacio-fluvial in origin.

The main surface water drainage feature in the area is the Timahoe River which flows in an approximately northerly direction 500m east of the site. The Timahoe River in turn joins the Honey Stream which flows in from the east and the combined flow becomes the Bauteoge River.

The watercourses in the area appear to have been modified and canalised in places, and arterial drainage has been used to improve the land and direct run-off towards the streams and rivers.

A natural unnamed watercourse skirts the northern boundary of the site, and there are also drains along the western southern and eastern boundaries of the site which were noted to be carrying some flow on the day of the site visit. The perimeter drains are typically 1.0m to 1.5m deep, and seem mainly to run to the North towards the stream.

Apart from occasional water logging after heavy rain, I am satisfied that there is no evidence of a flood risk to site from fluvial or groundwater sources. The modified drainage network in the area, does appear to work efficiently to remove water from the land.

There is surface water hydraulic connectivity between the site and an SAC (The River Barrow and River Nore SAC site code 002162), and I am satisfied that this has been adequately considered through the EIAR and consideration by the An Bord Pleanala Inspector.

I am satisfied that the proposed safeguards for surface water quality management during construction and the operational phase surface water management approach for managing run-off from paved and covered areas for the proposed development is robust. Any new information arising out of the recommended further works detailed below or the construction works when they commence should be reviewed, in the context of surface water management to ensure ultimate protection for water resources.

4. GROUNDWATER

An Bord Pleanala has approved the proposed development after an oral hearing and review of documentation. The Inspectors report (11.VA0015) states that "It appears that the substation at Coolnabacky can be constructed without undue risk to local groundwater sources. The development could be carried out and operated satisfactorily from an ecological standpoint". I have considered this decision in the context of both bedrock and shallow aquifers.

4.1 Bedrock Aquifer

I do agree that there is no significant risk posed by the development to the Kyle spring, because of the following factors

- Significant consistent thickness (8m approx.) of low permeability cohesive subsoil overlying the rock aquifer. This effectively isolates any on-site activities from the bedrock aquifer, since there will be no excavations deeper than 2m. I am satisfied that site tests have demonstrated very low permeability for this Clay material.

- The GSI source protection report (2000- Kyle & Orchard Springs Source Protection report) concludes that the Kyle Spring is generically a bedrock derived spring, (although the output may flow through overlying gravel for a short period).
- There is no groundwater pathway linking the site and the spring.
- The site is outside of the mapped source protection zone, eventhough the GSI report does state that that some groundwater may pass beneath the Timahoe/Bauteoge River through bedrock en route to the Kyle Spring.
- There is no hydraulic connectivity between the surface water features in the area and the Kyle Spring since all surface water from the site ultimately enters the Timahoe River System and the GSI report (2000- Kyle & Orchard Springs Source Protection report) states that surface water features are hydraulically isolated from the bedrock Aquifer.

4.2 Sand and Gravel Aquifer

The GSI have mapped a locally important Sand and Gravel Aquifer (Timahoe-Stradbally Aquifer) in the area, which includes the site. The GSI have stated in their review (response 2018) that work is in progress on better defining the boundaries and characteristics of this aquifer as part of the Groundwater 3D project.

I understand that the information available to the Hydrogeology Team preparing the EIS in 2013, suggested that the site was outside of the mapped Sand and Gravel aquifer area at the time. The Inspectors report confirms and accepts this. The fact that this has been changed by and is under further review by the GSI does warrant some scrutiny.

The 2017 Tobins report (Report to assess the impact of the unauthorized development on the Aquifer at Coolnabacky Construction site) prepared for ESB acknowledges this boundary change but argues that "*no significant saturated sand and gravel deposit was encountered in the vicinity of the sub-station site*".

This is consistent with the 2018 report by SLR (Hydrogeological assessment of excavations for the construction of a substation) prepared for Eirgrid which states:

> *"the site investigation showed that granular sand and gravel deposits at the site are very thin, laterally impersistent and contain limited groundwater; they are not therefore a significant groundwater source or aquifer. This conclusion is supported by GSI advice that states that gravel deposits must exceed 10m to be considered an aquifer. The subsoils at the site are not classified as an aquifer or a groundwater body due to their low permeability characteristics, shown to be typical of silt. This reflects the description of the subsoils as granular gravelly clay / clayey sand and gravel deposits and cohesive stiff – very stiff gravelly clay deposits". "The site investigations at the site have shown that there is no gravel aquifer (i.e. sands and gravels to a thickness exceeding 10m) at the site.*
>
> *Therefore, the shallow water ingress encountered in the subsoils at the site is representative of pore water or isolated pockets of groundwater that are not connected to the bedrock aquifer".*

The GSI (GSI www.gsi.ie) does indeed state that the sand and gravel deposit must be 10m in thickness to be considered an aquifer. I therefore expect, based on this observation, that the GSI will not include this site within a revised sand and gravel aquifer boundary.

Apart from the thickness constraint which appears to be definitive, the EIAR (Chapters 9 and 10 2013) presents a number of other pieces of evidence to state why the sand and gravel deposits on the site do not comprise an aquifer.

> *The sand and gravel deposits at the site not found to be saturated during the site investigation of 2012.*
>
> *In most cases, groundwater strikes were not recorded in the Sand and Gravel deposits.*
>
> *It is noted that, due to the presence of low permeability Clay deposits beneath the sand and gravel, the inflow volumes of groundwater encountered during drilling was minimal.*
>
> *As the sand and gravel was not saturated, this indicates that the quantities of groundwater present are not significant.*
>
> *During a subsequent intrusive site investigation carried out by AWN Consulting in 2013, 4 no. boreholes were installed around the boundary of the site, up gradient and down gradient of the*

> *predicted groundwater flow direction. (Appendix 10.1 Site Investigation and Hydrogeological report).*
>
> *The ground conditions consisted of soft to stiff sandy gravelly Clay and silty sandy Clay to approximately 3m bgl. At approximately 3m bgl, low permeability stiff to firm boulder Clay was encountered. At borehole BH4 Boulder Clay was found to extend to 8.6m bgl when returns were of angular rock suggesting boulders or bedrock.*
>
> *No fast inflow groundwater strikes were recorded during the site investigation.*
>
> *Data loggers were installed to record the static groundwater levels at hourly intervals. Based on data, to date the groundwater level at the site is typically less than c.1m bgl. (See Appendix 10.1 for more detailed information)*
>
> *Permeability tests carried out at each groundwater monitoring well (borehole) indicate that the hydraulic conductivity is typical of silt and clay soils.*
>
> *Therefore, the water present in the deposits represents pore water, rather than groundwater. The Sand and Gravel deposits at the centre of the site which would be expected to have a higher permeability were also found to be unsaturated.*

The 2018 SLR report suggests based on this information

> *"therefore, the shallow groundwater present in the subsoils represents pore water or isolated pockets of groundwater, rather than a groundwater resource, as defined by the EPA. It may not be feasible to define a water table in the subsoils as lateral movement is impeded, and so a shallow water table is not shown on the Conceptual Site Model. Should there be any flow in the granular subsoils, this flow is expected to follow the topography to the south east."*

I have reviewed the site investigation undertaken in February-March 2012. I examined the borehole and trial pit logs, which indicates reasonably consistent ground conditions across the site, comprising topsoil of approximately 300mm underlain by upto 1.9m of varying grades of granular material, which is described as Alluvium on the GSI maps. Alluvium because it is deposited by rivers (in this case probably glacial outwash rivers), often tends to be haphazard in a lateral sense.

It is accepted that the four groundwater monitoring borehole logs (from the 2013 investigation) show no granular material. However it does appear anomalous that these four boreholes around the periphery of the site encountered no granular material, and the boreholes and trial pits excavated in the middle of the site as part of a previous investigation phase did. The possible reasons for this anomaly may be of glacial origin and therefore natural, or may be related to a variation in the drilling methodology deployed in each phase. I am recommending that further investigation is undertaken to confirm the original findings. It is suggested that a geophysical survey would be the most appropriate approach to clarifying this anomaly.

I note that groundwater strikes were recorded in 8 out of 10 boreholes in 2012. In most cases no inflows were recorded, but the mode of drilling (Shell and Auger) can effectively seal out the water with casing, particularly when the granular interval is thin, thus giving the impression of no inflows.

I consider that because the method of drilling can quickly case out water, the trial pits give a better view of shallow groundwater conditions as follows

TRIAL PIT	GROUNDWATER OBSERVATIONS
S1	ROSE
S2	NONE
S3	STEADY INFLOW
1	SLIGHT SEEPAGE
2	STEADY INFLOW
3	NONE
4	NONE
5	STEADY INFLOW
6	NONE
7	STRUCK
8	STRUCK
9	SLOW TRICKLE
10	QUICK INFLOW
11	BASE OF PIT FILLED
12	NONE

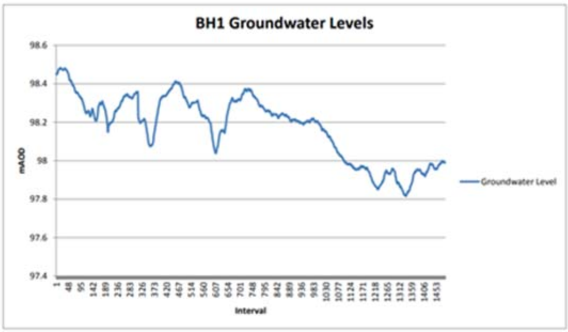
I would suggest that these observations suggest some groundwater activity.

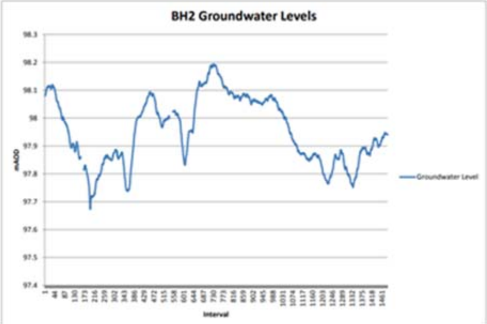
It is accepted that the borehole logs from 2013 indicate that no groundwater was encountered. However it is noted that February and March 2013, and indeed the same months in the previous year (2012) were dry months. I suspect that the Sands and Gravels on this site are actually quite free draining, and drain quite readily when there is little to no rain. The hydraulic controlling horizon is the stiff low permeability CLAY layer at 1.5m to 3m depth, which does not allow any vertical percolation.

I note the comments made by GSI in their review of the RTS presentation which highlighted the connection between the dry period and the lack of groundwater, but I suggest that conditions on this site comprise relatively free draining material close the surface, which is readily recharged by incident rainfall, but drains away quickly. The mainly dry condition of the field on the day of my site visit, with only minor water logging supports this view.

It is noted that the site assessment undertaken by Traynor Environmental (2012) noted T values and P of 16 and 29 respectively, which indicates excellent percolation. However it is also noted that the soakaway tests did not indicate available infiltration capacity for soakaways.

The 2013 boreholes were fitted with standpipes to allow groundwater levels to be measured. It is stated in the EIAR report that the boreholes were fitted with data logger water level transducers. I examined the data in appendix 10.1 and I noted that the boreholes were instrumented for June and July 2013. Data for BH4 was not presented, but plots for boreholes 1-3 do seem to indicate some fluctuations in groundwater levels as shown below and in fact BH1 and BH2 display very similar patterns. I am surprised that no comment was made on this in the EIAR, although it does have more significance in the context of the hydrological system supporting the Tufa Springs than any significance in the overall impact assessment on drinking water supplies.





I therefore do not fully agree with the conclusion, that the Sands and Gravels on the site are not active in the groundwater sense because;

- The T and P tests indicate permeable deposits
- The groundwater monitoring undertaken indicates fluctuations in groundwater levels, albeit in the small range.
- The relatively dry topsoil layer suggests that incident rainfall does percolate into the sand and gravel layer

I expect that there will be a gradient towards the un-named watercourse to the north east, with some lateral movement to drains. I suspect that the groundwater throughput has some influence on the tufa springs, and I have recommended that further work is undertaken on this to understand it better.

Despite this anomaly, my conclusion is that the sands and gravels on this site, are not substantially hydraulically connected with the Locally Important Sand and Gravel aquifer, for the following reasons.

1. The deposits are thin and underlain by an impermeable layer and
2. The perimeter drains and the permanent watercourse effectively intercept any flow.

The potential risk of impacts on groundwater resources beyond the site are therefore not considered significant, as a result of this lack of connectivity.

However I do feel that the groundwater from the site does have some influence/connection with the Tufa formations. Petrifying springs are lime-rich water sources that deposit tufa, a porous calcareous rock. They constitute a specialised habitat with a distinctive flora, typically dominated by bryophytes and often containing rare species. Their small extent and their vulnerability are recognised by their designation as a priority habitat in Annex I of the European Union Habitats Directive (92/43/EEC); whereby member states are obliged to monitor and report on the conservation status of such annexed habitats.

5. PETRIFYING SPRINGS-with TUFA FORMATION

The Tufa Springs were mentioned in the An Bord Pleanala Inspectors report which notes that an observer to the Oral hearing stated that a screening of these should have been undertaken in the context of the habitats directive on the basis of petrifying springs being designated a priority habitat under Annex 1 of the habitats directive. The Inspector did not agree with the argument and I fully concur with the conclusion of the Inspector, but nonetheless, I do feel that a more in depth assessment of the springs should be undertaken in the context that groundwater from the site, may have some influence on them as discussed above. This recommendation does not suggest any lacunae in the EIAR or NIS, that would have influenced the overall decision, but is a recommendation that ESB adopts an enhanced awareness of the connectivity of the site with a priory habitat.

Member states are required to monitor and report on the conservation status of such annexed habitats. An important stipulation within the habitats directive manual (Lyons and Kelly 2016) when referring to Petrifying Springs is that " in order to preserve this habitat of very limited expanse in the field it is essential to preserve its surroundings and whole hydrological system concerned" . The presence of Tufa deposits in close proximity (along the watercourse that forms the northern boundary) to the site, and their dependence on the hydrological conditions on the site, suggests that there is a requirement to better understand the interrelationship between the site conditions and the deposits. The 2016 NPWS publication "monitoring guidelines for the protection of petrifying springs in Ireland" should be referred to for guidance.

6. PROPOSED CONSTRUCTION AND OPERATIONAL CONTROLS TO PROTECT GROUNDWATER AND SURFACE WATER

The proposed mitigation measures for dealing with potential impacts to groundwater and surface water are best international practice, provided they are adhered to and overseen and signed off by a competent person during construction.

One of the key concerns (expressed by the RTS group) relates to the storage and use of oil in the proposed transformers. I am satisfied that the proposed infrastructure and operational protocols afford the optimum security for the prevention of loss to the environment. No absolute guarantees can be provided that there will never be accidental loss of oil to the environment.

In the event of any environmental incident the ESB Networks Emergency Response Procedure will be activated.

For minor spillages that enter the drainage network, the oil water separator will provide an adequate mitigation control measure.

For other spillages, on the basis of the proposed site topography, it is expected the oil will be easy to control on the site, and an appropriate remediation strategy would involve recovery and disposal of any free product, and appropriate disposal of any oil contaminated soil, backed up by validation sampling and analysis.

If some oil were to run across the surface or become mobilised in the shallow groundwater, it will migrate towards the surrounding drainage ditches approximately 40m from the nearest proposed transformer, and ultimately the natural Stream and surface water network. Again, appropriate oil remediation strategies will limit any environmental damage. I am satisfied that any loss of oil on the site will not present a significant risk to the either the Bedrock or Sand and Gravel aquifers and as a result the proposed use of oil on the site, does not present a significant risk to any drinking water supplies.

Dewatering may be required for foundations, but inflows are expected to be manageable and will not create any lasting impacts.

7. CONCLUSIONS

- I am satisfied that the proposed development does not present a significant risk to drinking water sources in the area.
- I am satisfied that adequate controls have been proposed to mitigate any potential accidental spillages or discharges, and to ensure that the proposed site development does not present any on-going impacts.
- The substantial thickness of low permeability CLAY on the site eliminates any significant pathway developing to the bedrock aquifer, and hence the Kyle spring.
- The shallow depth of the sand and gravels on the site and the fact that they are effectively intercepted by drainage ditches, means they are not hydraulically connected to off-site sand and gravel deposits.
- The sands and gravels on this site cannot be considered an aquifer and are not considered to be more widely connected to the mapped Sand and Gravel Aquifer.
- I suspect the GSI will not include the site in the Locally Important Aquifer when they consider the boundary of the Timahoe-Stradbally Sand and Gravel Aquifer.
- I am not convinced that the lateral extent and hydraulic properties of the granular material above the CLAY is fully understood and I am therefore recommending further investigation to better understand the dynamics.
- The information from this investigation, should be reviewed by the site drainage designers to ensure full compatibility with the proposed design approach to surface water management.

- I consider that the petrifying springs-tufa deposits are not fully understood, in the context of their dependence on site hydrology and hydrogeology, and in the context that the Sands and Gravels on site may be more active than previously understood. This warrants further investigation.

8. RECOMMENDATIONS

1. I would recommend that a geophysical survey is undertaken using electromagnetic surveying (such as EM31) to map the subsurface shallow deposits to better understand the subsoil profile and to enhance the original ground model.
2. I would recommend that 5 No. shallow groundwater monitoring points are installed around the site at locations away from the proposed footprint. These can comprise simple standpipes installed in trial pits, or shallow drilled boreholes to maximum 3m depth away from the building footprint or any areas where accommodation works are planned. These should be levelled to a common datum, and groundwater levels measured every six hours using water level transducers. This monitoring period should extend over two seasons at least ideally from the Winter period into Spring until construction of the substation proper commences. This will help to better understand the groundwater hydraulics of the shallow deposits on the site and inform the further assessment of the Tufa Springs.
3. A round of groundwater samples should be taken from the shallow wells and analysed for Nitrate, Nitrite, Phosphorous, Ammonia, Chloride, Potassium and Sodium, Conductivity, pH. This will provide a baseline for any future monitoring. The wells should be sampled twice per year, for the same range of parameters. The tufa springs are very sensitive to nutrient loading, and this monitoring will provide information to assist in the protection of the habitat.
4. A more in depth ecological assessment of the tufa springs should be undertaken in the context of it being an Annex 1 habitat using the above data, and following the NPWS guidelines. This will enhance the understanding of the tufa springs and their connectivity to the site.
5. Once items 1-4 are completed I would recommend that the design of the stormwater management system be reviewed in the context of ensuring the existing hydrological system is optimised to support the tufa springs as required under the habitats directive.
6. Once drilled, groundwater quality from the proposed supply well should be monitored twice per year.

Appendix B

Geophysical Survey

Proposed Substation
Coolnabacky, Co. Laois

Geophysical Survey

Report Status: Draft

MGX Project Number: 6555

MGX File Ref: 6555d-005.doc

30th April 2021

Confidential Report To:

ESB Networks Projects Delivery
Two Gateway
East Wall Road
Dublin 3
D03 A995

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: Hartmut Krahn (Senior Geophysicist)

Reviewer: John Connaughton (Geophysicist)

Minerex
Geophysics Limited

Subsurface Geophysical Investigations

EXECUTIVE SUMMARY

1. Minerex Geophysics Ltd. (MGX) carried out a geophysical survey consisting of EM31 Ground Conductivity surveying for the ground investigation for the proposed ESB substation at Coolnabacky, Co. Laois.
2. The main objectives of the survey were to determine ground conditions under the substation site and access road, to determine relative variations in subsoils and material type, to establish relative permeability and areas of higher and lower permeability.
3. Ground conductivities were measured and displayed on maps.
4. The interpretation shows that the subsoils vary in the material content between clayey silty Sand and Gravel (lowest conductivities) and slightly sandy and slightly gravelly Clay and Silt (highest conductivities).
5. At the substation site is has been shown that the ground is quite homogeneous with measurements representing a small change in overburden material between sandy and gravelly Clay and Silt and slightly sandy and slightly gravelly Clay and Silt.
6. The access road shows a larger variations of materials with Sand and Gravel occurring closest to the quarry.
7. The lowest ground water permeabilities occur at the highest conductivity values because the clay and silt content is highest here. The highest permeabilities occur where the conductivities are lowest because there the subsoils have the largest amount of Sand and Gravel.

CONTENTS

List of Tables, Maps and Figures:

1. INTRODUCTION

1.1 Background

Minerex Geophysics Ltd. (MGX) carried out a geophysical survey for the proposed ESB substation at Coolnabacky, Co. Laois. The survey consisted of EM31 ground conductivity measurements. The survey was requested by ESB based on recommendations of their hydrogeological consultant.

1.2 Objectives

The main objectives of the geophysical survey were:

- Determine the ground conductivities under the substation site and access road
- Map shallow subsoils to determine lateral variations and relative type (clay/silt or sand/gravel)
- Determine relative permeability of the subsoils
- Identify zones with higher and lower intergranular permeability

1.3 Geology

The online bedrock geological map of Ireland (GSI, 2021) indicates that the survey area is underlain by the Ballyadams Formation described as crinoidal wackestone/packstone limestone. The quaternary sediments are described as alluvium under the substation site and as gravels along the access road.

A previous geotechnical report (Soil Mechanics, 2012) describes the ground investigation work done and the results of direct investigation and laboratory testing. Boreholes show that rock is deeper than 6 m and does not play a tole in the current investigation with the EM31.

Ten boreholes on the substation site indicate mainly sandy gravelly clay with some lenses of sand or gravel. Most trial pits also show sandy gravelly clay with some silt, sand and gravel lenses. Trial pits 10 and 11 indicate sand while trial pit 12 indicates silt over sand.

1.4 Report

This report includes the results and interpretation of the geophysical survey. Maps and a table 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 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 was outlined in the tender documents and consisted of EM31 Ground Conductivity measurements.

The survey locations are within the colour contoured areas in the maps.

2.2 EM31 Ground Conductivity

The EM31 ground conductivity survey was carried out in the field containing the proposed substation (approx. 7 ha) and along the access road (approx. 3 ha).

The survey was done on lines nominally 10 m apart. Along each line a reading of ground conductivity was taken every second while walking along, thereby resulting in a survey grid of nominally 10 x 2 m. The locations were measured with a sub-meter accuracy SERES DGPS system attached to the EM31 and all data was jointly stored in a data logger. The conductivity meter was a GEONICS EM31 with Allegro data logger and NAV31 data acquisition software. The instrument was compared to base station readings and no EM drift was recorded.

The conductivity is typical for certain geological material types. Dry and clean Sand and Gravel and most rock types (Granite, Sandstone and clean Limestone) have relatively low conductivities while peat, clay and clay-rich rock types (mudstone, shale) have high conductivities.

EM31 ground conductivity determines the bulk conductivity of the subsurface over a typical depth between 0 and 6m bgl. and over a radius of approx. 5m around the instrument. In areas of thick overburden the instrument distinguished between clay/silt and sand/gravel.

The measurements can be disturbed by metal and other conductive objects in close proximity to the instrument, and therefore no geological interpretations can be made in the vicinity of such man-made objects. Either readings were not taken near sources of interference, or notes were taken by the surveyor in order to remove these during processing or to account for these in the interpretation.

The survey was done on the 23rd of April 2021 in good weather conditions. The instrument was checked repeatedly at a base station and the reading were very stable.

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 EM31 ground conductivity values were merged into one data file for the entire survey area and contoured and gridded with the SURFER contouring package. The contours are created by gridding and interpolation and care must be taken when using the data. The contour map is overlaid over the location and base map (Map 1) and the values in milliSiemens/metre (mS/m) are indicated on the colour scale bar.

Maps 2a and 2b display the same data as Map 1 but are displayed at a larger scale split for the substation site and access road.

The data indicates ground conductivities between 4 and 14 mS/m (MilliSiemens/meter). Because the electrical conductivity is the inverse of the electrical resistivity this can be also expressed as ground resistivity with 70 to 250 Ohmm (Ohmmeter).

Low conductivities indicate mainly sandy and gravely overburden while high conductivities indicate clayey and silty overburden. The highest readings on the contour map occur close to the quarry and the main road, there may be some component caused by metal of fencing and other object involved.

An interpretation can be made by allocating the overburden material to conductivity and resistivity ranges. Values of conductivity less than 5 mS/m (resistivity > 200 Ohmm) represent clayey silty Sand and Gravel within the depth reach (6m) of the EM31. Values between conductivity 5 - 10 mS/m (resistivity 100 – 200 Ohmm) can be described as sandy gravelly Clay and Silt. Values of conductivity higher than 10 mS/m (resistivity < 100 Ohmm) are typical for slightly sandy and slightly gravelly Clay and Silt.

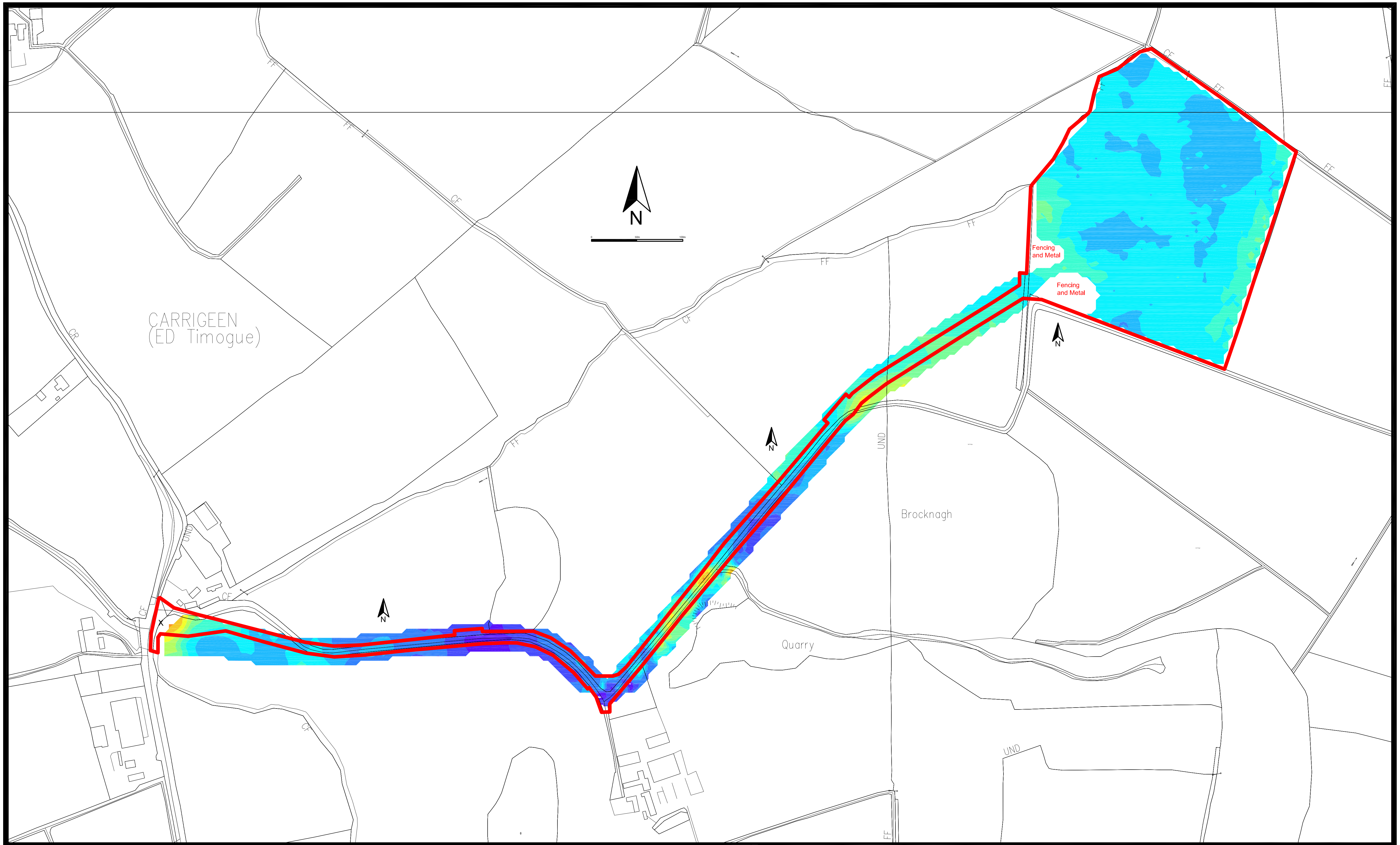
4. CONCLUSIONS

The following conclusions and recommendations are made:

- The EM31 survey was done over the substation site and the access road while avoiding some small areas with metal fencing.
- The subsoils under the site vary in the content between clayey silty Sand and Gravel (lowest conductivities) and slightly sandy and slightly gravelly Clay and Silt (highest conductivities).
- At the substation site ground conductivity values between 7 and 11 mS/m (resistivities from 90 to 143 Ohmm) have been determined. This shows that the site is quite homogeneous. Rock occurs deeper than 6 m bgl (as is known from the boreholes) so that the measurements are representing the change in overburden material.
- The interpretation shows sandy and gravelly Clay and Silt over most of the field with the proposed substation site. Some slightly sandy and slightly gravelly Clay and Silt occurs around the western and eastern edges of the field.
- The access road shows a larger variations of conductivities. The lowest occur closest to the quarry indication a high content of Sand and Gravel in the overburden.
- The lowest ground water permeabilities occur at the highest conductivity values because the clay and silt content is highest here. The highest permeabilities occur where the conductivities are lowest because there the subsoils have the largest amount of Sand and Gravel.

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, 2021.** Online Bedrock Geological Map of Ireland. Geological Survey of Ireland 2021.
5. **Milsom, 1989.** Field Geophysics. John Wiley and Sons.
6. **Reynolds, 1997.** An Introduction to Applied and Environmental Geophysics. John Wiley and Son
7. **Soil Mechanics, 2012**. Laois Kilkenny Reinforcement Project – Coolnabacky, Soil Mechanics, 2012.



Minerex
Geophysics Limited

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

CLIENT: ESB Networks Projects Delivery

PROJECT: Coolnabacky, County Laios
Geophysical Survey

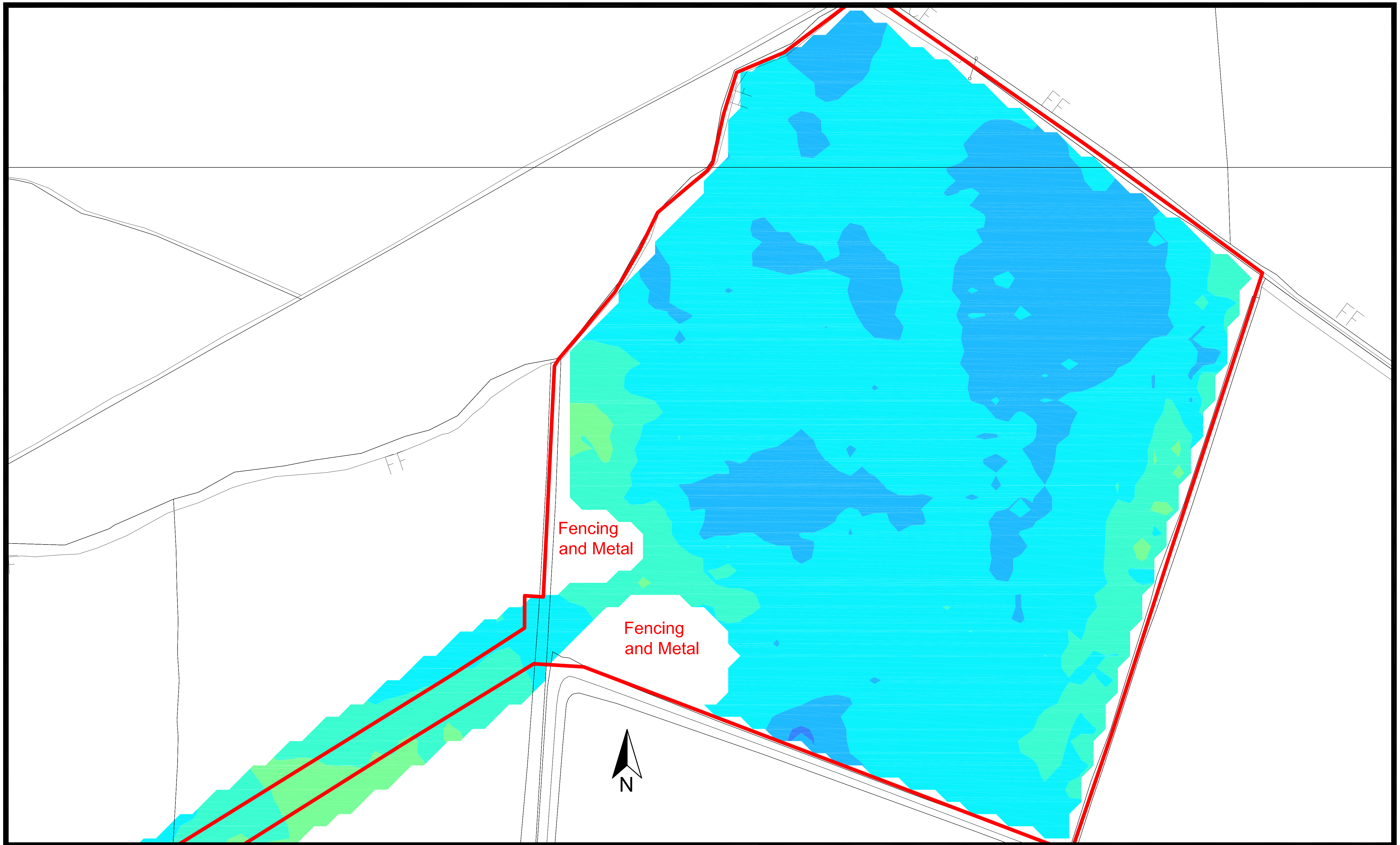
TITLE: Map 1: EM31 Ground Conductivity
Contour Map

SCALE:	1:4000 @ A3
PROJECT:	6555
DRAWN:	HK
DATE:	28/04/2021
MGX FILE:	6555d_Maps.dwg
STATUS:	Draft

LEGEND: EM31 Ground Conductivity Results:

Ground Conductivity in mS/m

4 5 6 7 8 9 10 11 12 13 14



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CLIENT ESB Networks Projects Delivery

PROJECT Coolnabacky, County Laios
Geophysical Survey

TITLE Map 2a: EM31 Ground Conductivity
Contour Map (Substation Site)

SCALE:	1:1500 @ A3
PROJECT:	6555
DRAWN:	HK
DATE:	28/04/2021
MGX FILE:	6555d_Maps.dwg
STATUS:	Draft

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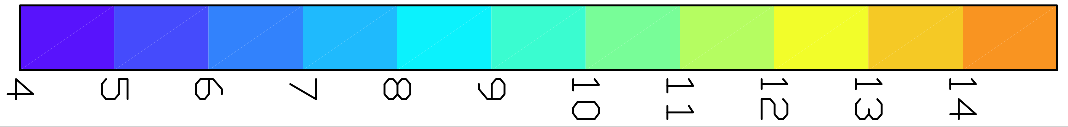
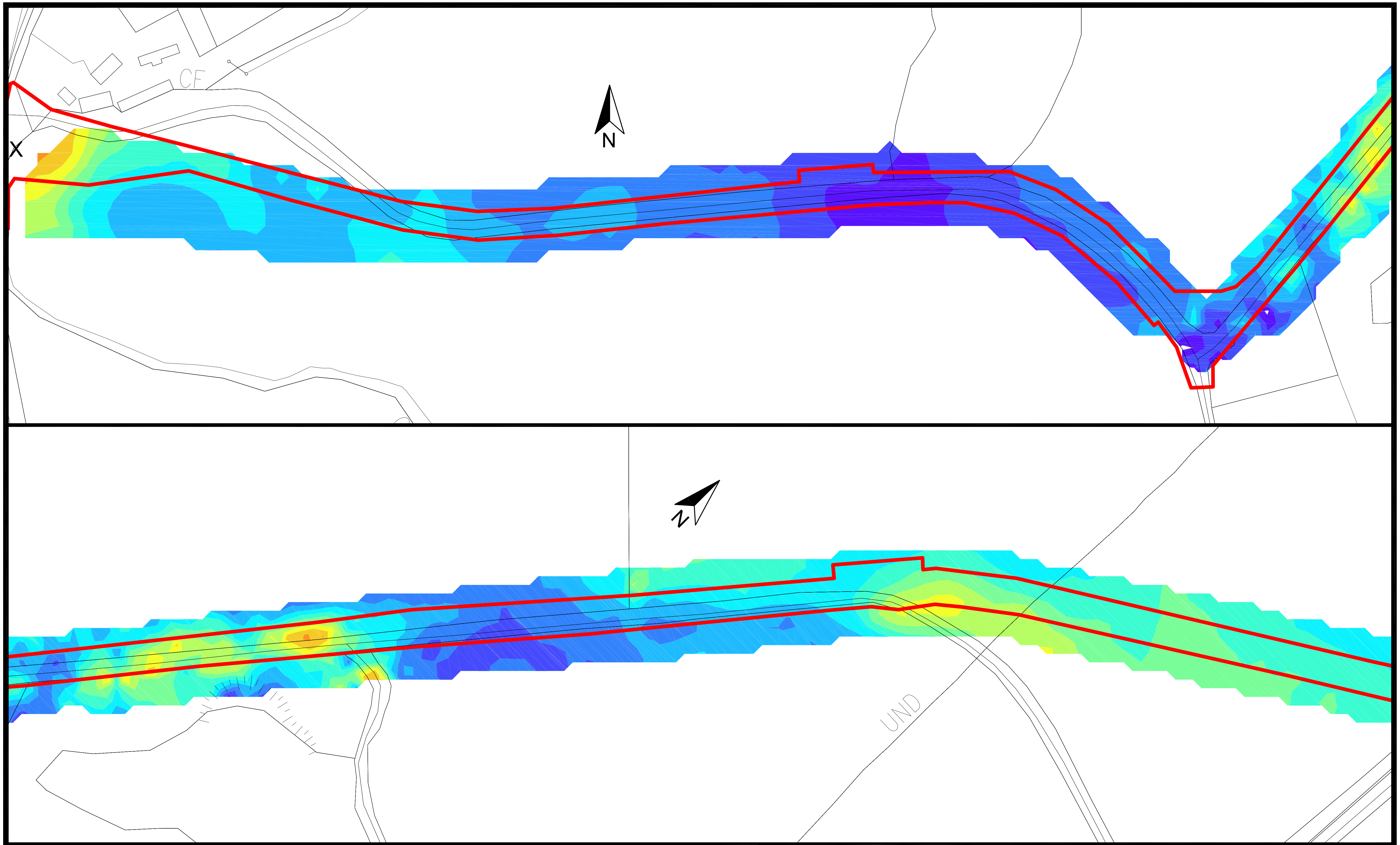
Ground Conductivity in mS/m





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CLIENT	ESB Networks Projects Delivery
PROJECT	Coolnabacky, County Laios Geophysical Survey
TITLE	Map 2b: EM31 Ground Conductivity Contour Map (Access Road)

SCALE:	1:1500 @ A3
PROJECT:	6555
DRAWN:	HK
DATE:	28/04/2021
MGX FILE:	6555d_Maps.dwg
STATUS:	Draft

LEGEND: EM31 Ground Conductivity Results:

Ground Conductivity in mS/m

4 5 6 7 8 9 10 11 12 13 14

Appendix C

Borehole Logs

Priority Geotechnical Ltd.
Tel: 021 4631600
Fax: 021 4638690
www.prioritygeotechnical.ie

Drilled By	KC
Logged By	
Borehole No.	**BH01**
	Sheet 1 of 1
Project Name:	Coolnabackey - Groundwater
Project No.	P21124
Co-ords:	
Hole Type	CP
Location:	Co. Laois
Level:	m OD
Scale	1:50
Client:	ESB
Date:	26/05/2021 - 26/05/2021

Well Backfill	Water Strike (m bgl)	Sample and In Situ Testing: Depth (m bgl)	Type	Results	Depth (m bgl)	Level (mOD)	Legend	Stratum Description
					1.00			Driller described: CLAY with cobble content.
					3.00			Driller described: Dense GRAVEL.
								End of Borehole at 3.000m

1
2
3
4
5
6
7
8
9

Groundwater:

Struck (m bgl)	Rose to (m bgl)	After (mins)	Sealed (m bgl)	Comment
				None encountered.

Hole Information:

Depth (m bgl)	Hole Dia (mm)	Casing Dia (mm)
3.00	200	200

Equipment: Dando 2000

Chiselling Details:

Top (m)	Base (m)	Duration (hh:mm)	Tool
2.40	2.60	01:00	Chisel.

Remarks:

Borehole terminated at 3.00m bgl, required depth. 50mm standpipe installed. Response zone from 0.50m to 3.00m bgl.

Shift Data:

GW (m bgl)	Shift	Depth (m bgl)	Remarks
	26/05/2021 08:00	0.00	Start of shift.
Dry.	26/05/2021 18:00	3.00	End of borehole.

Priority Geotechnical Ltd.
Tel: 021 4631600
Fax: 021 4638690
www.prioritygeotechnical.ie

Drilled By	KC
Logged By	
Borehole No.	**BH02**
	Sheet 1 of 1

Project Name:	Coolnabackey - Groundwater	**Project No.**	P21124
Co-ords:		**Hole Type**	CP
Location:	Co. Laois	**Level:**	m OD
Scale	1:50		
Client:	ESB	**Date:**	26/05/2021 - 26/05/2021

Well Backfill	**Water Strike (m bgl)**	**Sample and In Situ Testing** Depth (m bgl)	Type	Results	**Depth (m bgl)**	**Level (mOD)**	**Legend**	**Stratum Description**
					1.00			Driller described: CLAY with cobble content.
					3.00			Driller described: Dense GRAVEL.
								End of Borehole at 3.000m

1
2
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4
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8
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Groundwater:

Struck (m bgl)	**Rose to (m bgl)**	**After (mins)**	**Sealed (m bgl)**	**Comment**
				None encountered.

Hole Information:

Depth (m bgl)	**Hole Dia (mm)**	**Casing Dia (mm)**
3.00	200	200

Equipment: Dando 2000

Chiselling Details:

Top (m)	Base (m)	Duration (hh:mm)	Tool
2.60	2.80	00:30	Chisel.

Remarks:

Borehole terminated at 3.00m bgl, required depth. 50mm diameter standpipe installed. Response zone from 0.50m - 3.00m bgl.

Shift Data:

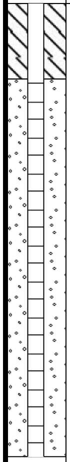
GW (m bgl)	Shift	Depth (m bgl)	Remarks
	26/05/2021 08:00	0.00	Start of shift.
Dry	26/05/2021 18:00	3.00	End of borehole.

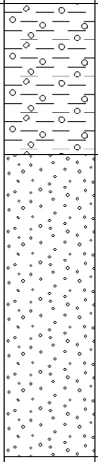
Priority Geotechnical Ltd.
Tel: 021 4631600
Fax: 021 4638690
www.prioritygeotechnical.ie

Drilled By	KC
Logged By	

Borehole No.
BH03
Sheet 1 of 1

Project Name:	Coolnabackey - Groundwater	**Project No.**	P21124
Co-ords:		**Hole Type**	CP
Location:	Co. Laois	**Level:**	m OD
Scale	1:50		
Client:	ESB	**Date:**	26/05/2021 - 26/05/2021





Well Backfill	Water Strike (m bgl)	Sample and In Situ Testing Depth (m bgl)	Type	Results	Depth (m bgl)	Level (mOD)	Legend	Stratum Description
					1.00			Driller described: CLAY with cobble content.
					3.00			Driller described: GRAVEL.
								End of Borehole at 3.000m

1
2
3
4
5
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7
8
9

Groundwater:

Struck (m bgl)	Rose to (m bgl)	After (mins)	Sealed (m bgl)	Comment
				None encountered.

Hole Information:

Depth (m bgl)	Hole Dia (mm)	Casing Dia (mm)
3.00	200	200

Equipment: Dando 2000

Chiselling Details:

Top (m)	Base (m)	Duration (hh:mm)	Tool
1.90	2.00	01:00	Chisel.

Remarks:

Borehole terminated at 3.00m bgl, required depth. 50mm diameter standpipe installed. Response zone from 0.50m to 3.00m bgl.

Shift Data:

GW (m bgl)	Shift	Depth (m bgl)	Remarks
	26/05/2021 08:00	0.00	Start of shift.
Dry	26/05/2021 18:00	3.00	End of borehole.

Appendix D

Onsite Raw Water Quality Data

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

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

W: www.element.com

IE Consulting
Innovation Centre
Green Road
Carlow
Co Carlow

4225

Attention :	Kevin Murphy
Date :	19th January, 2022
Your reference :	IE2219
Our reference :	Test Report 21/20239 Batch 1
Location :	ESB Coolnabacky
Date samples received :	16th December, 2021
Status :	Final Report
Issue :	1

Four samples were received for analysis on 16th December, 2021 of which four were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Authorised By:

Hayley Prowse

Project Manager

Client Name: IE Consulting
Reference: IE2219
Location: ESB Coolnabacky
Contact: Kevin Murphy
EMT Job No: 21/20239

Report : Liquid

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
H=H_2SO_4, Z=ZnAc, N=NaOH, HN=$HN0_3$

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-3	4-6	7-9	10-12									
Sample ID	BH1	BH2	BH3	BH4									
Depth													
COC No / misc													
Containers	H HN P	H HN P	H HN P	H HN P									
Sample Date	14/12/2021	14/12/2021	14/12/2021	14/12/2021									
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water									
Batch Number	1	1	1	1									
Date of Receipt	16/12/2021	16/12/2021	16/12/2021	16/12/2021							LOD/LOR	Units	Method No.
Dissolved Calcium #	191.9	102.1	114.5	111.2							<0.2	mg/l	TM30/PM14
Dissolved Magnesium #	6.6	2.2	10.8	10.0							<0.1	mg/l	TM30/PM14
Dissolved Potassium #	1.1	1.2	1.0	0.9							<0.1	mg/l	TM30/PM14
Dissolved Sodium #	14.9	4.3	6.3	7.3							<0.1	mg/l	TM30/PM14
Sulphate as SO4 #	245.0	4.2	6.7	13.3							<0.5	mg/l	TM38/PM0
Chloride #	6.9	3.7	6.0	9.6							<0.3	mg/l	TM38/PM0
Nitrate as NO3 #	1.1	<0.2	<0.2	<0.2							<0.2	mg/l	TM38/PM0
SRP Ortho Phosphate as PO4	0.04	<0.03	<0.03	<0.03							<0.03	mg/l	TM38/PM0
Ammoniacal Nitrogen as NH4 #	0.06	0.04	0.36	0.12							<0.03	mg/l	TM38/PM0
Dissolved Alkalinity as CaCO3 #	-	-	372	-							<1	mg/l	TM75/PM0
Total Alkalinity as CaCO3 #	846	3050	17580	2922							<1	mg/l	TM75/PM0
Electrical Conductivity @25C #	976	516	638	629							<2	uS/cm	TM76/PM0
pH #	7.71	7.72	6.97	7.65							<0.01	pH units	TM73/PM0

Client Name: IE Consulting
Reference: IE2219
Location: ESB Coolnabacky
Contact: Kevin Murphy
EMT Job No: 21/20239

Report : **Liquid (Duplicate results)**

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
H=H_2SO_4, Z=ZnAc, N=NaOH, HN=$HN0_3$

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	7-9											
Sample ID	BH3											
Depth												
COC No / misc												
Containers	H HN P											
Sample Date	14/12/2021											
Sample Type	Ground Water											
Batch Number	1											
Date of Receipt	16/12/2021										LOD/LOR	Units	Method No.
pH $^{\#}$	8.07									<0.01	pH units	TM73/PM0

Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

Notification of Deviating Samples

Client Name: IE Consulting
Reference: IE2219
Location: ESB Coolnabacky
Contact: Kevin Murphy

Matrix : Liquid

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analysis	Reason
21/20239	1	BH3		7-9	Alkalinity, pH	Sample holding time exceeded

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.
Only analyses which are accredited are recorded as deviating if set criteria are not met.

SOILS and ASH

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary. Asbestos samples are retained for 6 months.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C. Ash samples are dried at 37°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

STACK EMISSIONS

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation for Dioxins and Furans and Dioxin like PCBs has been performed on XAD-2 Resin, only samples which use this resin will be within our MCERTS scope.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.

Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
>>	Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

HWOL ACRONYMS AND OPERATORS USED

HS	Headspace Analysis.
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent.
CU	Clean-up - e.g. by florisil, silica gel.
1D	GC - Single coil gas chromatography.
Total	Aliphatics & Aromatics.
AL	Aliphatics only.
AR	Aromatics only.
2D	GC-GC - Double coil gas chromatography.
#1	EH_Total but with humics mathematically subtracted
#2	EU_Total but with fatty acids mathematically subtracted
_	Operator - underscore to separate acronyms (exception for +).
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total
MS	Mass Spectrometry.

EMT Job No: 21/20239

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM14	Preparation of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for Dissolved metals, and remain unfiltered for Total metals then acidified	Yes			
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l	PM0	No preparation is required.				
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l	PM0	No preparation is required.	Yes			
TM73	Modified US EPA methods 150.1 (1982) and 9045D Rev. 4 - 2004) and BS1377-3:1990. Determination of pH by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			
TM75	Modified US EPA method 310.1 (1978). Determination of Alkalinity by Metrohm automated titration analyser.	PM0	No preparation is required.	Yes			
TM76	Modified US EPA method 120.1 (1982). Determination of Specific Conductance by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			

Appendix E

Ecological Assessment of Tufa Spring

Memo

To: Jerome Keohane

From: Dr Joanne Denyer (Denyer Ecology)

Cc:

Date: 24 June 2021

Subject: Summary of Coolnabacky, Co. Laois site visit and petrifying springs survey

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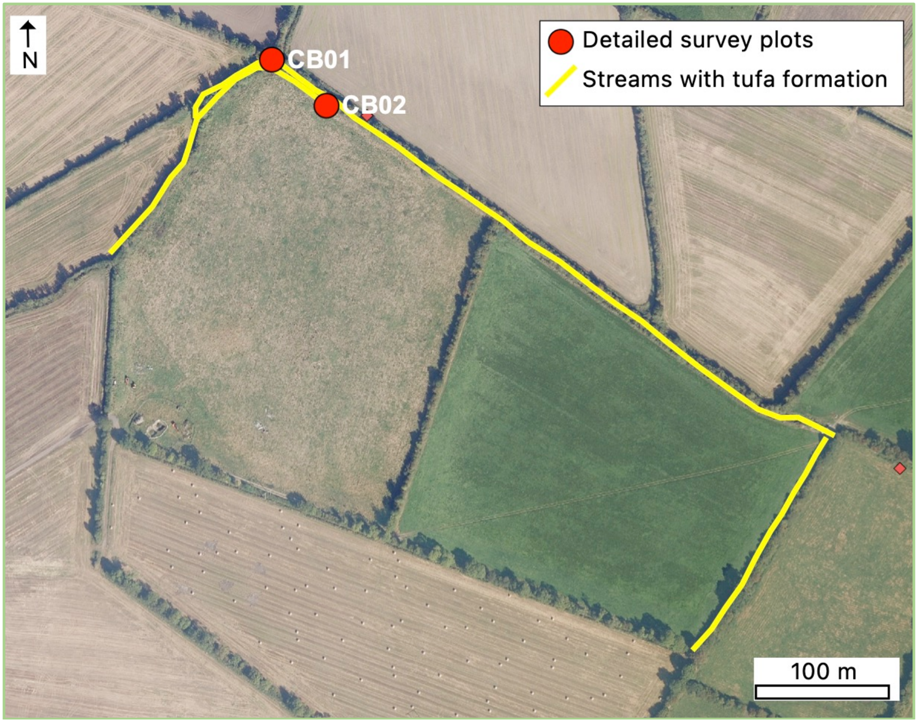
Today I visited the above site with Jerome Keohane (hydrogeologist) and undertook a petrifying spring survey. Petrifying springs with tufa formation (Cratoneurion) [*7220] are an EC Habitats Directive Annex I priority habitat.

Several small streams surrounding the site (Figure 1.1) were found to have a high pH and to support tufa formation as stream crust, paludal tufa, oncoids and ooids and cascade tufa. pH values of 8.30, 8.16 and 8.22 were recorded which is high for lowland streams. Cover of tufa ranged from absent to 90% of the stream bed. The streams had a good flow, despite the season and are highly likely to be largely groundwater fed. Positive indicator species for the Annex I priority habitat were rare. This is likely to be because the streams also act as drainage ditches and receive some surface water (and nutrients) from adjacent lands, increasing water depth at certain times of the year.

The surveyed streams with tufa deposition along some/ all of their length are shown in Figure 1.1.

Figure 1.1. Location of streams with tufa formation and detailed survey plots



RGB Aerial Photography - © Bluesky Geospatial Limited

Two detailed survey plots were undertaken following the methodology of Lyons and Kelly (2016) and Denyer (In press) (CB01 and CB02, Figure 1.1).

- CB01 had significant tufa formation (total 45% of cascade, stream crust and paludal tufa) but only one positive indicator species for *7220 habitat was recorded. Although this plot would not be considered a clear example of the *7220 habitat, it has high tufa formation and therefore has affinity to Annex I priority Petrifying spring habitat [*7220]
- CB02 had significant tufa formation (total 85% oncoids and ooids) and three positive indicator species for *7220 habitat were recorded. This section of stream is considered to be an example of Annex I priority Petrifying spring habitat [*7220]

The streams surrounding the site are groundwater fed and highly tufa producing. They are mostly lacking the species required to be clear examples of Annex I priority Petrifying spring habitat [*7220], but these species are present occasionally throughout the system.

A full report will be produced. Recommendations for the spring/ stream system include suitable measures to control surface water run-off from the site so that the groundwater in the spring/ stream system is not diluted, which would reduce it’s tufa forming capacity.

References:

Denyer, J. (In press) Guidelines for the Assessment of Annex I Priority Petrifying Springs in Ireland. *Irish Wildlife Manuals*, No. XXX. National Parks and Wildlife Service, Department of Housing, Local Government and Heritage, Ireland.

Lyons, M.D. & Kelly, D.L. (2016) Monitoring guidelines for the assessment of petrifying springs in Ireland. *Irish Wildlife Manuals*, No. 94. National Parks and Wildlife Service, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs, Ireland

Appendix 2

Water Monitoring Programme (including results to date)

Our Ref: 2219/JK/4888

Your Ref:

Date: 26th February 2021

IE CONSULTING
WATER-ENVIRONMENTAL-CIVIL

Attention: Seamus Boland CEO

Irish Rural Link
Moate Business Park,
Old Clara Road,
Moate,
Co. Westmeath.

Seamus,

Re: Clarification of Impact of Proposed Enabling works on Recommendations of IE Independent Hydrogeological and Hydrological Review-Proposed Coolnabacky Sub-station site

IE Consulting were engaged to undertake an independent review of hydrogeological and hydrological issues in regard to the proposed development of a Sub-Station at Coolnabacky, Timahoe, Co. Laois. A report was issued in January 2021 (DOCUMENT REF: IE2219_Report_4840) which included a number of recommendations for further investigation aimed at clarifying the conceptual ground model of the site, together with a more detailed assessment of the Tufa springs in proximity to the site.

It should be noted, that these recommendations do not suggest any deficiency in the information that was available to An Bord Pleanala in coming to a decision to approve the scheme, but rather, are aimed at developing a more complete understanding of the dynamics of the shallow perched groundwater environment on the site and its interaction with the Tufa springs which in turn discharge into a local watercourse.

We have been advised that ESB need to undertake some enabling works for the proposed development in advance of the main contract, and which may need to commence before the works outlined as part of our report can be commissioned. I understand that if this is the case, that ESB commits to undertaking the recommended studies in conjunction with or immediately following the enabling work.

I have reviewed the extent of the proposed enabling works, and am satisfied that progressing the proposed enabling works as planned, will not unduly impact/influence the recommended studies.

If you have any queries on our submission, please contact the undersigned

Yours Sincerely

Jer Keohane

Jer Keohane.

Director

For IE Consulting

JRP Integrated Engineering Ltd t/a IE Consulting
Registered Office: Innovation Centre, Green Road, Carlow R93 W248
Company Registration No. 519448
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Assessment of Tufa Springs

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Coolnabacky Sub-station site, Timahoe

March 2022

IE CONSULTING
WATER-ENVIRONMENTAL-CIVIL

Client: ESB Networks

Location: Coolnabacky Sub-station site, Timahoe

Date: 4th March 2022

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Appendix A	Hydrogeological and Hydrological Review (IE consulting, 2021)
Appendix B	Geophysical Survey (Minerex Geophysics Limited, 2021)
Appendix C	Borehole logs (Priority Geotechnitcal Ltd, 2021)
Appendix D	Onsite Raw Water Quality Data (2021)
Appendix E	Ecological Assessment Tufa Spring (Denyer Ecology, 2021)

1. Introduction

IE Consulting were appointed by ESB Networks to conduct an assessment of the Tufa springs and Tufa Deposits on and adjacent to the proposed ESB substation at Coolnabacky Co. Laois. The proposed substation is an element of a network improvement scheme for the Laois-Kilkenny Area.

1.1. Tufa (Petrifying) Springs

Petrifying springs (tufa springs) as described by Lyons and Kelly (2016), are springs with lime-rich water that deposit tufa (porous calcareous rock). This water is rich in carbon dioxide and calcium carbonate, resulting in a high pH environment with a constant source of water and precipitated calcium carbonate.

The tufa can also be deposited along outflow streams from the springs. The unique conditions of these springs means the flora and fauna that inhabit them are highly specialised.

Petrifying springs and the associated tufa are designated as a priority habitat under Annex I of the European Union Habitats Directive (92/43/EEC). This establishes that member states are obligated to monitor and report on the conservation status of these habitats. A significant condition within the Monitoring Guideline (Lyons and Kelly, 2016), in reference to tufa springs is that "in order to preserve this habitat of very limited expanse in the field it is essential to preserve its surroundings and whole hydrological system concerned."

Therefore it is important that any effect the proposed substation construction may have on the hydrogeological environment is considered in reference to these springs.

1.2. Summary of Hydrogeological Environment

The site is in a low lying, relatively flat area which becomes hummocky 150-200m south and west of the site. The location of the site is shown below in Figure 1.

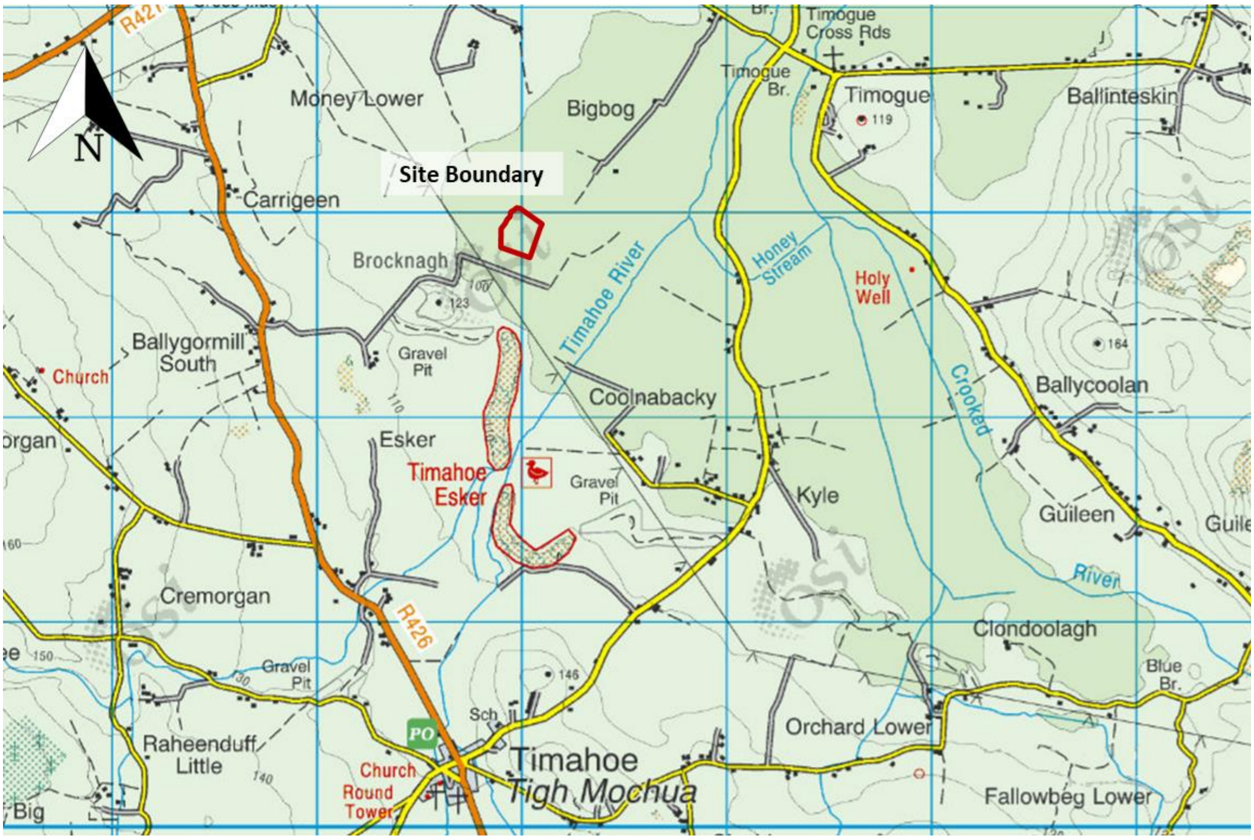

Figure 1: Location of site

The main surface water drainage feature in the area is the Timahoe River which flows 500m east of the site, which later becomes the Bauteoge River. The un-named stream that borders the site to the north eventually joins the Timahoe River. The majority of the surface water courses in the area are canalised or modified and there is extensive drainage in the low lying area. There are field drains on the western, eastern and southern borders of the Sub-station site.

The bedrock aquifer below the site is mapped as an Rkd (Regionally Important Aquifer – Karstified-diffuse). The GSI maps the area as being in a sand and gravel aquifer, but site specific studies have confirmed that the sand and gravel deposits on site do not comprise an aquifer (EIAR chapters 9 and 10, 2013; Tobins Report, 2007; SLR, 2018; IE Consulting, 2021).

The underlying bedrock geology of the site comprises limestone of the Ballyadams Formation which is described as thick bedded to massive wackestones and packstones (GSI, 2022). Subsoils consist of Alluvium under the site, with gravels derived from limestones mapped to the north, west, and south of the site (GSI, 2022). The GSI maps mineral alluvium as the soils beneath the site and shallow poorly drained mineral (manly basic) (BminSP) to the north, west, and south of the site (Teagasc, 2022).

For more detailed information on the hydrological and hydrogeological setting see Appendix A.

1.3. Recommendations for Tufa Study

In February 2021 IE consulting issued a hydrogeological report to assess the potential impact from the proposed substation on the hydrological and hydrogeological environment. This report made the following recommendations.

1. A geophysical survey using electromagnetic surveying to map the subsurface shallow deposits to better understand the subsoil profile and enhance the original ground model.
2. 5 No. shallow groundwater monitoring points be installed around the site locations away from the proposed footprint. These should be levelled to a common datum and groundwater levels measured every six hours using level transducers and this monitoring should continue over two seasons to help improve the understanding of groundwater hydraulics of the shallow deposits on the site and inform the further assessment of the tufa springs.
3. Groundwater samples should be taken from the shallow wells and analysed for Nitrate, Nitrite, Phosphorous, Ammonia, Chloride, Potassium and Sodium, Conductivity, pH. to provide a baseline for future monitoring. Future monitoring should continue twice a year for the same parameters. This will assist in the protection of tufa spring habitats as they are very sensitive to nutrient loading.
4. A more in depth ecological assessment of the tufa springs should be undertaken using the above data in the context of it being an Annex I habitat and following NPWS guidelines to enhance understanding of the tufa springs and their connectivity to the site.
5. Once items 1-4 are completed, the storm water management system should be reviewed to ensure the existing hydrological system is optimised to support the tufa springs as required under the habitats directive.
6. Once drilled, groundwater quality from the proposed supply well should be monitored twice per year.

1.4. Approach to study

This report is based on the review of the data and findings from the following:

- Hydrogeological and Hydrological Review (IE consulting, 2021)
- Geophysical Survey (Minerex Geophysics Limited, 2021)
- Borehole logs (Priority Geotechnical Ltd, 2021)
- Onsite Groundwater Level Data-undertaken by IE Consulting (2021-2022)

- Onsite Raw Water Quality Data from samples taken by IE Consulting (2021)
- Met Eireann Rainfall Teagasc, Oak Park Carlow (2021)
- Ecological Assessment Tufa Spring (Denyer Ecology, 2021)
- Monitoring Guidelines for the Assessment of Petrifying Springs in Ireland. Irish Wildlife Manual No. 94 NPWS (Lyons & Kelly, 2016)

2. Geophysical Survey

A geophysical survey comprising an EM31 ground conductivity survey was conducted by Minerex Geophysics Ltd. (MGX) on April 23rd 2021. The survey was undertaken to better understand the ground conditions beneath the site and along the access road, survey relative variations in subsoil and material type and to establish permeability and how it changes across the site. This survey technique penetrates up to 6m bgl.

Boreholes on the site show that bedrock is deeper than 6m and therefore all variation in conductivity is due to soil and subsoil. The boreholes and trial puts on the site indicated sandy, gravelly, clay and some sand or gravel lenses. This information was used to interpret changes in conductivity across the site.

Lower conductivities are typical of dry clean sands and gravels, while higher conductivities are typical of peats and clays. This in the context of the previously collected information on the subsoil helped with the interpretation of the variation in conductivity across the site.

The geophysical interpretation indicates that conductivity less than 5 mS/m represents clayey, silty Sand and Gravel, conductivity between 5 - 10 mS/m is sandy, gravelly Clay and Silt, and conductivity higher than 10 mS/m are for slightly sandy and slightly gravelly Clay and Silt. The permeability is highest in areas with low conductivity (more sand and gravel) and lowest in areas of high conductivity (higher clay and silt content).

The ground underlying the proposed substation site was found to be relatively homogenous (7-11 mS/m) while the access road shows larger variation, with sand and gravel occurring closest to the quarry. The substation site is mostly underlain by sandy and gravelly clay and silt with slightly gravelly clay and silt around the western and eastern edges of the field. There are patches with higher sand and gravel content (low conductivity) under the site, especially towards the north, with expected higher permeability.

These higher permeability sand and gravel rich lenses that were targeted for monitoring boreholes to be drilled.

Detailed results of the geophysical survey are presented in Appendix B. Figure 2 shows the relative variation in conductivity across the site.

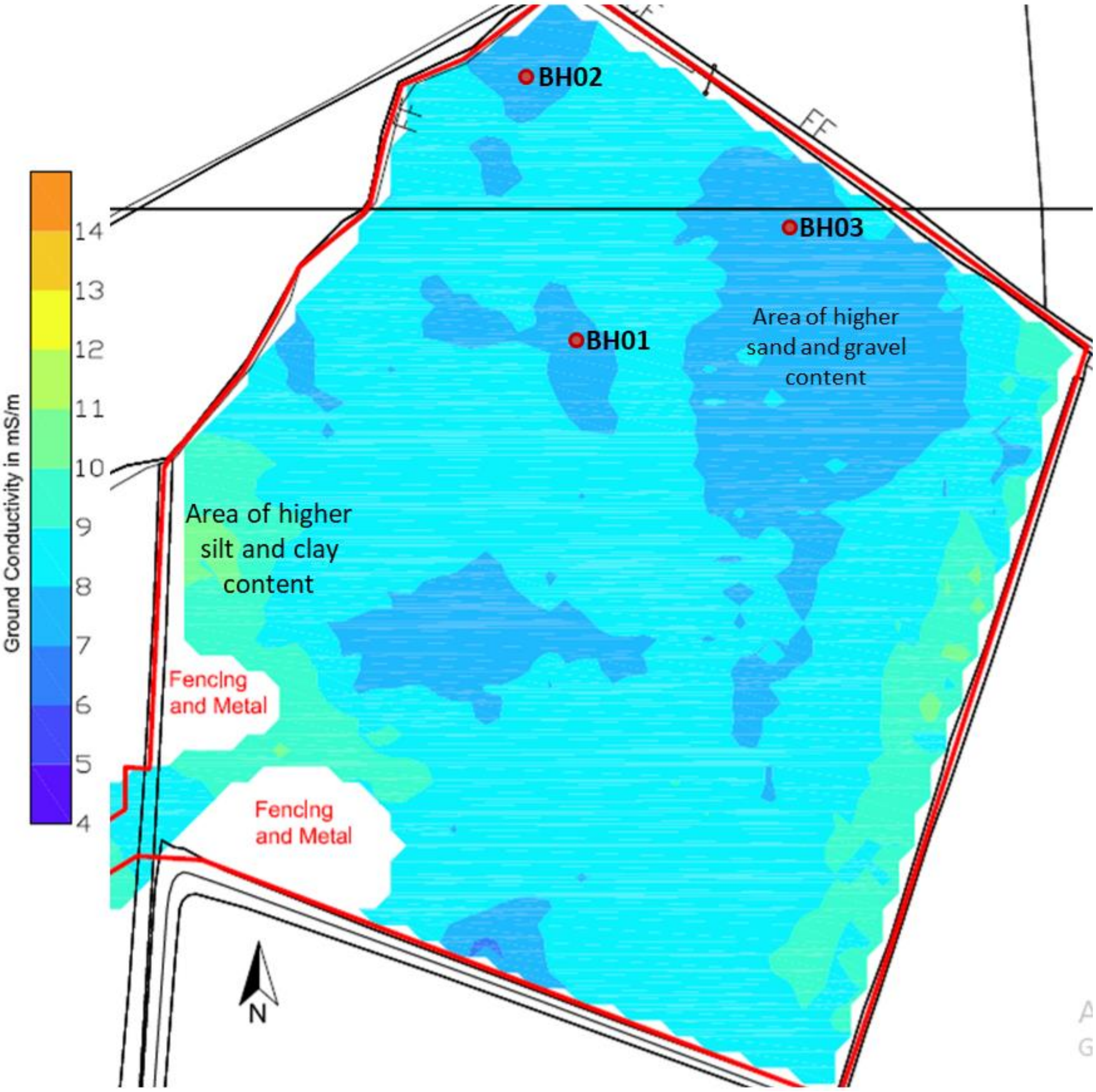

Figure 2: Conductivity variation across substation site (adapted from Minerex report, 2021)

3. Boreholes

Three Cable Percussion Boreholes were drilled on the site on 26/05/2021, each to a depth of 3m (BH1, BH2, BH3). There were a further two boreholes on the site from previous investigations, which were found to be usable to make up the required compliment of 5. The locations of the three new boreholes are shown above in Figure 4. A Bentonite seal was placed at the base of each borehole and from 0.3m to ground level to prevent ingress of surface water. Each borehole was fitted with a 50mm casing with a bottom cap, slotted up to 0.5m from ground level and surrounded by pea gravel.

All wells were described as having clay with cobble content to 1m bgl and gravel from 1-3m bgl. BH1 and BH2 were recorded as having dense gravel.

Figure 2 shows the location of these boreholes. Drilling logs for the boreholes are in Appendix C.

3.1. Water Level Monitoring

Water level monitoring was undertaken at all three wells using transducers from 24/06/2021 to 12/12/2021. All wells were levelled to common datum and water level was measured every six hours using water level recorder pressure transducers.

Water levels at BH1 ranged from 1.3442m depth (below top of casing) (08/12/21) to 0.39m depth (below top of casing). (27/10/21). At BH2 water levels ranged from 1.173m depth (below top of casing) (09/12/21) to 0.3404m depth (07/10/21) (below top of casing) . At BH3 water levels ranged from 0.8016m (below top of casing) (08/12/21) to 0.0625m (05/10/21).

Manual groundwater level readings were also taken by an IE Consulting hydrologist four times between August 2021 and January 2022. The reduced levels m.O.D are shown in Table 1. This data show a fluctuation of about 0.3m to 0.4 from dry period to a few weeks of rain. The reduced levels also confirms the groundwater gradient from southwest to northeast.

Table 1: Groundwater level as measured by IE Consulting Hydrologist (m.O.D)

BH	12-Aug-2021	15-Nov-2021	14-Dec-2021	6-Jan-2022
1	97.585	97.655	97.885	97.91
2	97.339	97.609	97.859	97.941*
3	96.624	96.564	96.904	96.984

* Borehole had collapsed

The water levels are lowest at well BH3 which shows a gradient towards BH3, from southwest to northeast. Figure 3 shows groundwater contours for the site. This would suggest that the source spring for the tufa deposits, is fed from off-site to the southwest.

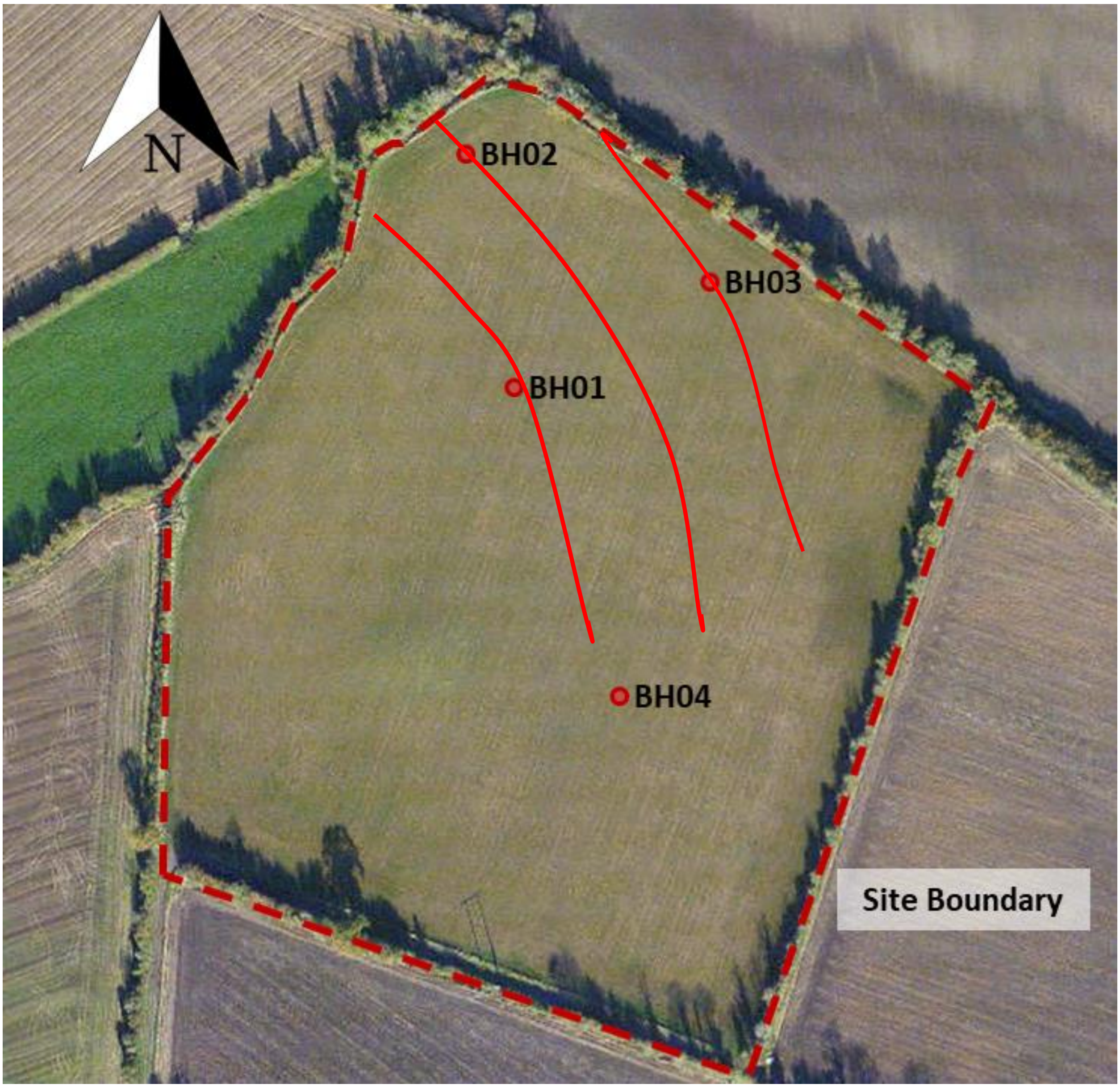

Figure 3: Groundwater contours for site

The long term transducer data was examined to understand how changes in rainfall effect changes in groundwater levels at the site. Met Eireann rainfall records from Teagasc, Oak Park, Carlow were used to investigate this relationship. Figure 4 below shows rainfall graphed against groundwater levels at each of the three boreholes. This data shows that water levels are closely connected to rainfall and rise after extensive rainfalls. The data shows a steady decline in water levels through the late summer into

Autumn, with sporadic increases associated with rainfall events. However, the expected low SMD (soil moisture deficit) and below average monthly rainfall for the three month period (July August and September), could not avert the downward trend. The above average (120% of LTA) rainfall from October, starts to overcome the positive SMD and perched groundwater levels start to rise.

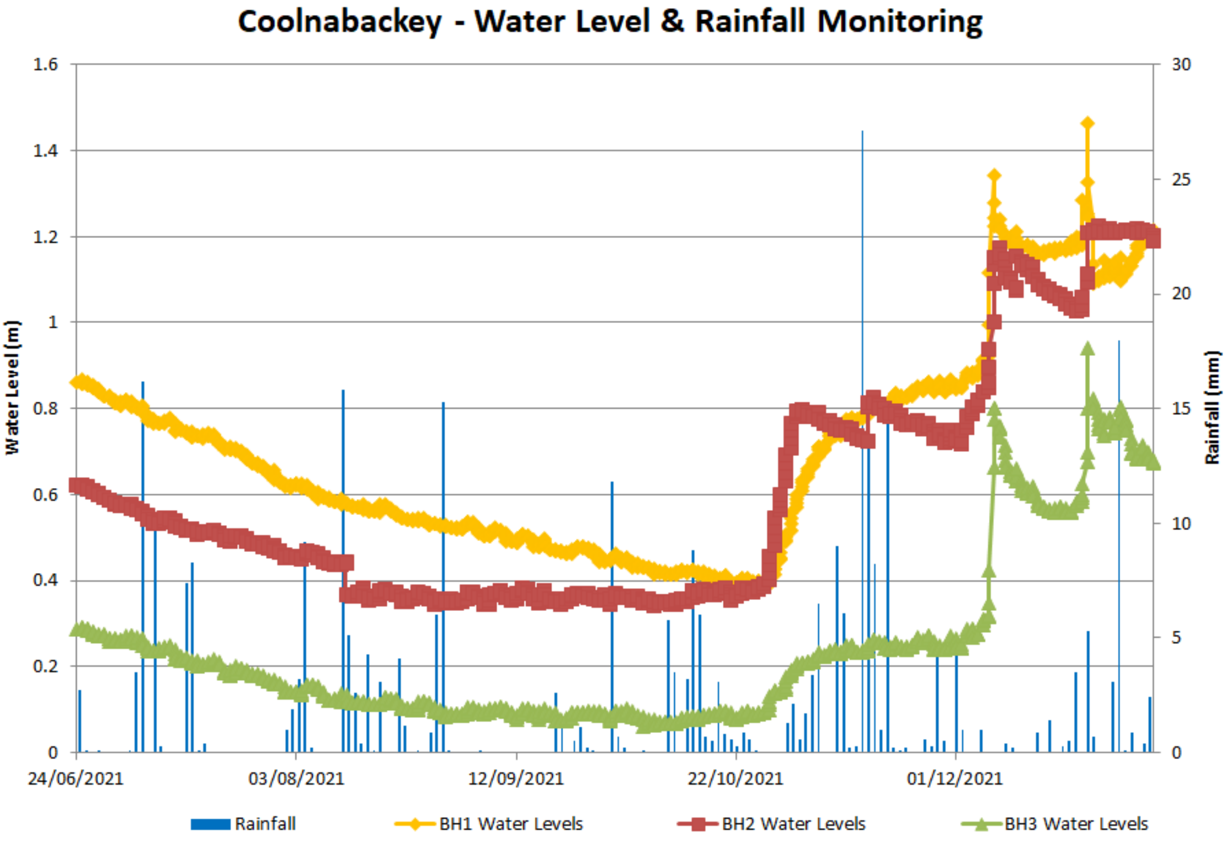

Figure 4: Variation in groundwater level and rainfall

Overall, the data shows a dynamic perched groundwater system, that has a definite groundwater gradient, with water levels that respond to sustained rainfall periods, that overcome the positive SMD.

3.2. Water Quality

Water quality was sampling was undertaken on 14/12/2021 by an IE Consulting hydrogeologist. Four groundwater wells across the site were sampled. In addition to the three drilled boreholes BH04 (drilled as part of a ground investigation by Causeway Geotech) was also sampled. The borehole is located further south than the other three. It is 9.5m deep and does not reach bedrock.

The location of the boreholes is shown below in Figure 5.

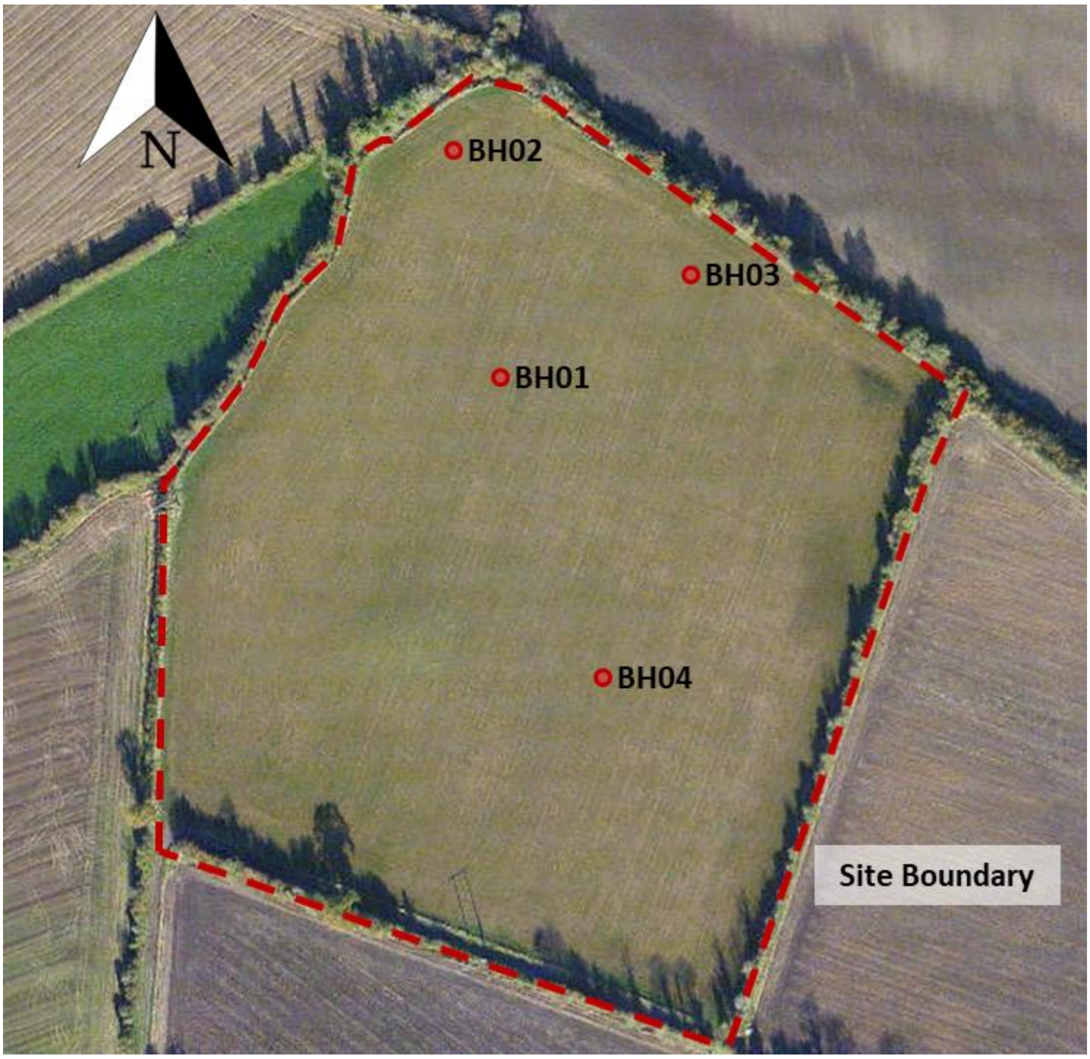

Figure 5: Location of sampling boreholes (OSi, 2022)

Data from the four wells was compared to:

- S. I. No. 366/2016 – European Union Environmental Objectives (Groundwater) (Amendment) Regulations 2016.
- EPA Guideline Values (EPA, 2003).

This is shown in Table 2 below.

pH is between 6.97 (BH03) and 7.72 (BH02). The reading from BH03 is considered to be anomalous when compared with the other values.

Electrical conductivity is generally indicative of good quality water, between 516 uS/cm (BH02) and 976 uS/cm (BH01) – only rising above the lower GTV in BH01. This may be due to a localised naturally elevated sulphate and sodium concentration, or a residual of borehole drilling.

Nitrate as NO_3 ranges from <0.2 mg/l (BH02, BH03, BH04) to 1.1 m/gl (BH01). These values are very low and safely below the EPA IGV (25 mg/l) and GTV (37.5 mg/l) and do not indicate any issues with excess nitrogen in the system.

Orthophosphate as PO4 ranges from <0.03 mg/l (BH02, BH03, BH04) to 0.04 mg/l (BH01). BH01 is the only well to rise above guideline values and breaches both the GTV (0.03 mg/l) and EPA IGV (0.035 mg/l). The slight exceedance at BH1 is an anomaly when compared to the other values and overall there is no indication of excess nutrients in the shallow groundwater environment that would impact the Tufa deposits.

Ammoniacal nitrogen as NH_4 ranges from 0.04 mg/l (BH02) to 0.36 mg/l (BH03). Well BH04 (0.12 mg/l) surpasses the GTV (0.084 mg/l) and BH03 (0.36 mg/l) surpasses the GTV and EPA IGV (0.15 mg/l). The occasional anomaly such as at BH4 would warrant further assessment with monitoring, but generally the values show no sign of organic contamination.

Chloride ranges from 3.7 mg/l (BH02) to 9.6 mg/l (BH04) in the wells. These values are generally low for groundwater and may suggest rapid throughput of rainfall and limited sources of contamination. This remains well below the GTV of 24 mg/l and EPA IGV of 30 mg/l.

Potassium is between 0.9 mg/l (BH04) and 1.2 mg/l (BH02). This is low and does not surpass the EPA IGV of 5 mg/l, again suggesting little impact from farmyard/agricultural activities.

Sodium ranges between 4.3 mg/l (BH02) and 14.9 (BH01). This is well below the EPA IGV of 150 mg/l.

Sodium Potassium ratio is less than 10:1, suggesting no influence from pollution sources such as septic tanks or farmyards

Calcium is between 191.9 mg/l (BH01) and 102.1 mg/l (BH02). These levels are elevated, but consistent with the limestone provenance of the subsoils, and supports some connectivity with the Tufa deposits along the adjoining stream

The data is good quality with low values of nutrients and significantly calcium mineralisation, suggestive of rapid throughput of rainfall recharge,

Table 2: Groundwater Quality Results

Groundwater Quality Data						
	S.I. 366/2016 (Groundwater)	EPA IGV 2003	**BH01**	**BH02**	**BH03**	**BH04**
Dissolved Calcium (mg/l)	-	200	191.9	102.1	114.5	111.2
Dissolved Magnesium (mg/l)	-	50	6.6	2.2	10.8	10.0
Dissolved Potassium (mg/l)	-	5	1.1	1.2	1.0	0.9
Dissolved Sodium (mg/l)	-	150	14.9	4.3	6.3	7.3
Sulphate as SO4 (mg/l)	187.5	200	245.0	4.2	6.7	13.3
Chloride (mg/l)	24	30	6.9	3.7	6.0	9.6
Nitrate as NO3 (mg/l)	37.5	25	1.1	<0.2	<0.2	<0.2
Orthophosphate as PO4 (mg/l)	0.035	0.03	0.04	<0.03	<0.03	<0.03
Ammoniacal Nitrogen as NH4 (mg/l)	0.084	0.15	0.06	0.04	0.36	0.12
Dissolved Alkalinity as CaCO3 (mg/l)	-	-	-	-	372	-
Total Alkalinity CaCO3 (mg/l)	-	-	846	3050	17580	2922
Electrical conductivity @25C (uS/cm)	800-1875	1000	976	516	638	629
pH		≥ 6.5 and ≤ 9.5	7.71	7.72	6.97	7.65

4. Ecologists Report

On 24/06/2021 Ecologist Dr Joanne Denyer of Denyer Ecology visited the site with an IE Consulting hydrogeologist and undertook a survey of the petrifying springs.

The survey examined several small streams Figure 6 around the site that had good flow, even in a dry season, and are likely groundwater fed.

They were found to have high pH (8.30, 8.16, 8.22). These streams were also found to support tufa formations which varied (stream crust, paludal tufa, oncoids, ooids, and cascade tufa). The cover of tufa ranged from absent to covering 90% of the stream bed.

Images of tufa cover on stream base

There were few positive indicator species for the Annex I priority habitat. This is likely because the streams also act as drainage ditches for surrounding fields and receive surface water and contaminants from adjacent fields which changes water depth and chemistry during the year.

Following the methodology of Lyons and Kelly (2016) and Denyer (In press) two survey plots were undertaken. The first (CB01) had significant tufa formation and only one positive indicator species and is therefore only considered to have affinity to Annex I priority Petrifying spring habitat. The second (CB02) had significant tufa formation and three positive indicator species, therefore this section of the stream is considered an example of an Annex I priority Petrifying spring habitat. This section is wholly on ESB lands, and exits the site, via a gap in the boundary ditch, joining the larger stream as indicated in the image above (yellow box) about 40 m along the ditch from the corner of the field.

In summary the streams around the site are groundwater fed and tufa producing but mostly lack the species needed to be a clear example of an Annex I priority petrifying spring habitat. The ecological report recommends suitable measures are employed to reduce surface water run-off from the site so that the streams are not diluted.

For more detailed results of the ecological assessment see Appendix E.

Figure 6: Streams with tufa formation and location of survey sites (adapted from Denyer, 2021)

5. Conclusions

This report results in the following conclusions:

- The site is in a low lying flat area with a natural stream on the north border and small drains on the western, eastern and southern borders. Some of these bordering water bodies have tufa deposits.
- The site is located over a regionally important bedrock aquifer (Karstified - diffuse).
- A geophysical survey on the site confirmed the ground underlying the substation was relatively homogenous, mostly underlain by sandy and gravelly clay and silt with slightly gravelly clay.
- No bedrock was indicated on the geophysical survey to a depth of 6m, and boreholes have confirmed no bedrock to depths of 9m below ground level.
- Three boreholes were drilled in sand and gravel rich lenses, meeting stiff boulder clay at 3m depth.
- There is a shallow perched aquifer, which is hydraulically isolated from the underlying bedrock aquifer, and this forms the source waters for Tufa formation on the site.
- Water level monitoring over the course of 6 months showed a groundwater gradient from southwest to northeast. It also showed water levels are closely connected to rainfall and rise after extensive periods of rainfall, when any positive soil moisture deficit is overcome.
- If the groundwater flow direction is consistent off-site, then the tufa deposits on the site are probably recharged from lands to the southwest, beyond the sub-station site.
- It is suspected that the drains around all four sides of the site, will have intercepted a significant portion of any incoming shallow groundwater flow, so the opportunity for the groundwater on the site to become highly mineralised on the site is not available.
- Water quality monitoring was undertaken at four boreholes. Overall water quality was good.
- Although there are some unexplained anomalies, the general overview is of groundwater on the site mineralised with calcium, and with very low nutrient concentrations, which will be supportive of the tufa deposits.
- The Ecologist report mapped streams with tufa deposits on the western and northern border of the site.
- Two survey plots along the streams found these streams to be groundwater fed and tufa producing, but mostly lacking in species needed to be a clear example of an Annex I priority petrifying spring habitat.

- It is more likely that the closest tufa spring CB01 is fed from ground to the west of the site, whereas CB02 does probably receive some groundwater feed from the site via the nearby spring.
- CB02 flows inside the site boundary for most of its course, exiting the site through a gap in the boundary ditch, to join the larger stream that skirts the northern boundary of the site.

6. Recommendations

The tufa streams surrounding the site do not qualify as a clear example of an Annex I priority petrifying spring habitat apart from CB02. However these streams should still be protected to prevent further degradation. The following are recommendations from the conclusions of this report.

- Suitable measures should be employed to reduce surface water run-off from the site to prevent dilution of the streams upstream of the identified Tufa sites.
- There should be no outfalls of surface water from the site into the drains west and north (as far as the point where the tufa stream joins the main stream 40m from the corner of the field). The outfalls should be to the main stream beyond this point.
- Groundwater monitoring should continue at the site to ensure there is no excessive nutrient loading, this should also occur at the proposed supply well twice a year.
- Surface water samples should be taken from each of the side streams and from the main stream and analysed for the same parameters as groundwater samples.
- A further assessment should be undertaken by the ecologist to advise on further management of the habitat.

Appendix A

Hydrogeological and Hydrological Review

Hydrogeological and Hydrological Review

Proposed Coolnabacky Sub-station site Timahoe




February 2021

IE CONSULTING
WATER-ENVIRONMENTAL-CIVIL

Hydrogeological and Hydrological Review

Location: Proposed Coolnabacky Sub-station site, Timahoe

Date: 16th February 2021

Document Control

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1. INTRODUCTION

IE Consulting were engaged to conduct an independent audit of the process undertaken (during planning) to assess the potential impact on the hydrological and hydrogeological environment from the proposed construction of a substation at Coolnabacky, near Timahoe, Co. Laois. The Substation is an element of an overall network improvement scheme for the Laois-Kilkenny Area.

IE Consulting were invited by Irish Rural Link to submit a Tender for the following brief

The scope for the independent review for Coolnabacky (also known as Laois-Kilkenny) would broadly involve reviewing the planning documentation, in particular:

- *To review scheme as planned from a hydrological/ hydrogeologic risk point of view*
- *Review of relevant planning information*
- *Recommendations on any gaps in the scheme as planned (e.g. Bunding arrangements, dealing with contaminated runoff, flooding risk etc.)*
- *Comment on whether the scheme is in line with best international practice*
- *Assessment of risk to aquifer*
- *Additional areas to focus on or any further pre-construction site investigations etc.*
- *Provide information of site specific mitigation measures for construction stage*

The main issues of concern are the potential risks to the groundwater water supply.

Irish Rural Link, requested that IE Consulting confirm that they had not undertaken work for Eirgrid or ESB in the recent past or in any way connected to the proposed scheme. This we were happy to confirm.

Irish Rural Link also stressed that IE should confirm that the audit was independent and not influenced in any way by Eirgrid or ESB. This we are happy to confirm.

2. APPROACH TO STUDY

This report is based on a review of the following;

- Documents at the public link: http://eirgridlaoiskilkenny.ie/environmental.html
- A review of the information provided on the An Bord Pleanala website, when a search for VA0015 was made http://www.pleanala.ie/search/index.php?q=va0015&case_scope=all&include_reports_etc=0
- Eirgrid and ESB reports and drawings-provided on request.
- Assessment reports By SLR and Tobins associated with the unauthorised development in
- 2017 Tobins report (Report to assess the impact of the unauthorized development on the Aquifer at Coolnabacky Construction site) 2017
- 2018 SLR Hydrogeological assessment of excavations for the construction of a substation prepared for: Eirgrid SLR Ref: 180720 00357 00004
- GSI 2000- Kyle & Orchard Springs Source Protection report
- GSI 2018 assessment and response to RTS presentation to Minister Naughten
- GSI public viewer maps
- Site walk-over visit under taken by J Keohane on 18th December 2020
- Lyons & Kelly 2016 Monitoring Guidelines for the Assessment of Petrifying Springs in Ireland. Irish Wildlife Manual No. 94 NPWS
- ESBI site drainage report PE687-F0261-R261-016 which included Traynor Environmental Site suitability assessment 2012
- 2012 Soil Mechanics Report No Y2012-12A factual report on ground investigation.

3. TOPOGRAPHY AND SURFACE WATER DRAINAGE

The site lies in a low lying, mostly flat area which extends to the east and north of the site. The surrounding land to the south and west becomes hummocky within 150m to 200m of the site. The geomorphology appears to be glacio-fluvial in origin.

The main surface water drainage feature in the area is the Timahoe River which flows in an approximately northerly direction 500m east of the site. The Timahoe River in turn joins the Honey Stream which flows in from the east and the combined flow becomes the Bauteoge River.

The watercourses in the area appear to have been modified and canalised in places, and arterial drainage has been used to improve the land and direct run-off towards the streams and rivers.

A natural unnamed watercourse skirts the northern boundary of the site, and there are also drains along the western southern and eastern boundaries of the site which were noted to be carrying some flow on the day of the site visit. The perimeter drains are typically 1.0m to 1.5m deep, and seem mainly to run to the North towards the stream.

Apart from occasional water logging after heavy rain, I am satisfied that there is no evidence of a flood risk to site from fluvial or groundwater sources. The modified drainage network in the area, does appear to work efficiently to remove water from the land.

There is surface water hydraulic connectivity between the site and an SAC (The River Barrow and River Nore SAC site code 002162), and I am satisfied that this has been adequately considered through the EIAR and consideration by the An Bord Pleanala Inspector.

I am satisfied that the proposed safeguards for surface water quality management during construction and the operational phase surface water management approach for managing run-off from paved and covered areas for the proposed development is robust. Any new information arising out of the recommended further works detailed below or the construction works when they commence should be reviewed, in the context of surface water management to ensure ultimate protection for water resources.

4. GROUNDWATER

An Bord Pleanala has approved the proposed development after an oral hearing and review of documentation. The Inspectors report (11.VA0015) states that "It appears that the substation at Coolnabacky can be constructed without undue risk to local groundwater sources. The development could be carried out and operated satisfactorily from an ecological standpoint". I have considered this decision in the context of both bedrock and shallow aquifers.

4.1 Bedrock Aquifer

I do agree that there is no significant risk posed by the development to the Kyle spring, because of the following factors

- Significant consistent thickness (8m approx.) of low permeability cohesive subsoil overlying the rock aquifer. This effectively isolates any on-site activities from the bedrock aquifer, since there will be no excavations deeper than 2m. I am satisfied that site tests have demonstrated very low permeability for this Clay material.

- The GSI source protection report (2000- Kyle & Orchard Springs Source Protection report) concludes that the Kyle Spring is generically a bedrock derived spring, (although the output may flow through overlying gravel for a short period).
- There is no groundwater pathway linking the site and the spring.
- The site is outside of the mapped source protection zone, eventhough the GSI report does state that that some groundwater may pass beneath the Timahoe/Bauteoge River through bedrock en route to the Kyle Spring.
- There is no hydraulic connectivity between the surface water features in the area and the Kyle Spring since all surface water from the site ultimately enters the Timahoe River System and the GSI report (2000- Kyle & Orchard Springs Source Protection report) states that surface water features are hydraulically isolated from the bedrock Aquifer.

4.2 Sand and Gravel Aquifer

The GSI have mapped a locally important Sand and Gravel Aquifer (Timahoe-Stradbally Aquifer) in the area, which includes the site. The GSI have stated in their review (response 2018) that work is in progress on better defining the boundaries and characteristics of this aquifer as part of the Groundwater 3D project.

I understand that the information available to the Hydrogeology Team preparing the EIS in 2013, suggested that the site was outside of the mapped Sand and Gravel aquifer area at the time. The Inspectors report confirms and accepts this. The fact that this has been changed by and is under further review by the GSI does warrant some scrutiny.

The 2017 Tobins report (Report to assess the impact of the unauthorized development on the Aquifer at Coolnabacky Construction site) prepared for ESB acknowledges this boundary change but argues that "*no significant saturated sand and gravel deposit was encountered in the vicinity of the sub-station site*".

This is consistent with the 2018 report by SLR (Hydrogeological assessment of excavations for the construction of a substation) prepared for Eirgrid which states:

> *“the site investigation showed that granular sand and gravel deposits at the site are very thin, laterally impersistent and contain limited groundwater; they are not therefore a significant groundwater source or aquifer. This conclusion is supported by GSI advice that states that gravel deposits must exceed 10m to be considered an aquifer. The subsoils at the site are not classified as an aquifer or a groundwater body due to their low permeability characteristics, shown to be typical of silt. This reflects the description of the subsoils as granular gravelly clay / clayey sand and gravel deposits and cohesive stiff – very stiff gravelly clay deposits”. “The site investigations at the site have shown that there is no gravel aquifer (i.e. sands and gravels to a thickness exceeding 10m) at the site.*
>
> *Therefore, the shallow water ingress encountered in the subsoils at the site is representative of pore water or isolated pockets of groundwater that are not connected to the bedrock aquifer”.*

The GSI (GSI www.gsi.ie) does indeed state that the sand and gravel deposit must be 10m in thickness to be considered an aquifer. I therefore expect, based on this observation, that the GSI will not include this site within a revised sand and gravel aquifer boundary.

Apart from the thickness constraint which appears to be definitive, the EIAR (Chapters 9 and 10 2013) presents a number of other pieces of evidence to state why the sand and gravel deposits on the site do not comprise an aquifer.

> *The sand and gravel deposits at the site not found to be saturated during the site investigation of 2012.*
>
> *In most cases, groundwater strikes were not recorded in the Sand and Gravel deposits.*
>
> *It is noted that, due to the presence of low permeability Clay deposits beneath the sand and gravel, the inflow volumes of groundwater encountered during drilling was minimal.*
>
> *As the sand and gravel was not saturated, this indicates that the quantities of groundwater present are not significant.*
>
> *During a subsequent intrusive site investigation carried out by AWN Consulting in 2013, 4 no. boreholes were installed around the boundary of the site, up gradient and down gradient of the*

> *predicted groundwater flow direction. (Appendix 10.1 Site Investigation and Hydrogeological report).*
>
> *The ground conditions consisted of soft to stiff sandy gravelly Clay and silty sandy Clay to approximately 3m bgl. At approximately 3m bgl, low permeability stiff to firm boulder Clay was encountered. At borehole BH4 Boulder Clay was found to extend to 8.6m bgl when returns were of angular rock suggesting boulders or bedrock.*
>
> *No fast inflow groundwater strikes were recorded during the site investigation.*
>
> *Data loggers were installed to record the static groundwater levels at hourly intervals. Based on data, to date the groundwater level at the site is typically less than c.1m bgl. (See Appendix 10.1 for more detailed information)*
>
> *Permeability tests carried out at each groundwater monitoring well (borehole) indicate that the hydraulic conductivity is typical of silt and clay soils.*
>
> *Therefore, the water present in the deposits represents pore water, rather than groundwater. The Sand and Gravel deposits at the centre of the site which would be expected to have a higher permeability were also found to be unsaturated.*

The 2018 SLR report suggests based on this information

> *"therefore, the shallow groundwater present in the subsoils represents pore water or isolated pockets of groundwater, rather than a groundwater resource, as defined by the EPA. It may not be feasible to define a water table in the subsoils as lateral movement is impeded, and so a shallow water table is not shown on the Conceptual Site Model. Should there be any flow in the granular subsoils, this flow is expected to follow the topography to the south east."*

I have reviewed the site investigation undertaken in February-March 2012. I examined the borehole and trial pit logs, which indicates reasonably consistent ground conditions across the site, comprising topsoil of approximately 300mm underlain by upto 1.9m of varying grades of granular material, which is described as Alluvium on the GSI maps. Alluvium because it is deposited by rivers (in this case probably glacial outwash rivers), often tends to be haphazard in a lateral sense.

It is accepted that the four groundwater monitoring borehole logs (from the 2013 investigation) show no granular material. However it does appear anomalous that these four boreholes around the periphery of the site encountered no granular material, and the boreholes and trial pits excavated in the middle of the site as part of a previous investigation phase did. The possible reasons for this anomaly may be of glacial origin and therefore natural, or may be related to a variation in the drilling methodology deployed in each phase. I am recommending that further investigation is undertaken to confirm the original findings. It is suggested that a geophysical survey would be the most appropriate approach to clarifying this anomaly.

I note that groundwater strikes were recorded in 8 out of 10 boreholes in 2012. In most cases no inflows were recorded, but the mode of drilling (Shell and Auger) can effectively seal out the water with casing, particularly when the granular interval is thin, thus giving the impression of no inflows.

I consider that because the method of drilling can quickly case out water, the trial pits give a better view of shallow groundwater conditions as follows

TRIAL PIT	GROUNDWATER OBSERVATIONS
S1	ROSE
S2	NONE
S3	STEADY INFLOW
1	SLIGHT SEEPAGE
2	STEADY INFLOW
3	NONE
4	NONE
5	STEADY INFLOW
6	NONE
7	STRUCK
8	STRUCK
9	SLOW TRICKLE
10	QUICK INFLOW
11	BASE OF PIT FILLED
12	NONE

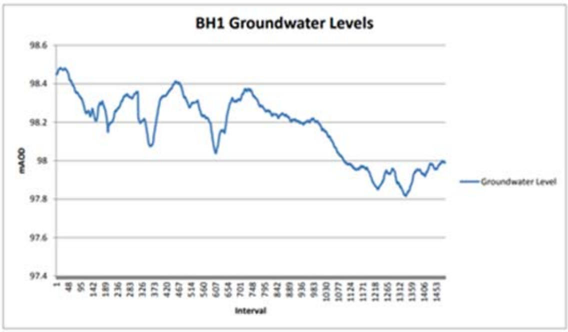
I would suggest that these observations suggest some groundwater activity.

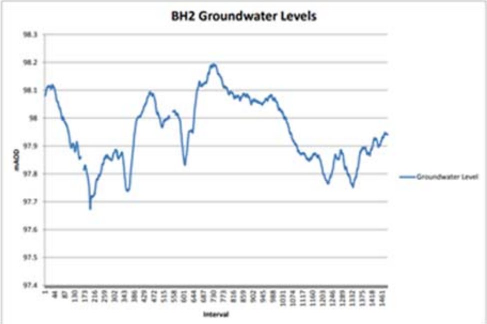
It is accepted that the borehole logs from 2013 indicate that no groundwater was encountered. However it is noted that February and March 2013, and indeed the same months in the previous year (2012) were dry months. I suspect that the Sands and Gravels on this site are actually quite free draining, and drain quite readily when there is little to no rain. The hydraulic controlling horizon is the stiff low permeability CLAY layer at 1.5m to 3m depth, which does not allow any vertical percolation.

I note the comments made by GSI in their review of the RTS presentation which highlighted the connection between the dry period and the lack of groundwater, but I suggest that conditions on this site comprise relatively free draining material close the surface, which is readily recharged by incident rainfall, but drains away quickly. The mainly dry condition of the field on the day of my site visit, with only minor water logging supports this view.

It is noted that the site assessment undertaken by Traynor Environmental (2012) noted T values and P of 16 and 29 respectively, which indicates excellent percolation. However it is also noted that the soakaway tests did not indicate available infiltration capacity for soakaways.

The 2013 boreholes were fitted with standpipes to allow groundwater levels to be measured. It is stated in the EIAR report that the boreholes were fitted with data logger water level transducers. I examined the data in appendix 10.1 and I noted that the boreholes were instrumented for June and July 2013. Data for BH4 was not presented, but plots for boreholes 1-3 do seem to indicate some fluctuations in groundwater levels as shown below and in fact BH1 and BH2 display very similar patterns. I am surprised that no comment was made on this in the EIAR, although it does have more significance in the context of the hydrological system supporting the Tufa Springs than any significance in the overall impact assessment on drinking water supplies.





I therefore do not fully agree with the conclusion, that the Sands and Gravels on the site are not active in the groundwater sense because;

- The T and P tests indicate permeable deposits
- The groundwater monitoring undertaken indicates fluctuations in groundwater levels, albeit in the small range.
- The relatively dry topsoil layer suggests that incident rainfall does percolate into the sand and gravel layer

I expect that there will be a gradient towards the un-named watercourse to the north east, with some lateral movement to drains. I suspect that the groundwater throughput has some influence on the tufa springs, and I have recommended that further work is undertaken on this to understand it better.

Despite this anomaly, my conclusion is that the sands and gravels on this site, are not substantially hydraulically connected with the Locally Important Sand and Gravel aquifer, for the following reasons.
1. The deposits are thin and underlain by an impermeable layer and
2. The perimeter drains and the permanent watercourse effectively intercept any flow.

The potential risk of impacts on groundwater resources beyond the site are therefore not considered significant, as a result of this lack of connectivity.

However I do feel that the groundwater from the site does have some influence/connection with the Tufa formations. Petrifying springs are lime-rich water sources that deposit tufa, a porous calcareous rock. They constitute a specialised habitat with a distinctive flora, typically dominated by bryophytes and often containing rare species. Their small extent and their vulnerability are recognised by their designation as a priority habitat in Annex I of the European Union Habitats Directive (92/43/EEC); whereby member states are obliged to monitor and report on the conservation status of such annexed habitats.

5. PETRIFYING SPRINGS-with TUFA FORMATION

The Tufa Springs were mentioned in the An Bord Pleanala Inspectors report which notes that an observer to the Oral hearing stated that a screening of these should have been undertaken in the context of the habitats directive on the basis of petrifying springs being designated a priority habitat under Annex 1 of the habitats directive. The Inspector did not agree with the argument and I fully concur with the conclusion of the Inspector, but nonetheless, I do feel that a more in depth assessment of the springs should be undertaken in the context that groundwater from the site, may have some influence on them as discussed above. This recommendation does not suggest any lacunae in the EIAR or NIS, that would have influenced the overall decision, but is a recommendation that ESB adopts an enhanced awareness of the connectivity of the site with a priory habitat.

Member states are required to monitor and report on the conservation status of such annexed habitats. An important stipulation within the habitats directive manual (Lyons and Kelly 2016) when referring to Petrifying Springs is that " in order to preserve this habitat of very limited expanse in the field it is essential to preserve its surroundings and whole hydrological system concerned" . The presence of Tufa deposits in close proximity (along the watercourse that forms the northern boundary) to the site, and their dependence on the hydrological conditions on the site, suggests that there is a requirement to better understand the interrelationship between the site conditions and the deposits. The 2016 NPWS publication "monitoring guidelines for the protection of petrifying springs in Ireland" should be referred to for guidance.

6. PROPOSED CONSTRUCTION AND OPERATIONAL CONTROLS TO PROTECT GROUNDWATER AND SURFACE WATER

The proposed mitigation measures for dealing with potential impacts to groundwater and surface water are best international practice, provided they are adhered to and overseen and signed off by a competent person during construction.

One of the key concerns (expressed by the RTS group) relates to the storage and use of oil in the proposed transformers. I am satisfied that the proposed infrastructure and operational protocols afford the optimum security for the prevention of loss to the environment. No absolute guarantees can be provided that there will never be accidental loss of oil to the environment.

In the event of any environmental incident the ESB Networks Emergency Response Procedure will be activated.

For minor spillages that enter the drainage network, the oil water separator will provide an adequate mitigation control measure.

For other spillages, on the basis of the proposed site topography, it is expected the oil will be easy to control on the site, and an appropriate remediation strategy would involve recovery and disposal of any free product, and appropriate disposal of any oil contaminated soil, backed up by validation sampling and analysis.

If some oil were to run across the surface or become mobilised in the shallow groundwater, it will migrate towards the surrounding drainage ditches approximately 40m from the nearest proposed transformer, and ultimately the natural Stream and surface water network. Again, appropriate oil remediation strategies will limit any environmental damage. I am satisfied that any loss of oil on the site will not present a significant risk to the either the Bedrock or Sand and Gravel aquifers and as a result the proposed use of oil on the site, does not present a significant risk to any drinking water supplies.

Dewatering may be required for foundations, but inflows are expected to be manageable and will not create any lasting impacts.

7. CONCLUSIONS

- I am satisfied that the proposed development does not present a significant risk to drinking water sources in the area.
- I am satisfied that adequate controls have been proposed to mitigate any potential accidental spillages or discharges, and to ensure that the proposed site development does not present any on-going impacts.
- The substantial thickness of low permeability CLAY on the site eliminates any significant pathway developing to the bedrock aquifer, and hence the Kyle spring.
- The shallow depth of the sand and gravels on the site and the fact that they are effectively intercepted by drainage ditches, means they are not hydraulically connected to off-site sand and gravel deposits.
- The sands and gravels on this site cannot be considered an aquifer and are not considered to be more widely connected to the mapped Sand and Gravel Aquifer.
- I suspect the GSI will not include the site in the Locally Important Aquifer when they consider the boundary of the Timahoe-Stradbally Sand and Gravel Aquifer.
- I am not convinced that the lateral extent and hydraulic properties of the granular material above the CLAY is fully understood and I am therefore recommending further investigation to better understand the dynamics.
- The information from this investigation, should be reviewed by the site drainage designers to ensure full compatibility with the proposed design approach to surface water management.

- I consider that the petrifying springs-tufa deposits are not fully understood, in the context of their dependence on site hydrology and hydrogeology, and in the context that the Sands and Gravels on site may be more active than previously understood. This warrants further investigation.

8. RECOMMENDATIONS

1. I would recommend that a geophysical survey is undertaken using electromagnetic surveying (such as EM31) to map the subsurface shallow deposits to better understand the subsoil profile and to enhance the original ground model.
2. I would recommend that 5 No. shallow groundwater monitoring points are installed around the site at locations away from the proposed footprint. These can comprise simple standpipes installed in trial pits, or shallow drilled boreholes to maximum 3m depth away from the building footprint or any areas where accommodation works are planned. These should be levelled to a common datum, and groundwater levels measured every six hours using water level transducers. This monitoring period should extend over two seasons at least ideally from the Winter period into Spring until construction of the substation proper commences. This will help to better understand the groundwater hydraulics of the shallow deposits on the site and inform the further assessment of the Tufa Springs.
3. A round of groundwater samples should be taken from the shallow wells and analysed for Nitrate, Nitrite, Phosphorous, Ammonia, Chloride, Potassium and Sodium, Conductivity, pH. This will provide a baseline for any future monitoring. The wells should be sampled twice per year, for the same range of parameters. The tufa springs are very sensitive to nutrient loading, and this monitoring will provide information to assist in the protection of the habitat.
4. A more in depth ecological assessment of the tufa springs should be undertaken in the context of it being an Annex 1 habitat using the above data, and following the NPWS guidelines. This will enhance the understanding of the tufa springs and their connectivity to the site.
5. Once items 1-4 are completed I would recommend that the design of the stormwater management system be reviewed in the context of ensuring the existing hydrological system is optimised to support the tufa springs as required under the habitats directive.
6. Once drilled, groundwater quality from the proposed supply well should be monitored twice per year.

Appendix B

Geophysical Survey

Proposed Substation
Coolnabacky, Co. Laois

Geophysical Survey

Report Status: Draft

MGX Project Number: 6555

MGX File Ref: 6555d-005.doc

30th April 2021

Confidential Report To:

ESB Networks Projects Delivery
Two Gateway
East Wall Road
Dublin 3
D03 A995

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: Hartmut Krahn (Senior Geophysicist)

Reviewer: John Connaughton (Geophysicist)

Minerex
Geophysics Limited

Subsurface Geophysical Investigations

EXECUTIVE SUMMARY

1. Minerex Geophysics Ltd. (MGX) carried out a geophysical survey consisting of EM31 Ground Conductivity surveying for the ground investigation for the proposed ESB substation at Coolnabacky, Co. Laois.
2. The main objectives of the survey were to determine ground conditions under the substation site and access road, to determine relative variations in subsoils and material type, to establish relative permeability and areas of higher and lower permeability.
3. Ground conductivities were measured and displayed on maps.
4. The interpretation shows that the subsoils vary in the material content between clayey silty Sand and Gravel (lowest conductivities) and slightly sandy and slightly gravelly Clay and Silt (highest conductivities).
5. At the substation site is has been shown that the ground is quite homogeneous with measurements representing a small change in overburden material between sandy and gravelly Clay and Silt and slightly sandy and slightly gravelly Clay and Silt.
6. The access road shows a larger variations of materials with Sand and Gravel occurring closest to the quarry.
7. The lowest ground water permeabilities occur at the highest conductivity values because the clay and silt content is highest here. The highest permeabilities occur where the conductivities are lowest because there the subsoils have the largest amount of Sand and Gravel.

CONTENTS

List of Tables, Maps and Figures:

1. INTRODUCTION

1.1 Background

Minerex Geophysics Ltd. (MGX) carried out a geophysical survey for the proposed ESB substation at Coolnabacky, Co. Laois. The survey consisted of EM31 ground conductivity measurements. The survey was requested by ESB based on recommendations of their hydrogeological consultant.

1.2 Objectives

The main objectives of the geophysical survey were:

- Determine the ground conductivities under the substation site and access road
- Map shallow subsoils to determine lateral variations and relative type (clay/silt or sand/gravel)
- Determine relative permeability of the subsoils
- Identify zones with higher and lower intergranular permeability

1.3 Geology

The online bedrock geological map of Ireland (GSI, 2021) indicates that the survey area is underlain by the Ballyadams Formation described as crinoidal wackestone/packstone limestone. The quaternary sediments are described as alluvium under the substation site and as gravels along the access road.

A previous geotechnical report (Soil Mechanics, 2012) describes the ground investigation work done and the results of direct investigation and laboratory testing. Boreholes show that rock is deeper than 6 m and does not play a tole in the current investigation with the EM31.

Ten boreholes on the substation site indicate mainly sandy gravelly clay with some lenses of sand or gravel. Most trial pits also show sandy gravelly clay with some silt, sand and gravel lenses. Trial pits 10 and 11 indicate sand while trial pit 12 indicates silt over sand.

1.4 Report

This report includes the results and interpretation of the geophysical survey. Maps and a table 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 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 was outlined in the tender documents and consisted of EM31 Ground Conductivity measurements.

The survey locations are within the colour contoured areas in the maps.

2.2 EM31 Ground Conductivity

The EM31 ground conductivity survey was carried out in the field containing the proposed substation (approx. 7 ha) and along the access road (approx. 3 ha).

The survey was done on lines nominally 10 m apart. Along each line a reading of ground conductivity was taken every second while walking along, thereby resulting in a survey grid of nominally 10 x 2 m. The locations were measured with a sub-meter accuracy SERES DGPS system attached to the EM31 and all data was jointly stored in a data logger. The conductivity meter was a GEONICS EM31 with Allegro data logger and NAV31 data acquisition software. The instrument was compared to base station readings and no EM drift was recorded.

The conductivity is typical for certain geological material types. Dry and clean Sand and Gravel and most rock types (Granite, Sandstone and clean Limestone) have relatively low conductivities while peat, clay and clay-rich rock types (mudstone, shale) have high conductivities.

EM31 ground conductivity determines the bulk conductivity of the subsurface over a typical depth between 0 and 6m bgl. and over a radius of approx. 5m around the instrument. In areas of thick overburden the instrument distinguished between clay/silt and sand/gravel.

The measurements can be disturbed by metal and other conductive objects in close proximity to the instrument, and therefore no geological interpretations can be made in the vicinity of such man-made objects. Either readings were not taken near sources of interference, or notes were taken by the surveyor in order to remove these during processing or to account for these in the interpretation.

The survey was done on the 23rd of April 2021 in good weather conditions. The instrument was checked repeatedly at a base station and the reading were very stable.

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 EM31 ground conductivity values were merged into one data file for the entire survey area and contoured and gridded with the SURFER contouring package. The contours are created by gridding and interpolation and care must be taken when using the data. The contour map is overlaid over the location and base map (Map 1) and the values in milliSiemens/metre (mS/m) are indicated on the colour scale bar.

Maps 2a and 2b display the same data as Map 1 but are displayed at a larger scale split for the substation site and access road.

The data indicates ground conductivities between 4 and 14 mS/m (MilliSiemens/meter). Because the electrical conductivity is the inverse of the electrical resistivity this can be also expressed as ground resistivity with 70 to 250 Ohmm (Ohmmeter).

Low conductivities indicate mainly sandy and gravely overburden while high conductivities indicate clayey and silty overburden. The highest readings on the contour map occur close to the quarry and the main road, there may be some component caused by metal of fencing and other object involved.

An interpretation can be made by allocating the overburden material to conductivity and resistivity ranges. Values of conductivity less than 5 mS/m (resistivity > 200 Ohmm) represent clayey silty Sand and Gravel within the depth reach (6m) of the EM31. Values between conductivity 5 - 10 mS/m (resistivity 100 – 200 Ohmm) can be described as sandy gravelly Clay and Silt. Values of conductivity higher than 10 mS/m (resistivity < 100 Ohmm) are typical for slightly sandy and slightly gravelly Clay and Silt.

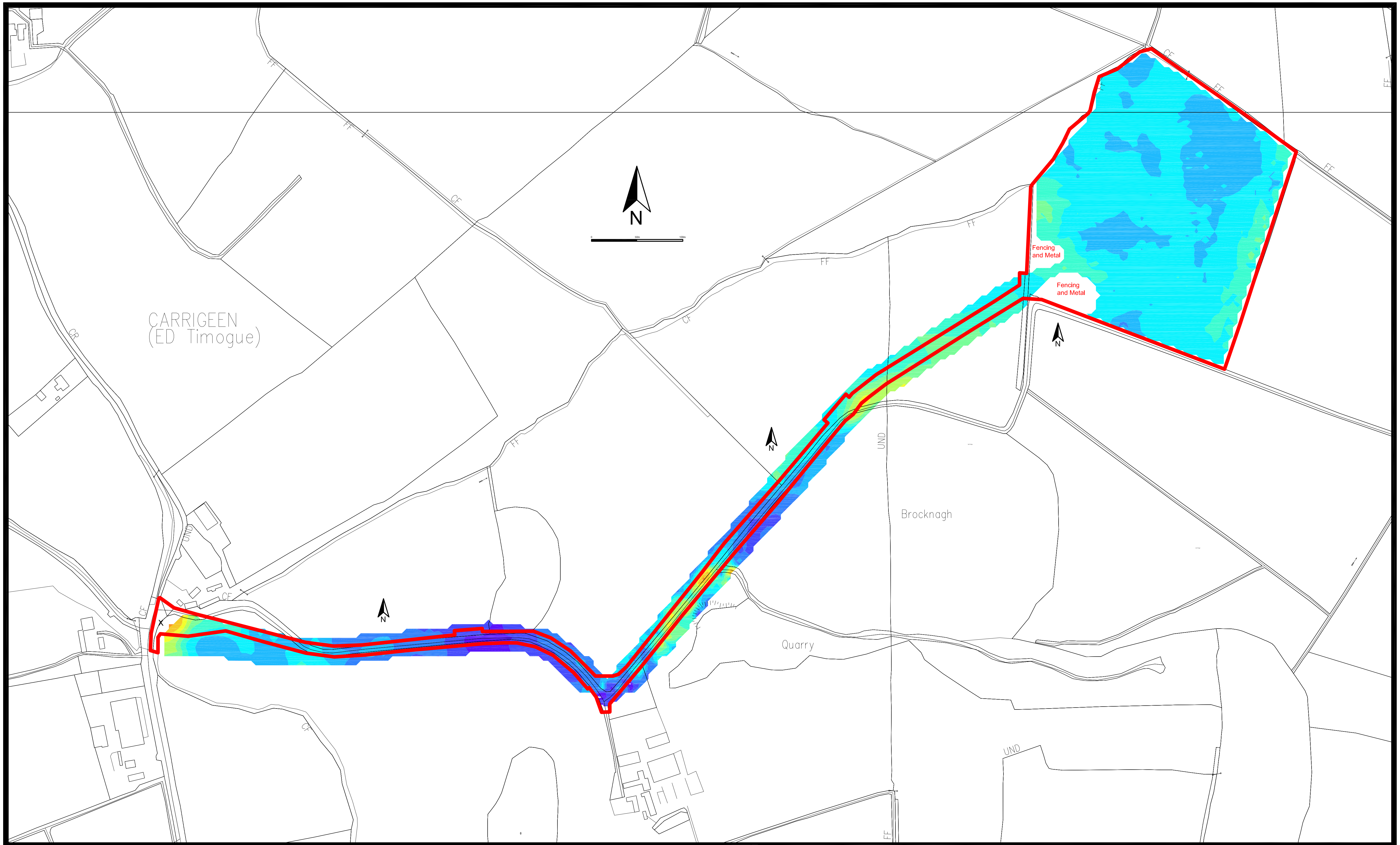
4. CONCLUSIONS

The following conclusions and recommendations are made:

- The EM31 survey was done over the substation site and the access road while avoiding some small areas with metal fencing.
- The subsoils under the site vary in the content between clayey silty Sand and Gravel (lowest conductivities) and slightly sandy and slightly gravelly Clay and Silt (highest conductivities).
- At the substation site ground conductivity values between 7 and 11 mS/m (resistivities from 90 to 143 Ohmm) have been determined. This shows that the site is quite homogeneous. Rock occurs deeper than 6 m bgl (as is known from the boreholes) so that the measurements are representing the change in overburden material.
- The interpretation shows sandy and gravelly Clay and Silt over most of the field with the proposed substation site. Some slightly sandy and slightly gravelly Clay and Silt occurs around the western and eastern edges of the field.
- The access road shows a larger variations of conductivities. The lowest occur closest to the quarry indication a high content of Sand and Gravel in the overburden.
- The lowest ground water permeabilities occur at the highest conductivity values because the clay and silt content is highest here. The highest permeabilities occur where the conductivities are lowest because there the subsoils have the largest amount of Sand and Gravel.

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, 2021.** Online Bedrock Geological Map of Ireland. Geological Survey of Ireland 2021.
5. **Milsom, 1989.** Field Geophysics. John Wiley and Sons.
6. **Reynolds, 1997.** An Introduction to Applied and Environmental Geophysics. John Wiley and Son
7. **Soil Mechanics, 2012**. Laois Kilkenny Reinforcement Project – Coolnabacky, Soil Mechanics, 2012.



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CLIENT ESB Networks Projects Delivery

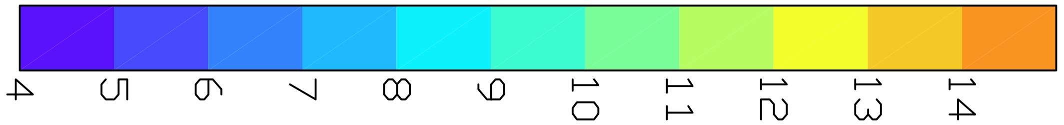
PROJECT Coolnabacky, County Laios
Geophysical Survey

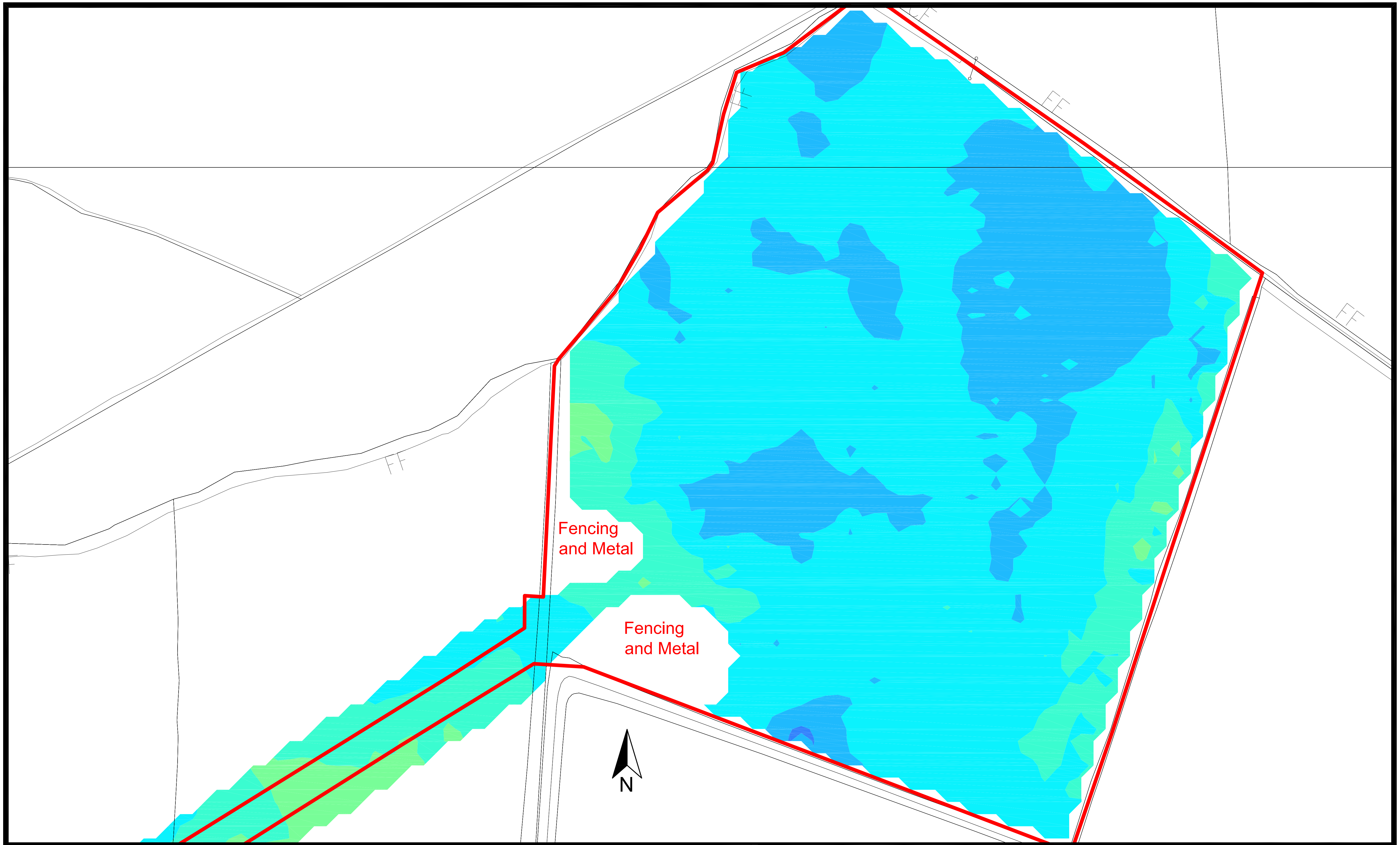
TITLE Map 1: EM31 Ground Conductivity
Contour Map

SCALE:	1:4000 @ A3
PROJECT:	6555
DRAWN:	HK
DATE:	28/04/2021
MGX FILE:	6555d_Maps.dwg
STATUS:	Draft

LEGEND: EM31 Ground Conductivity Results:

Ground Conductivity in mS/m





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CLIENT ESB Networks Projects Delivery

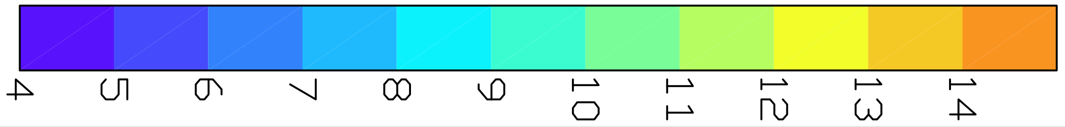
PROJECT Coolnabacky, County Laios
Geophysical Survey

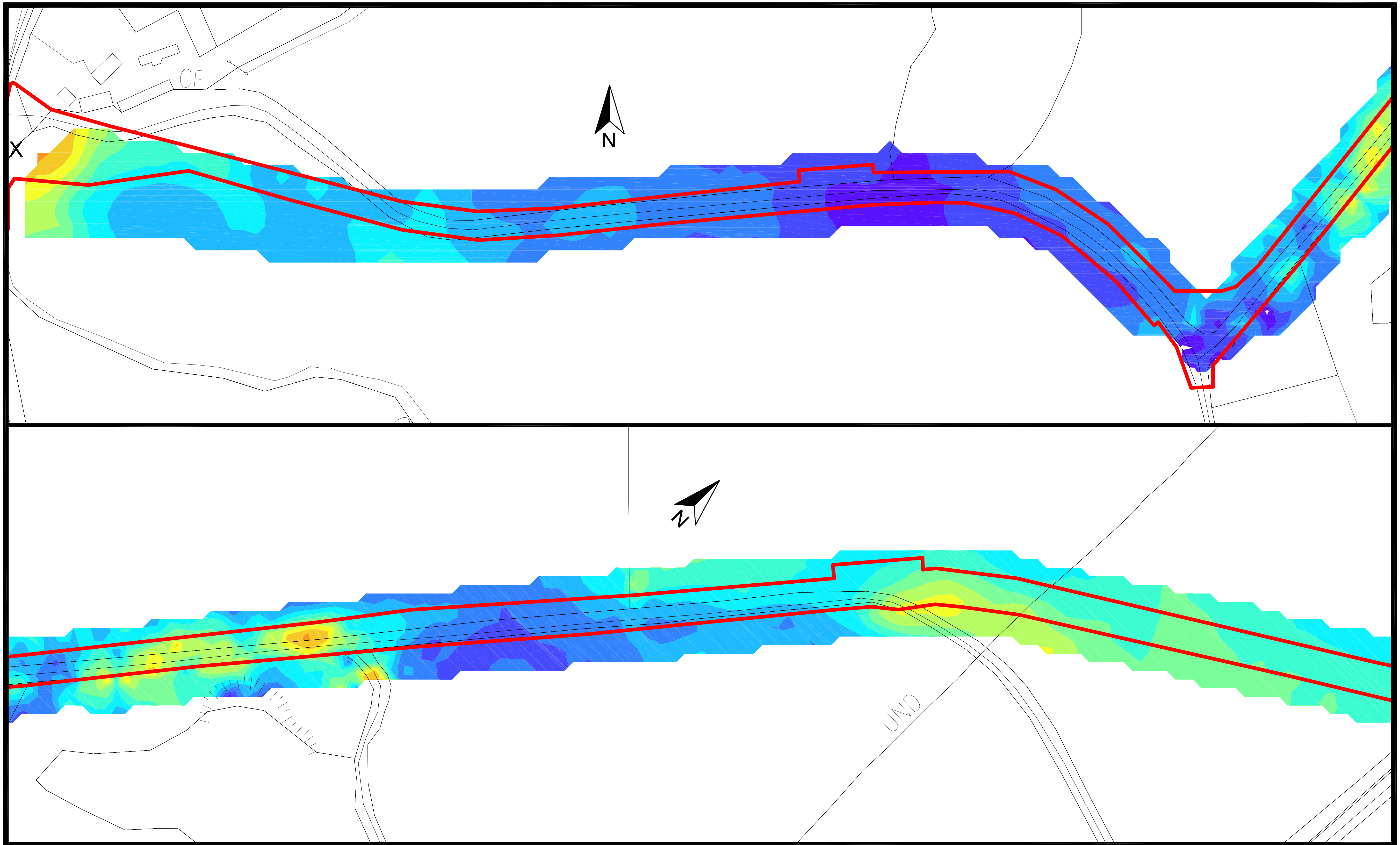
TITLE Map 2a: EM31 Ground Conductivity
Contour Map (Substation Site)

SCALE:	1:1500 @ A3
PROJECT:	6555
DRAWN:	HK
DATE:	28/04/2021
MGX FILE:	6555d_Maps.dwg
STATUS:	Draft

LEGEND: EM31 Ground Conductivity Results:

Ground Conductivity in mS/m





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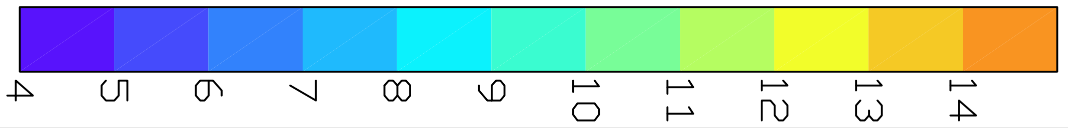
CLIENT	ESB Networks Projects Delivery
PROJECT	Coolnabacky, County Laios Geophysical Survey
TITLE	Map 2b: EM31 Ground Conductivity Contour Map (Access Road)

SCALE:	1:1500 @ A3
PROJECT:	6555
DRAWN:	HK
DATE:	28/04/2021
MGX FILE:	6555d_Maps.dwg
STATUS:	Draft

LEGEND: EM31 Ground Conductivity Results:

Ground Conductivity in mS/m



IE CONSULTING
WATER-ENVIRONMENTAL-CIVIL

Appendix C

Borehole Logs

Priority Geotechnical Ltd.
Tel: 021 4631600
Fax: 021 4638690
www.prioritygeotechnical.ie

Drilled By	KC
Logged By	
Borehole No.	**BH01**
	Sheet 1 of 1
Project Name:	Coolnabackey - Groundwater
Project No.	P21124
Co-ords:	
Hole Type	CP
Location:	Co. Laois
Level:	m OD
Scale	1:50
Client:	ESB
Date:	26/05/2021 - 26/05/2021

Well Backfill	Water Strike (m bgl)	Sample and In Situ Testing: Depth (m bgl)	Type	Results	Depth (m bgl)	Level (mOD)	Legend	Stratum Description
▨								
⁘					1.00		○—	Driller described: CLAY with cobble content.
⁘					3.00		⁘	Driller described: Dense GRAVEL.
								End of Borehole at 3.000m

1
2
3
4
5
6
7
8
9

Groundwater:

Struck (m bgl)	Rose to (m bgl)	After (mins)	Sealed (m bgl)	Comment
				None encountered.

Hole Information:

Depth (m bgl)	Hole Dia (mm)	Casing Dia (mm)
3.00	200	200

Equipment: Dando 2000

Chiselling Details:

Top (m)	Base (m)	Duration (hh:mm)	Tool
2.40	2.60	01:00	Chisel.

Remarks:

Borehole terminated at 3.00m bgl, required depth. 50mm standpipe installed. Response zone from 0.50m to 3.00m bgl.

Shift Data:

GW (m bgl)	Shift	Depth (m bgl)	Remarks
	26/05/2021 08:00	0.00	Start of shift.
Dry.	26/05/2021 18:00	3.00	End of borehole.

Priority Geotechnical Ltd. **Tel: 021 4631600** **Fax: 021 4638690** **www.prioritygeotechnical.ie**	**Drilled By** KC	**Logged By**	Borehole No. **BH02** Sheet 1 of 1

Project Name: Coolnabackey - Groundwater	**Project No.** P21124	**Co-ords:**	**Hole Type** CP
Location: Co. Laois		**Level:** m OD	**Scale** 1:50
Client: ESB		**Date:** 26/05/2021 - 26/05/2021	

Well Backfill	Water Strike (m bgl)	Sample and In Situ Testing: Depth (m bgl)	Type	Results	Depth (m bgl)	Level (mOD)	Legend	Stratum Description
					1.00			Driller described: CLAY with cobble content.
					3.00			Driller described: Dense GRAVEL.
								End of Borehole at 3.000m

1
2
3
4
5
6
7
8
9

Groundwater:

Struck (m bgl)	Rose to (m bgl)	After (mins)	Sealed (m bgl)	Comment
				None encountered.

Hole Information:

Depth (m bgl)	Hole Dia (mm)	Casing Dia (mm)
3.00	200	200

Equipment: Dando 2000

Chiselling Details:

Top (m)	Base (m)	Duration (hh:mm)	Tool
2.60	2.80	00:30	Chisel.

Remarks:

Borehole terminated at 3.00m bgl, required depth. 50mm diameter standpipe installed. Response zone from 0.50m - 3.00m bgl.

Shift Data:

GW (m bgl)	Shift	Depth (m bgl)	Remarks
	26/05/2021 08:00	0.00	Start of shift.
Dry	26/05/2021 18:00	3.00	End of borehole.

Priority Geotechnical Ltd. Tel: 021 4631600 Fax: 021 4638690 www.prioritygeotechnical.ie	**Drilled By** KC **Logged By**	Borehole No. **BH03** Sheet 1 of 1

Project Name:	Coolnabackey - Groundwater	**Project No.** P21124	**Co-ords:**	**Hole Type** CP
Location:	Co. Laois		**Level:** m OD	**Scale** 1:50
Client:	ESB		**Date:** 26/05/2021 - 26/05/2021	

Well Backfill	Water Strike (m bgl)	Sample and In Situ Testing: Depth (m bgl)	Type	Results	Depth (m bgl)	Level (mOD)	Legend	Stratum Description
					1.00			Driller described: CLAY with cobble content.
					3.00			Driller described: GRAVEL.
								End of Borehole at 3.000m

Groundwater:

Struck (m bgl)	Rose to (m bgl)	After (mins)	Sealed (m bgl)	Comment
				None encountered.

Hole Information:

Depth (m bgl)	Hole Dia (mm)	Casing Dia (mm)
3.00	200	200

Equipment: Dando 2000

Chiselling Details:

Top (m)	Base (m)	Duration (hh:mm)	Tool
1.90	2.00	01:00	Chisel.

Remarks:

Borehole terminated at 3.00m bgl, required depth. 50mm diameter standpipe installed. Response zone from 0.50m to 3.00m bgl.

Shift Data:

GW (m bgl)	Shift	Depth (m bgl)	Remarks
	26/05/2021 08:00	0.00	Start of shift.
Dry	26/05/2021 18:00	3.00	End of borehole.

Appendix D

Onsite Raw Water Quality Data

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

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W: www.element.com

IE Consulting
Innovation Centre
Green Road
Carlow
Co Carlow

4225

Attention :	Kevin Murphy
Date :	19th January, 2022
Your reference :	IE2219
Our reference :	Test Report 21/20239 Batch 1
Location :	ESB Coolnabacky
Date samples received :	16th December, 2021
Status :	Final Report
Issue :	1

Four samples were received for analysis on 16th December, 2021 of which four were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Authorised By:

Hayley Prowse
Project Manager

Client Name: IE Consulting
Reference: IE2219
Location: ESB Coolnabacky
Contact: Kevin Murphy
EMT Job No: 21/20239

Report : Liquid

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
H=H_2SO_4, Z=ZnAc, N=NaOH, HN=$HN0_3$

EMT Sample No.	1-3	4-6	7-9	10-12									
Sample ID	BH1	BH2	BH3	BH4									
Depth													
COC No / misc													
Containers	H HN P	H HN P	H HN P	H HN P									
Sample Date	14/12/2021	14/12/2021	14/12/2021	14/12/2021									
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water									
Batch Number	1	1	1	1							LOD/LOR	Units	Method No.
Date of Receipt	16/12/2021	16/12/2021	16/12/2021	16/12/2021									
Dissolved Calcium #	191.9	102.1	114.5	111.2							<0.2	mg/l	TM30/PM14
Dissolved Magnesium #	6.6	2.2	10.8	10.0							<0.1	mg/l	TM30/PM14
Dissolved Potassium #	1.1	1.2	1.0	0.9							<0.1	mg/l	TM30/PM14
Dissolved Sodium #	14.9	4.3	6.3	7.3							<0.1	mg/l	TM30/PM14
Sulphate as SO4 #	245.0	4.2	6.7	13.3							<0.5	mg/l	TM38/PM0
Chloride #	6.9	3.7	6.0	9.6							<0.3	mg/l	TM38/PM0
Nitrate as NO3 #	1.1	<0.2	<0.2	<0.2							<0.2	mg/l	TM38/PM0
SRP Ortho Phosphate as PO4	0.04	<0.03	<0.03	<0.03							<0.03	mg/l	TM38/PM0
Ammoniacal Nitrogen as NH4 #	0.06	0.04	0.36	0.12							<0.03	mg/l	TM38/PM0
Dissolved Alkalinity as CaCO3 #	-	-	372	-							<1	mg/l	TM75/PM0
Total Alkalinity as CaCO3 #	846	3050	17580	2922							<1	mg/l	TM75/PM0
Electrical Conductivity @25C #	976	516	638	629							<2	uS/cm	TM76/PM0
pH #	7.71	7.72	6.97	7.65							<0.01	pH units	TM73/PM0

Please see attached notes for all abbreviations and acronyms

Client Name: IE Consulting
Reference: IE2219
Location: ESB Coolnabacky
Contact: Kevin Murphy
EMT Job No: 21/20239

Report : **Liquid (Duplicate results)**

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
H=H_2SO_4, Z=ZnAc, N=NaOH, HN=$HN0_3$

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	7-9											
Sample ID	BH3											
Depth												
COC No / misc												
Containers	H HN P											
Sample Date	14/12/2021											
Sample Type	Ground Water											
Batch Number	1											
Date of Receipt	16/12/2021										LOD/LOR	Units	Method No.
pH $^{\#}$	8.07										<0.01	pH units	TM73/PM0

Client Name: IE Consulting
Reference: IE2219
Location: ESB Coolnabacky
Contact: Kevin Murphy

Matrix : Liquid

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analysis	Reason
21/20239	1	BH3		7-9	Alkalinity, pH	Sample holding time exceeded

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.
Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 21/20239

SOILS and ASH

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary. Asbestos samples are retained for 6 months.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C. Ash samples are dried at 37°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

STACK EMISSIONS

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation for Dioxins and Furans and Dioxin like PCBs has been performed on XAD-2 Resin, only samples which use this resin will be within our MCERTS scope.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.

Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
>>	Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

HWOL ACRONYMS AND OPERATORS USED

HS	Headspace Analysis.
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent.
CU	Clean-up - e.g. by florisil, silica gel.
1D	GC - Single coil gas chromatography.
Total	Aliphatics & Aromatics.
AL	Aliphatics only.
AR	Aromatics only.
2D	GC-GC - Double coil gas chromatography.
#1	EH_Total but with humics mathematically subtracted
#2	EU_Total but with fatty acids mathematically subtracted
_	Operator - underscore to separate acronyms (exception for +).
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total
MS	Mass Spectrometry.

EMT Job No: 21/20239

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM14	Preparation of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for Dissolved metals, and remain unfiltered for Total metals then acidified	Yes			
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l	PM0	No preparation is required.				
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l	PM0	No preparation is required.	Yes			
TM73	Modified US EPA methods 150.1 (1982) and 9045D Rev. 4 - 2004) and BS1377-3:1990. Determination of pH by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			
TM75	Modified US EPA method 310.1 (1978). Determination of Alkalinity by Metrohm automated titration analyser.	PM0	No preparation is required.	Yes			
TM76	Modified US EPA method 120.1 (1982). Determination of Specific Conductance by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			

Appendix E

Ecological Assessment of Tufa Spring

Memo

To: Jerome Keohane

From: Dr Joanne Denyer (Denyer Ecology)

Cc:

Date: 24 June 2021

Subject: Summary of Coolnabacky, Co. Laois site visit and petrifying springs survey

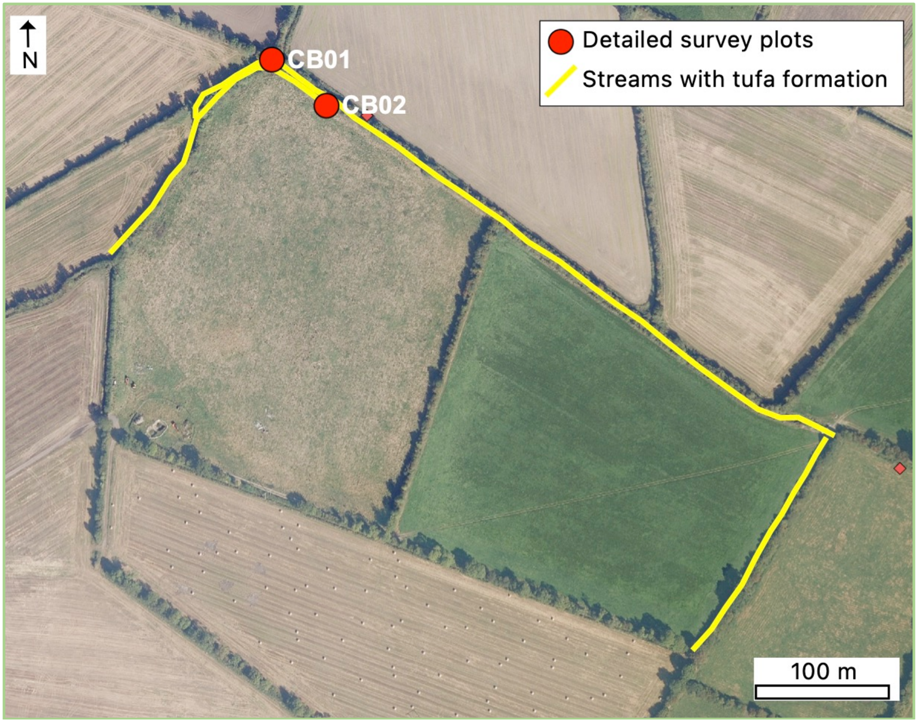
---

Today I visited the above site with Jerome Keohane (hydrogeologist) and undertook a petrifying spring survey. Petrifying springs with tufa formation (Cratoneurion) [*7220] are an EC Habitats Directive Annex I priority habitat.

Several small streams surrounding the site (Figure 1.1) were found to have a high pH and to support tufa formation as stream crust, paludal tufa, oncoids and ooids and cascade tufa. pH values of 8.30, 8.16 and 8.22 were recorded which is high for lowland streams. Cover of tufa ranged from absent to 90% of the stream bed. The streams had a good flow, despite the season and are highly likely to be largely groundwater fed. Positive indicator species for the Annex I priority habitat were rare. This is likely to be because the streams also act as drainage ditches and receive some surface water (and nutrients) from adjacent lands, increasing water depth at certain times of the year.

The surveyed streams with tufa deposition along some/ all of their length are shown in Figure 1.1.

Figure 1.1. Location of streams with tufa formation and detailed survey plots



RGB Aerial Photography - © Bluesky Geospatial Limited

Two detailed survey plots were undertaken following the methodology of Lyons and Kelly (2016) and Denyer (In press) (CB01 and CB02, Figure 1.1).

- CB01 had significant tufa formation (total 45% of cascade, stream crust and paludal tufa) but only one positive indicator species for *7220 habitat was recorded. Although this plot would not be considered a clear example of the *7220 habitat, it has high tufa formation and therefore has affinity to Annex I priority Petrifying spring habitat [*7220]
- CB02 had significant tufa formation (total 85% oncoids and ooids) and three positive indicator species for *7220 habitat were recorded. This section of stream is considered to be an example of Annex I priority Petrifying spring habitat [*7220]

The streams surrounding the site are groundwater fed and highly tufa producing. They are mostly lacking the species required to be clear examples of Annex I priority Petrifying spring habitat [*7220], but these species are present occasionally throughout the system.

A full report will be produced. Recommendations for the spring/ stream system include suitable measures to control surface water run-off from the site so that the groundwater in the spring/ stream system is not diluted, which would reduce it's tufa forming capacity.

References:

Denyer, J. (In press) Guidelines for the Assessment of Annex I Priority Petrifying Springs in Ireland. *Irish Wildlife Manuals*, No. XXX. National Parks and Wildlife Service, Department of Housing, Local Government and Heritage, Ireland.

Lyons, M.D. & Kelly, D.L. (2016) Monitoring guidelines for the assessment of petrifying springs in Ireland. *Irish Wildlife Manuals*, No. 94. National Parks and Wildlife Service, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs, Ireland

PETRIFYING SPRING SURVEY AND ASSESSMENT
COOLNABACKY, CO. LAOIS

December 2022

Report produced by Denyer Ecology for:
ESB

CONTENTS

1 INTRODUCTION

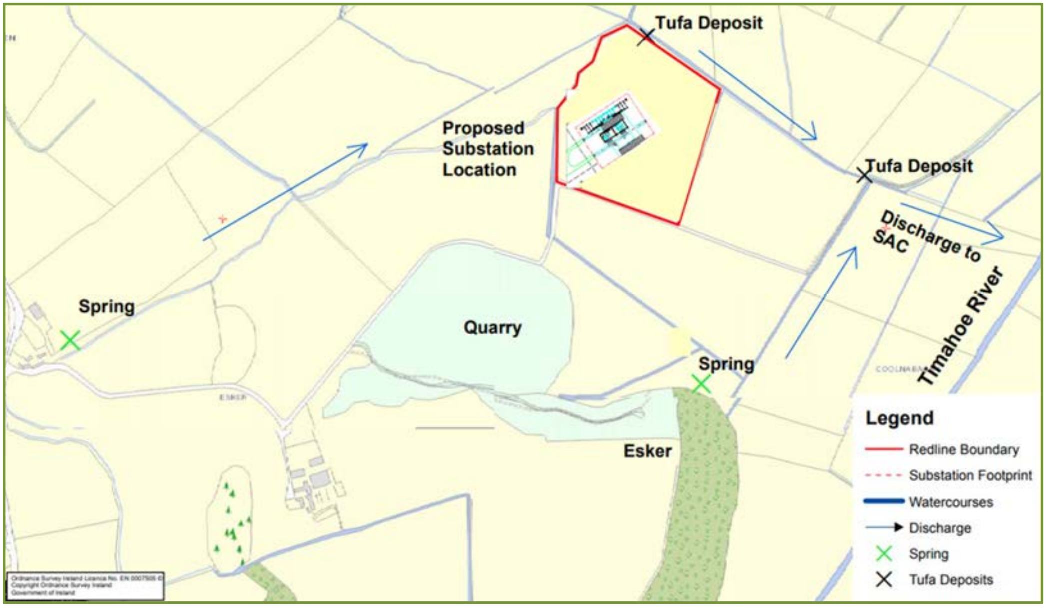
1.1 Background

Denyer Ecology was commissioned by ESB to map petrifying springs of lands at Coolnabacky, Timahoe, Co. Laois. Annex I Priority Habitat Petrifying springs with tufa formation (*Cratoneurion*) [7220] is an Annex I priority habitat listed under the Habitats Directive and was recorded from the project site in 2021.

1.2 Project aims and survey area

The aim of the petrifying spring assessment was to map and assess all locations of examples of Petrifying spring habitat *7220 within the project area (Figure 1.1).

Figure 1.1. Project site (red line) and location of known petrifying springs in vicinity of site



Map provided by IE Consulting

1.3 Relevant expertise

Dr Joanne Denyer

Dr Joanne Denyer is a highly experienced botanist and bryologist with 20 years' experience of ecological survey and research. She is experienced in the identification of all plant groups, including difficult groups such as aquatic macrophytes, charophytes and bryophytes. She specialises in wetland habitats and is Ireland's leading Annex I habitat priority petrifying spring specialist. She has worked on a wide range of projects and sites in relation to this habitat. This includes detailed survey, assessment and monitoring, Ecological Impact Assessment and acting as an expert witness on calcareous springs at Oral Hearing. She provides advice on this habitat to County Councils and National Parks and Wildlife Service (NPWS). In 2018 she assisted NPWS in the latest Article 17 reporting (National Conservation Status Assessment) on Petrifying springs to the European Commission (under Article 11 of the Habitats Directive, each member state must report every 6 years on the conservation status of Annex I habitats). Dr Denyer is currently preparing updated '*Guidelines for the assessment of Annex I priority petrifying springs in Ireland'* for NPWS.

2 METHODOLOGY

2.1 Desktop data

Desktop data accessed in this assessment includes the following data sources:

- British Bryological Society Atlas dataset.

- Aerial photography and OSI mapping.

2.2 Walk-over survey

The site was walked over in June 2021 and all streams with tufa formation within the project site were mapped.

2.3 Detailed spring survey

- Two detailed plots were undertaken in two streams where tufa formation is present. The relevé locations were positioned to contain representative spring vegetation at each stream location and to encompass the variation of tufa types in the survey area. The two plots were surveyed in June 2021 and July 2022.
- Data collected from each plot included habitat and plot photographs; plot location(s) (GPS); recording of percentage cover of all vascular plant and bryophyte species (including positive and negative indicator species); shading; tufa type and extent; and, impacting activities (such as grazing, invasive species, changes to water quality and/ or quality, trampling and dumping).
- The plot sampling methodology follows Lyons, M.D. & Kelly, D.L. (2016). Monitoring guidelines for the assessment of petrifying springs in Ireland. *Irish Wildlife Manuals*, No. 94. National Parks and Wildlife Service, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs, Ireland
- Petrifying spring/ stream vegetation communities were classified using Lyons, M.D. & Kelly, D.L. (2017). Plant community ecology of petrifying springs (*Cratoneurion*) – a priority habitat. *Phytocoenologia* 47 (1): 13-32.

2.4 Condition assessment

- The ecological condition of the springs was assessed using the '*Monitoring Guidelines for the Assessment of Petrifying Springs in Ireland*' (Lyons & Kelly, 2016). Criteria include positive and negative indicator species (frequency and cover), woody species cover, vegetation height and disturbance.

2.5 Conservation score

- The 'Conservation Score' of the petrifying springs was assessed using the '*Monitoring Guidelines for the Assessment of Petrifying Springs in Ireland*' (Lyons & Kelly, 2016. Criteria such as species diversity, High Quality indicator species, tufa-forming capacity and other positive characteristics are used to calculate the 'Conservation Score' for each spring. This score is then be used to rank the quality of the spring at a national level (Lyons & Kelly, 2016).

2.6 Plant species nomenclature

Vascular plant nomenclature follows that of the *New Flora of the British Isles*. 4th Edition (Stace, 2019). Bryophyte nomenclature follows Blockeel et al. (2021).

2.7 Limitations

Some of the streams have dense hedgerows adjacent to them which limits access. However, it was possible to walk most sections of the streams, and this did not limit the site assessment for petrifying springs.

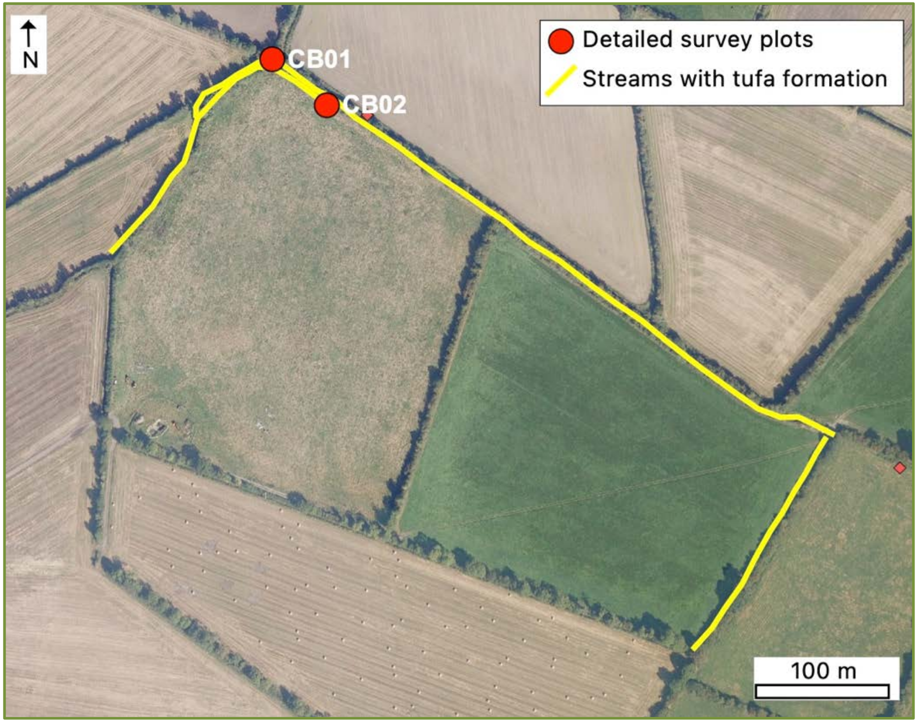
3 SPRING SURVEY RESULTS AND EVALUATION

3.1 Walk-over survey

Several small streams surrounding the site (Figure 3.1) were found to have a high pH and to support tufa formation as stream crust, paludal tufa, oncoids and ooids and cascade tufa. pH values of 8.30, 8.16 and 8.22 were recorded, which is high for lowland streams and typical of petrifying springs. Cover of tufa within the streams ranged from absent to 90% of the stream bed (e.g. Photograph 3.1). The streams had a good flow, despite the season and are highly likely to be largely groundwater fed. Positive indicator species (e.g. Photograph 3.2) for the Annex I priority habitat were rare. This is likely

to be because the streams also act as drainage ditches and receive some surface water (and nutrients) from adjacent lands, increasing water depth at certain times of the year.
The surveyed streams with tufa deposition along some or all of their length are shown in Figure 3.1.

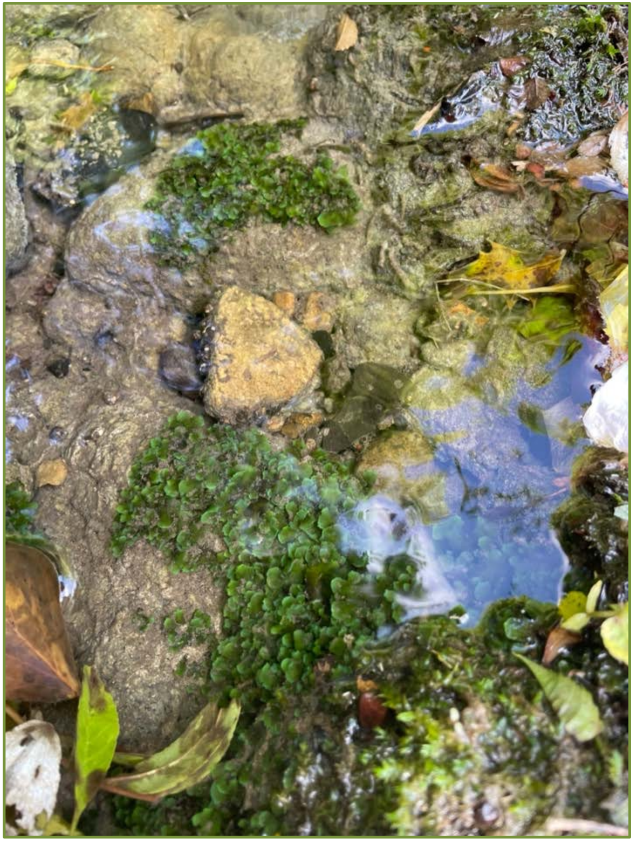
Figure 3.1. Location of streams with tufa formation and detailed survey plots



RGB Aerial Photography - © Bluesky Geospatial Limited

Photograph 3.1. High cover of tufa (mainly oncoids and ooids) in section of stream

Photograph 3.2. The Annex I petrifying spring indicator species *Pellia endiviifolia* in a stream section



3.2 Detailed plot survey and condition assessment

Two detailed petrifying spring plots were surveyed (Figure 3.1). A summary of the results is shown in Tables 3.1 and 3.2. and the full results of the plot survey and condition assessment (from 2021 and 2022) are shown in Appendix A. Stream 1 had slightly lower than average species richness and this is likely to be related to shading. Nitrate levels are high in both streams (baseline water quality sampling data from March 2022; Appendix B), related to agricultural activity in the area. Although this may partly cause the lower species richness and positive indicator species number in the plots, there was little sign of filamentous algae in either plot. The 2021 Stream 2 plot (CB02) had become overgrown and shaded in 2022 and the plot was moved to where the two streams join.

Both plots fail the condition assessment (Table 3.3). This is because of the low number of positive indicator species, high nitrate levels and shading in plot CB02 (Stream 2).

Table 3.2. Main tufa formation, vegetation type and species richness in each plot

Spring no.	Plot no.	Vegetation community[1]	Tufa formation	Plot species richness	Average sp. richness for vegetation community[2]
Stream 1	CB01	Group 3	Total 23%: Cascade 20%; paludal 3%	13 (2021); 12 (2021)	13.8
Stream 2	CB02	Group 3	Total 53%: Cascade 50%; paludal 3%	18 (2021); 16 (2022)	13.8

[1]Lyons & Kelly (2017); [2]Lyons (2015)

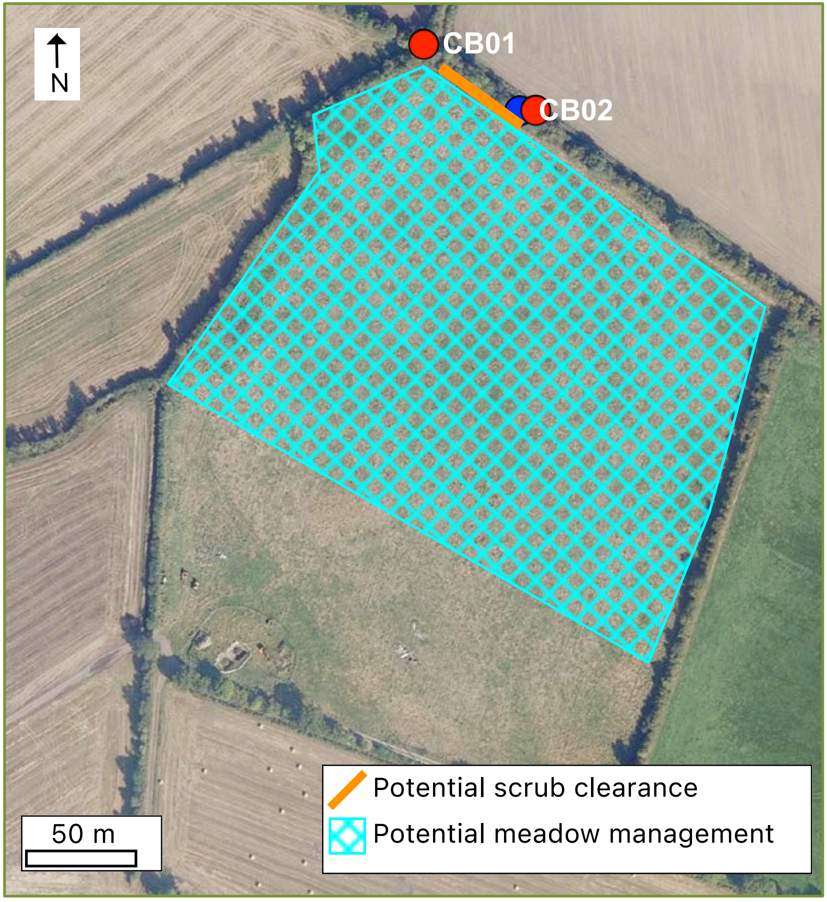
Table 3.3. Conservation score, ranking and condition assessment summary for each plot

Spring no.	Annex I spring	Conservation score	Conservation ranking	Condition assessment result
CB01	Yes	4	Moderate	UNFAVOURABLE
CB02	Yes	5	High	UNFAVOURABLE

4 RECOMMENDATIONS

- Petrifying springs are highly sensitive to changes in water chemistry and water flow. Any works in the vicinity of the streams must protect the streams from run-off to prevent sediment entering the streams. Surface water should not be discharged in locations where it could dilute the water in the tufa forming sections of the streams, as this would change the water chemistry and could affect tufa formation.
- Stream 2, which runs along the inside of the northern boundary of the site, is becoming overgrown with tall vegetation. This is shading the stream and reducing species richness in the tufa forming sections. Clearance of scrub from the ditch edge on the south-west side (Figure 4,1) would reduce the shading. This should only be undertaken with input and supervision from the project ecologist, to ensure that there are no negative impacts on fauna using this area of the site. Once agreed, an ongoing maintenance plan can be created.
- In addition to localised scrub clearance, annual mowing of the grassland in this area (Figure 4.1) would prevent the re-development of long vegetation and scrub. This could be an annual cut of the grassland around mid-August, with the cuttings removed. This would also enhance species diversity in the grassland. Not all of the grassland needs to be cut each year and retaining some areas of long grass would provide refuge for overwintering insects and other fauna. Again, this should only be undertaken with input and supervision from the project ecologist. Once agreed, an ongoing maintenance plan can be created.
- The petrifying springs should be re-surveyed in 2023 to ensure there are no negative impacts from any works on the survey site and to provide further habitat management recommendations as required.

Figure 4.1. Location of potential habitat management actions



5 REFERENCES

Blockeel, T.L., Bell, N.E., Hill, M.O., Hodgetts, N.G., Long, D.G., Pilkington, S.L. and Rothero, S.L. (2021): A new checklist of the bryophytes of Britain and Ireland, 2020, Journal of Bryology, DOI: 10.1080/03736687.2020.1860866

Lyons, M.D. & Kelly, D.L. (2017). Plant community ecology of petrifying springs (*Cratoneurion*) – a priority habitat. *Phytocoenologia* 47 (1): 13-32.

Lyons, M.D. & Kelly, D.L. (2016) *Monitoring guidelines for the assessment of petrifying springs in Ireland*. Irish Wildlife Manuals, No. 94. National Parks and Wildlife Service, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs, Ireland.

Lyons, M.D. (2015). *The Flora and Conservation Status of Petrifying Springs in Ireland.* Unpublished phD thesis, Trinity College Dublin.

Stace, C.A. (2019). *New Flora of the British Isles.* 4th Edition. C&M Floristics, Stowmarket, UK.

APPENDIX A - SURVEY AND CONDITION ASSESSMENT RESULTS

SITE AND SPRING DETAILS

Site name: Coolnabacky	**Spring name:** Stream 1	**Relevé No.:** CB01
Survey dates: 24/06/22 & 24/07/22	**Relevé dimensions:** 1m x 4m	**Relevé area:** $4m^2$
Grid reference: S 53818 93075	**Spring type:** Spring-fed stream	
Slope: <5°	**Altitude (m):** *c.* 100m	**Aspect:** SW
pH: 8.16 (2021); 7.85 (2022)	**EC:** 1890 µS (2021); 1060 µS (2022)	**Temp.:** 12.8 (2021); 12.6 (2022)

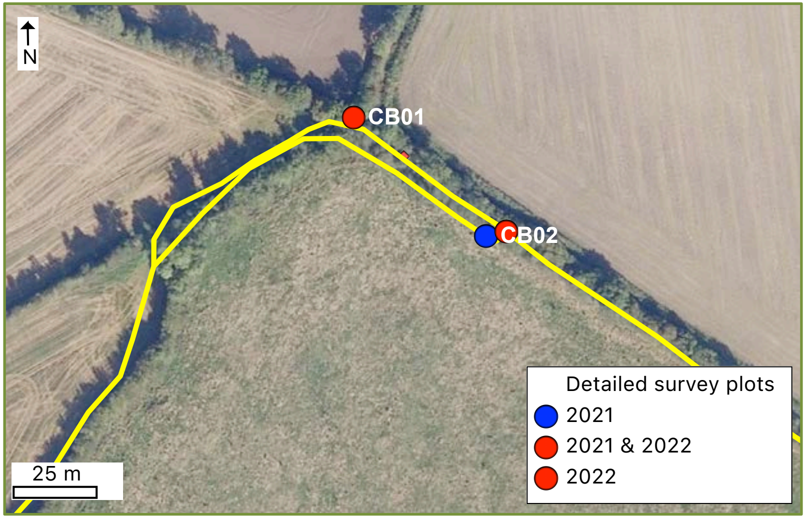
Spring description:

This stream flows SW to NE across the NW corner of the site. The stream originates further to the SW, but tufa is only present in the stream *c.* 200m SW of the plot location (Figure 1). This suggests that groundwater is entering the stream around this location. The stream had good flow in both surveys despite dry summer conditions. The tufa is mainly present as oncoids and ooids in the SW, but cascade tufa and stream crust tufa are more frequent in the vicinity of the plot. The stream is shaded by hedgerows for most of its length. Positive indicator species for the Annex I habitat 'petrifying springs with tufa formation' are rare. This is likely to be because the streams also act as drainage ditches and receive some surface water (and nutrients) from adjacent lands, increasing water depth at certain times of the year. Although measured nitrate levels are high, there was little/ none filamentous algae.
The stream is an example of **Group 3 *Brachythecium rivulare-Platyhypnidium riparioides* tufaceous streams and flushes** vegetation community (Lyons & Kelly, 2017).

Plot location:

The plot (CB01) is located in the NW of the site, just upstream of where several streams join and flow to the SE along the northern boundary of the site.

Figure 1.1. Plot location (CB01)



RGB Aerial Photography - © Bluesky Geospatial Limited

Photograph 1.1. Plot CB01 (view to SW), 2021

Photograph 1.2. Plot CB01 (view to SW), 2022

APPENDIX A - SURVEY AND CONDITION ASSESSMENT RESULTS

DETAILED RELEVÉ

Physical characteristics (2021)

Tufa	% Cover	Water	% Cover	Surface	% Cover
Cascade	30	Flowing/ trickling	100	Living field/ ground flora	60
Paludal (1)	5	Pool/ standing water	-	Bare tufa (active/ recent)	10
Stream crust	10	Dripping	-	Ancient/ inactive tufa	-
Oncoids/ ooids	-	Damp	-	Leaf litter/ standing dead	-
Dam	-	Dry, not impacted by spring	-	Bare soil	-
Cemented rudites	-	Other:	-	Bare stone	30
Non-tufa	55			Other:	-
TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Paludal tufa: 1 = weak/ thin/ discontinuous, 3 = strongly forming/ continuous/ conspicuous
Cover values: record to nearest 5%. If <5% then use 3%, 1% 0.5%, 0.1%

Physical characteristics (2022)

Tufa	% Cover	Water	% Cover	Surface	% Cover
Cascade	30	Flowing/ trickling	100	Living field/ ground flora	60
Paludal (1)	5	Pool/ standing water	-	Bare tufa (active/ recent)	25
Stream crust	30	Dripping	-	Ancient/ inactive tufa	-
Oncoids/ ooids	10	Damp	-	Leaf litter/ standing dead	-
Dam	-	Dry, not impacted by spring	-	Bare soil	-
Cemented rudites	-	Other:	-	Bare stone	15
Non-tufa	25			Other:	-
TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Paludal tufa: 1 = weak/ thin/ discontinuous, 3 = strongly forming/ continuous/ conspicuous
Cover values: record to nearest 5%. If <5% then use 3%, 1% 0.5%, 0.1%

Shrub/ canopy layer (2021)

Species	Routed outside Canopy (%)	Routed inside Canopy (%)	Routed inside Height (m)
Alnus glutinosa	10	-	-
Corylus avellana	5		
Fraxinus excelsior	15		
Prunus spinosa	10		
Rosa canina	5	-	-
TOTAL CANOPY (ROOTED INSIDE + ROOTED OUTSIDE) %	**TOTAL %:** 45	**TOTAL %**	**TOTAL %**
MAX HEIGHT (m) ABOVE QUADRAT (ROOTED INSIDE + ROOTED OUTSIDE): 10m			

Shrub/ canopy layer (2022)

Species	Routed outside Canopy (%)	Routed inside Canopy (%)	Routed inside Height (m)
Alnus glutinosa	10	-	-
Corylus avellana	5		
Fraxinus excelsior	5		
Prunus spinosa	10		
Rosa canina	5	-	-
TOTAL CANOPY (ROOTED INSIDE + ROOTED OUTSIDE) %	**TOTAL %:** 35	**TOTAL %**	**TOTAL %**
MAX HEIGHT (m) ABOVE QUADRAT (ROOTED INSIDE + ROOTED OUTSIDE): 10m			

APPENDIX A - SURVEY AND CONDITION ASSESSMENT RESULTS

Field/ ground flora (2021)

FORBS	%	GRAMINOIDS	%	BRYOPHYTES	%	WOODY	%
Helioscadium nodiflorum	3	*Agrostis stolonifera* A	3	*Cratoneuron filicinum*	3	*Hedera hibernica*	3
Ranunculus repens A	3	*Poa trivialis* A	1	*Pellia endiviifolia**	30	*Rubus fruticosus*	3
Heracleum sphondylium	5	*Brachypodium sylvaticum*	1				
Filipendula ulmaria A	3					**TOTAL WOODY <50cm**	**6**
Viola riviniana	<1					**PTERIDOPHYTES**	
Cardamine pratense A	1						
						TOTAL PTERIDOPHYTES	**0**
						ALGAE	
						TOTAL ALGAE	**0**
TOTAL FORBS	**16**	**TOTAL GRAMINOIDS**	**5**	**TOTAL BRYOPHYTES**	**33**	**TOTAL CANOPY**	**60**

*=Annex I positive indicator species; A=Accompanying species

Field/ ground flora (2022)

FORBS	%	GRAMINOIDS	%	BRYOPHYTES	%	WOODY	%
Helioscadium nodiflorum	3	*Agrostis stolonifera* A	3	*Cratoneuron filicinum*	8	*Hedera hibernica*	3
Ranunculus repens A	1	*Brachypodium sylvaticum*	1	*Pellia endiviifolia**	40	*Rubus fruticosus*	1
Filipendula ulmaria A	1			*Kindbergia praelonga*	<1		
Epilobium hirsutum	<1					**TOTAL WOODY <50cm**	**4**
Veronica montana	<1					**PTERIDOPHYTES**	
						TOTAL PTERIDOPHYTES	**0**
						ALGAE	
						TOTAL ALGAE	**0**
TOTAL FORBS	**6**	**TOTAL GRAMINOIDS**	**4**	**TOTAL BRYOPHYTES**	**45**	**TOTAL CANOPY**	**60**

*=Annex I positive indicator species; A=Accompanying species

APPENDIX A - SURVEY AND CONDITION ASSESSMENT RESULTS

Photos

Photo 1.3. Plot, view to SW (upstream), 2021

Photo 1.4. Plot, view to SW (upstream), 2022

Photo 1.5. Close up of plot vegetation, 2021

Photo 1.6. Close up of plot vegetation, 2022

Condition assessment (2021 & 2022)

Criteria	Result	Target value	Result and pass/ Fail
Species assessment criteria			
High quality indicator species	None recorded	n/a (included below)	n/a (included with positive indicator species)
Positive indicator species	1 species recorded (* in species table)	3 species AND no loss from baseline number of species	**FAIL**
Typical accompanying species (neutral indicators)	5 species (2021), 3 species (2022) (^{A} in species table)	n/a	For information only

APPENDIX A - SURVEY AND CONDITION ASSESSMENT RESULTS

Criteria	**Result**	**Target value**	**Result and pass/ Fail**
Invasive species	None recorded	Absent	Result = absent **PASS**
Negative herbaceous indicator species	1 species recorded: *Helioscadium nodiflorum*	Total cover should not be dominant or abundant	**PASS**
Negative bryophyte indicator species	1 species recorded: *Cratoneuron filicinum* (occasional to frequent)	No one species dominant or abundant; if ≥2 species present) then fails if ≥2 are frequent or 1 is abundant	**PASS**
Negative woody indicator species	n/a as wooded spring	Absent (except in wooded springs)	n/a
Spring water composition and flow			
Nitrate level	Upstream value of 39.4 mg/l and downstream of 37.7 mg/l	No increase from baseline and not above 10 mg/l	**FAIL**
Phosphate level	Upstream value 2021 of <15 mg/l and downstream of <15 mg/l	No increase from baseline and not above 15 µg/l	**PASS**
Water flow	No obvious alteration	No alteration of natural flow	**PASS**
Impacts of grazing			
Field layer height	<2cm	Height between 10 and 50cm	**PASS***
Trampling/dung	None recorded	Impact should not be abundant/dominant	**Result =** none recorded **PASS**
Overall Structure & Functions Assessment			
All pass or one minor/borderline fail AND, if some indicators are Not Determined, the number of passes is at least five AND there is a pass for Positive Indicator Species		Green - Favourable	
1 - 2 Fail		Amber - Unfavourable Inadequate	**UNFAVOURABLE**
>2 Fail		Red – Unfavourable Bad	
Future prospects: Negative activities			
None recorded			**UNFAVOURABLE**

***Vegetation height lower as dominated by thalloid liverwort = passes this criterion

Conservation Score

Criteria	**Result**	**Score**
Species diversity score	1 positive indicator species (=low)	1
HQ Indicator Species	0	0
Tufa-forming capacity	Smaller consolidated deposits or strongly formed paludal tufa (=high)	3
Other positive characteristics	None	0
Conservation Score		4
Rank		**Moderate**

APPENDIX A - SURVEY AND CONDITION ASSESSMENT RESULTS

SITE AND SPRING DETAILS

Site name: Coolnabacky	**Spring name:** Stream 2	**Relevé No.:** CB02
Survey dates: 24/06/22 & 24/07/22	**Relevé dimensions:** 1m x 4m (2021), 2x2m (2022)	**Relevé area:** $4m^2$
Grid reference: S 53859 93043 (2021); S 53868 93044 (2022)	**Spring type:** Spring-fed stream	
Slope: <1-30^{o}	**Altitude (m):** *c.* 100m	**Aspect:** SE (2021); SW (2022)
pH: 8.30 (2021); 7.78 (2022)	**EC:** 840 µS (2021); 910 µS (2022)	**Temp.:** 15.1 (2021); 12.8. (2022)

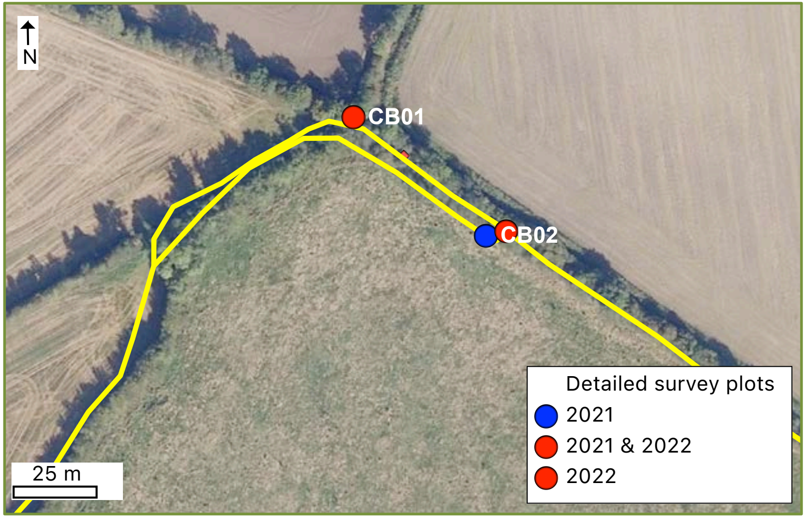
Spring description:

This stream arises near Stream 1 and flows parallel along the other side of the hedgerow but at a slightly higher elevation. It then enters Stream 1 through a gap in the hedgerow. It flows down over a tufa cascade to join Stream 1. Tufa cover is up to 85% cover in places, mostly oncoids and ooids except where cascade tufa forms where the two streams join. In 2021 a plot was positioned just upstream of where the two streams join, where they are parallel to each other either side of the hedgerow (CB02 blue circle, Figure 2.1). This had become overgrown and shaded in 2022 and the plot was moved to where the two streams join (CB02 red circle, Figure 2.1). The stream is shaded by hedgerows for most of its length except where it joins Stream 2 (where the 2022 plot is located). As for Stream 1, positive indicator species for the Annex I habitat 'petrifying springs with tufa formation' are rare. This is likely to be because the streams also act as drainage ditches and receive some surface water (and nutrients) from adjacent lands, increasing water depth at certain times of the year. Also there is shading from tall vegetation within the ditch in some areas (e.g. 2021 plot location). Although measured nitrate levels are high, there was little/ none filamentous algae. The stream is an example of **Group 3 *Brachythecium rivulare-Platyhypnidium riparioides* tufaceous streams and flushes** vegetation community (Lyons & Kelly, 2017).

Plot location:

The plot (CB02) is located in the NW of the site. In 2021 it was located just upstream of where two streams join. In 2022, the plot was moved to the location where the streams join.

Figure 2.1. Plot location (CB02) (blue circle, 2021; red circle, 2022)



RGB Aerial Photography - © Bluesky Geospatial Limited

Photograph 2.1. Plot CB01 (view to SW), 2021

Photograph 2.2. Plot CB01 (view to SW), 2022

DETAILED RELEVÉ

Physical characteristics (2021)

Tufa	% Cover	Water	% Cover	Surface	% Cover
Cascade	-	Flowing/ trickling	100	Living field/ ground flora	60
Paludal (1)	-	Pool/ standing water	-	Bare tufa (active/ recent)	30
Stream crust	-	Dripping	-	Ancient/ inactive tufa	-
Oncoids/ ooids	85	Damp	-	Leaf litter/ standing dead	5
Dam	-	Dry, not impacted by spring	-	Bare soil	5
Cemented rudites	-	Other:	-	Bare stone	-
Non-tufa	15			Other:	-
TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Paludal tufa: 1 = weak/ thin/ discontinuous, 3 = strongly forming/ continuous/ conspicuous
Cover values: record to nearest 5%. If <5% then use 3%, 1% 0.5%, 0.1%

Physical characteristics (2022)

Tufa	% Cover	Water	% Cover	Surface	% Cover
Cascade	50	Flowing/ trickling	100	Living field/ ground flora	45
Paludal (1)	3	Pool/ standing water	-	Bare tufa (active/ recent)	30
Stream crust	-	Dripping	-	Ancient/ inactive tufa	-
Oncoids/ ooids	20	Damp	-	Leaf litter/ standing dead	-
Dam	-	Dry, not impacted by spring	-	Bare soil	20
Cemented rudites	-	Other:	-	Bare stone	-
Non-tufa	27			Other:	5
TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Paludal tufa: 1 = weak/ thin/ discontinuous, 3 = strongly forming/ continuous/ conspicuous
Cover values: record to nearest 5%. If <5% then use 3%, 1% 0.5%, 0.1%

Shrub/ canopy layer (2021)

Species	Routed outside Canopy (%)	Routed inside Canopy (%)	Routed inside Height (m)
Corylus avellana	30		
Crataegus monogyna	5		
Prunus spinosa	5		
Rosa canina	1	-	-
TOTAL CANOPY (ROOTED INSIDE + ROOTED OUTSIDE) %	**TOTAL %:** 41	**TOTAL %**	**TOTAL %**
MAX HEIGHT (m) ABOVE QUADRAT (ROOTED INSIDE + ROOTED OUTSIDE): 8m			

APPENDIX A - SURVEY AND CONDITION ASSESSMENT RESULTS

Shrub/ canopy layer (2022)

Species	**Routed outside Canopy (%)**	**Routed inside Canopy (%)**	**Routed inside Height (m)**
Ilex aquifolium	20		
Corylus avellana	20		
Crataegus monogyna	20		
Prunus spinosa		<1	2m
Rosa canina	5		
Sambucus nigra	<1		
TOTAL CANOPY (ROOTED INSIDE + ROOTED OUTSIDE) %	**TOTAL %:** 65	**TOTAL %**	**TOTAL %**
MAX HEIGHT (m) ABOVE QUADRAT (ROOTED INSIDE + ROOTED OUTSIDE): 10m			

Field/ ground flora (2021)

FORBS	**%**	**GRAMINOIDS**	**%**	**BRYOPHYTES**	**%**	**WOODY**	**%**
Epilobium hirsutum	10	*Brachypodium sylvaticum* ^{A}	1	*Cratoneuron filicinum*	1	*Rubus fruticosus*	5
Mentha aquatica ^{A}	10	*Poa trivialis* ^{A}	1	*Pellia endiviifolia**	3		
Galium aparine	3	*Carex flacca* ^{A}	3	*Kindbergia praelonga*	3		
Filipendula ulmaria ^{A}	5	*Festuca rubra**	1	*Eurhynchium striatum*	3	**TOTAL WOODY <50cm**	**5**
Lythrum salicaria	3			*Plagiomnium undulatum*	1	**PTERIDOPHYTES**	
				Brachythecium rivulare	3	*Equisetum palustre*	3
				*Palustriella commutata**	1	**TOTAL PTERIDOPHYTES**	**0**
						ALGAE	
						TOTAL ALGAE	**0**
TOTAL FORBS	**31**	**TOTAL GRAMINOIDS**	**6**	**TOTAL BRYOPHYTES**	**15**	**TOTAL CANOPY**	**60**

*=Annex I positive indicator species; ^{A}=Accompanying species

Field/ ground flora (2022)

FORBS	**%**	**GRAMINOIDS**	**%**	**BRYOPHYTES**	**%**	**WOODY**	**%**
Helioscadium nodiflorum	3	*Agrostis stolonifera* ^{A}	3	*Cratoneuron filicinum*	1	*Rubus fruticosus*	15
Geranium robertianum	<1	*Brachypodium sylvaticum*	3	*Pellia endiviifolia**	10		
Mentha aquatica ^{A}	<1	*Carex remota*	<1	*Fissidens taxifolius*	<1		
Epilobium hirsutum	<1	*Poa trivialis* ^{A}	<1	*Palustriella commutata**	3	**TOTAL WOODY <50cm**	**15**
				Eurhynchium striatum	<1	**PTERIDOPHYTES**	
						Equisetum arvense	3
						Asplenium scolopendrium	<1
						TOTAL PTERIDOPHYTES	**4**
						ALGAE	
						TOTAL ALGAE	**0**
TOTAL FORBS	**4**	**TOTAL GRAMINOIDS**	**7**	**TOTAL BRYOPHYTES**	**15**	**TOTAL CANOPY**	**45**

*=Annex I positive indicator species; ^{A}=Accompanying species

APPENDIX A - SURVEY AND CONDITION ASSESSMENT RESULTS

Photos

Photo 2.3. Plot, view to NE (across stream), 2021

Photo 2.4. Plot, view to SW (upstream), 2022

Photo 2.5. Close up of plot vegetation, 2021

Photo 2.6. Close up of plot vegetation, 2022

APPENDIX A - SURVEY AND CONDITION ASSESSMENT RESULTS

Condition assessment (2021 & 2022)

Criteria	Result	Target value	Result and pass/ Fail
Species assessment criteria			
High quality indicator species	None recorded	n/a (included below)	n/a (included with positive indicator species)
Positive indicator species	3 species (2021), 2 species (2022) (* in species table)	3 species AND no loss from baseline number of species	**FAIL**
Typical accompanying species (neutral indicators)	5 species (2021), 3 species (2022) (^{A} in species table)	n/a	For information only
Invasive species	None recorded	Absent	Result = absent **PASS**
Negative herbaceous indicator species	1 species recorded 2022: *Helioscadium nodiflorum*	Total cover should not be dominant or abundant	**PASS**
Negative bryophyte indicator species	1 species recorded: *Cratoneuron filicinum* (rare)	No one species dominant or abundant; if ≥2 species present) then fails if ≥2 are frequent or 1 is abundant	**PASS**
Negative woody indicator species	n/a as wooded spring	Absent (except in wooded springs)	n/a
Spring water composition and flow			
Nitrate level	Upstream value of 39.4 mg/l and downstream of 37.7 mg/l	No increase from baseline and not above 10 mg/l	**PASS**
Phosphate level	Upstream value 2021 of <15 mg/l and downstream of <15 mg/l	No increase from baseline and not above 15 µg/l	**PASS**
Water flow	No obvious alteration	No alteration of natural flow	**PASS**
Impacts of grazing			
Field layer height	>1m (2021); 5-20 (2022)	Height between 10 and 50cm	**FAIL***
Trampling/dung	None recorded	Impact should not be abundant/dominant	**Result =** none recorded **PASS**
Overall Structure & Functions Assessment			
All pass or one minor/borderline fail AND, if some indicators are Not Determined, the number of passes is at least five AND there is a pass for Positive Indicator Species		Green - Favourable	
1 - 2 Fail		Amber - Unfavourable Inadequate	**UNFAVOURABLE**
>2 Fail		Red – Unfavourable Bad	
Future prospects: Negative activities			
None recorded			**UNFAVOURABLE**

*Vegetation height passed in plot in 2022, but would fail along the length of the stream in both years

Conservation Score

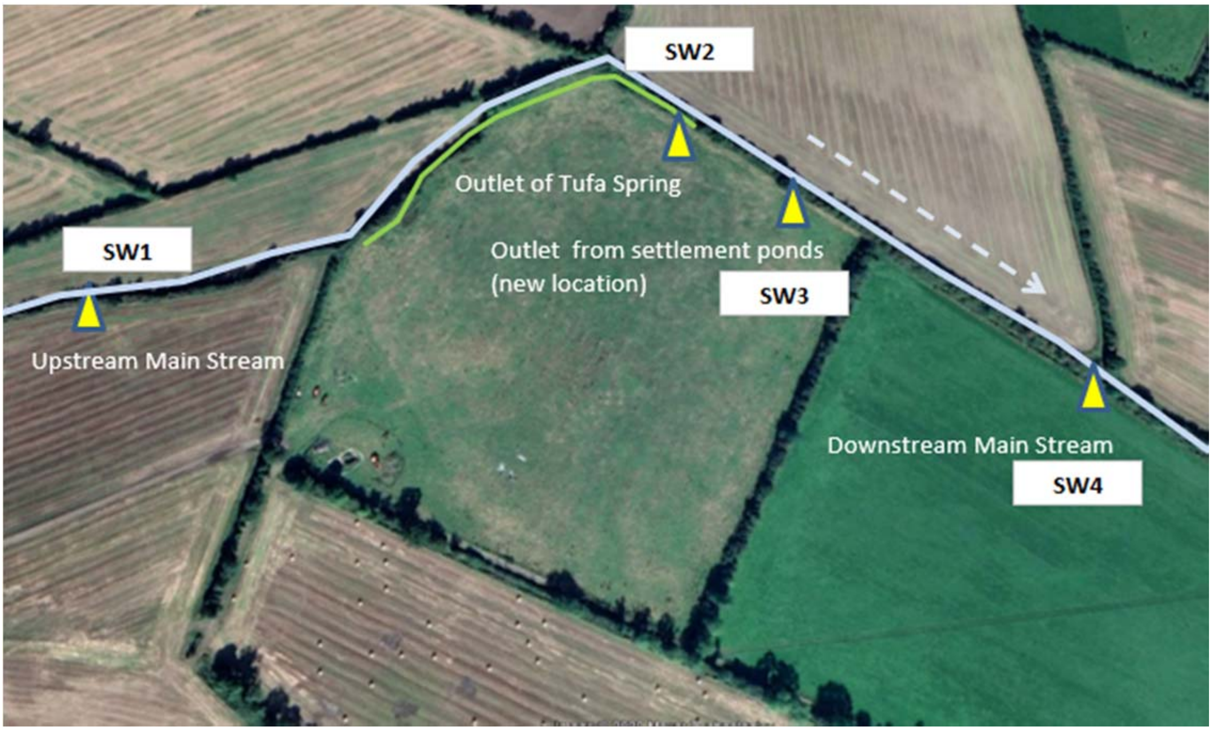
Criteria	Result	Score
Species diversity score	3 positive indicator species (=low)	1
HQ Indicator Species	0	0
Tufa-forming capacity	Massive, strongly consolidated deposits	4
Other positive characteristics	None	0
Conservation Score		5
Rank		**High**

BASELINE SURFACE WATER SAMPLING 30TH MARCH 2022

COOLNABACKY, TIMAHOE, CO. LAOIS

INTRODUCTION

IE Consulting took surface water samples at three locations SW1, SW2 and SW4 as shown below, because SW3 has not yet been constructed. The samples were taken to establish baseline conditions prior to commencement of the main civils works at the site



The samples were analysed at Element Laboratories, and the results were interpreted by IE Consulting

INTERPRETATION

The results of analysis are provided in the table below and are compared to the relevant EQS standards.

The results are all very similar suggesting, that all streams are calcium rich groundwater fed in the area.

There is no evidence of any deterioration in water quality as the stream passes the site.

The only negative is the elevated Nitrate concentrations since nutrient enrichment can cause damage to Tufa spring habitats. The results suggest some nutrient loss to groundwater from the agricultural activity in the vicinity of the site.

Parameter Surface Water Monitoring	**SI272/2009 as amended by SI372/2012; SI386/2015; SI77/2019; SI659/2021**	**Units**	**SW1**	**SW2**	**SW4**
			Upstream	**Tufa Spring Outlet**	**Downstream**
			30/03/2022	**30/03/2022**	**30/03/2022**
Calcium	-	mg/l	117.5	118.8	117.3
Magnesium	-	mg/l	5.2	5.3	6.5
Potassium	-	mg/l	3.2	3	3
Sodium	-	mg/l	6.8	7	9.6
Sulphate as SO_4	-	mg/l	22.8	22.4	22.9
Chloride	-	mg/l	23.8	23.8	32.6
Nitrate as NO_3	-	mg/l	39.4	37.7	38.2
Molybdate Reactive Phosphorous as P	≤ 0.035 Good Status	mg/l	<0.015	<0.015	<0.015
Ammoniacal Nitrogen as NH_4	≤ 0.004 High Status	mg/l	<0.03	0.03	0.03
Electrical Conductivity	-	uS/cm	678	677	699
pH	6.0 < pH < 9.0 *	pH units	8.14	8.31	8.19
Total Alkalinity as $CaCO_3$	-	mg/l	302	292	290
TPH CWG					
>C5-C6	-	ug/l	<10	<10	<10
>C6-C8	-	ug/l	<10	<10	<10
>C8-C10	-	ug/l	<10	<10	<10
>C10-C12	-	ug/l	<5	<5	<5
>C12-C16	-	ug/l	<10	<10	<10
>C16-C21	-	ug/l	<10	<10	<10
>C21-C35	-	ug/l	<10	<10	<10
>C35-C44	-	ug/l	<10	<10	<10
Total aliphatics C5-44	-	ug/l	<10	<10	<10
>C5-C6	-	ug/l	<10	<10	<10
>C5-EC7	-	ug/l	<10	<10	<10
>EC7-EC8	-	ug/l	<10	<10	<10
>EC8-EC10	-	ug/l	<10	<10	<10
>EC10-EC12	-	ug/l	<5	<5	<5
>EC12-EC16	-	ug/l	<10	<10	<10
>EC16-EC21	-	ug/l	<10	<10	<10
>EC21-EC35	-	ug/l	<10	<10	<10
>EC35-EC44	-	ug/l	<10	<10	<10
Total aromatics C5-44	-	ug/l	<10	<10	<10
Total aliphatics and aromatics (C5-44)	-	ug/l	<10	<10	<10
MTBE	-	ug/l	<5	<5	<5
Benzene	10 #	ug/l	<5	<5	<5
Toluene	10 #	ug/l	<5	<5	<5
Ethylbenzene	-	ug/l	<5	<5	<5
m/p-Xylene	10 #	ug/l	<5	<5	<5
o-Xylene	10 #	ug/l	<5	<5	<5

*Water hardness > 100 mg/l

River Water body

Decommissioning of 2 No. Boreholes (BH04 & BH05) and installation of 1 No. replacement borehole (BH04b)

Coolnabacky, Timahoe, Co. Laois

May 2023

IE CONSULTING
WATER-ENVIRONMENTAL-CIVIL

Decommissioning of 2 No. Boreholes (BH04 & BH05) and installation of 1 No. replacement borehole (BH04b)

Client: ESB Networks

Location: Coolnabacky, Timahoe, Co. Laois

Date: 17th May 2023

Document Control

PROJECT NUMBER: IE2219		DOCUMENT REF: IE2219-5766-ISSUE			
2.0	Issue	J Mackey	J Keohane		17/05/2023
1.0	Draft	J Mackey	J Keohane		12/05/2023
Revision	Purpose Description	Originated	Checked	Reviewed	Date

Contents

List of Figures

1. Introduction

IE Consulting were engaged by ESB Engineering and Major Projects (EMP), on behalf of ESB Networks to support the procurement and supervision of the decommissioning of 2 No. Boreholes (BH04 & BH05) and installation of 1 No. replacement borehole (BH04b), at Coolnabacky, Timahoe, Co. Laois.

These works are part of the proposed construction of a substation at Coolnabacky, which is an element of the network improvement scheme for the Laois-Kilkenny Project.

The objective of this document is to provide a specification for the decommissioning of 2 No. Boreholes (BH04 & BH05) and the installation of 1 No. replacement borehole (BH04b), together with a site specific environmental and health and safety risk assessment, plus method statement for the works.

2. Location and Topography

The site lies 2.5km north of Timahoe in Co. Laois with access off the R426. The site is bounded on all sides by agricultural land. The site is a low lying, mostly flat area which extends east and north of the site, although the surrounding land to the south and west becomes hummocky within 150m to 200m of the site. The geomorphology in the area of the site is glacio-fluvial in origin.

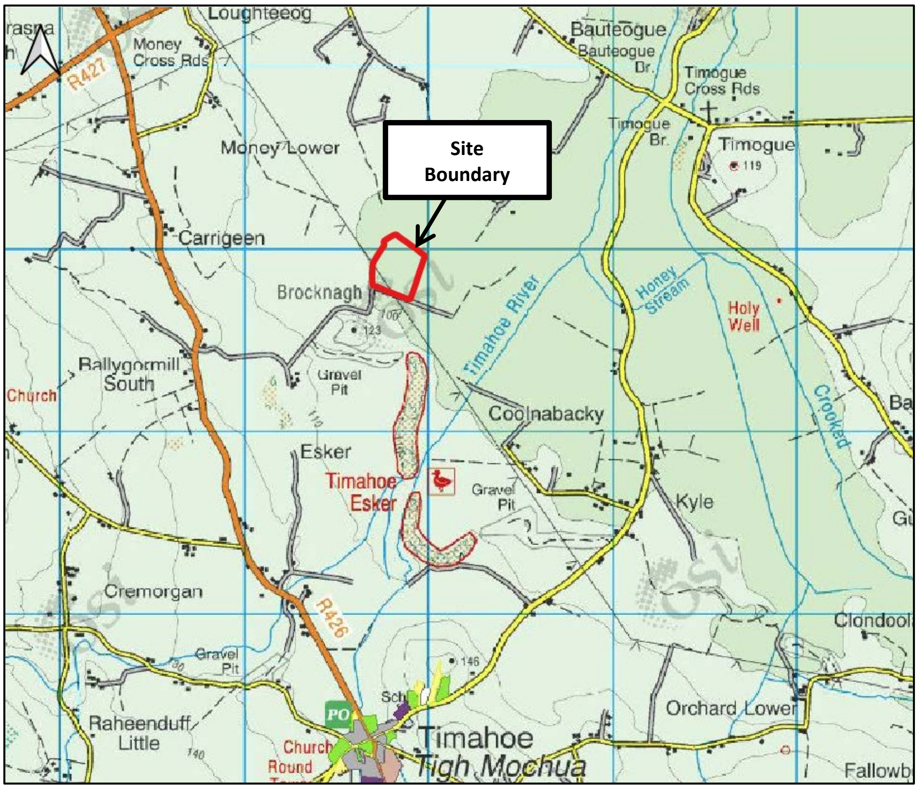


Figure 1: Location of Coolnabacky Site (modified from OSI, 2023)

3. Geological and Hydrogeological Environment

The main surface water drainage feature in the area is the Timahoe River which flows 500m east of the site, which later becomes the Bauteoge River. The un-named stream that borders the site to the north eventually joins the Timahoe River. The majority of the surface watercourses in the area are canalised or modified and there is extensive drainage in the low lying area. There are field drains on the western, eastern and southern borders of the Sub-station site.

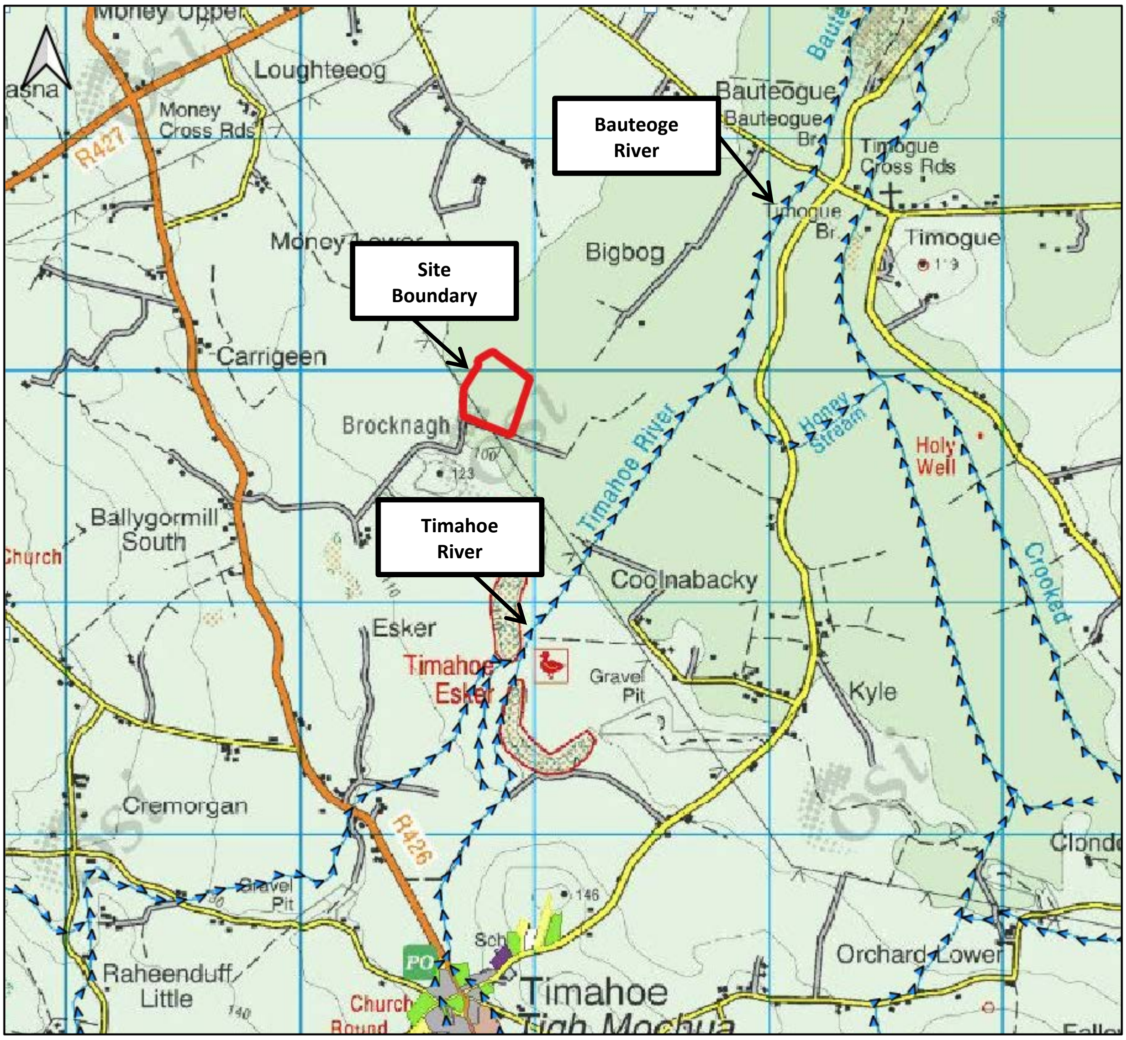


Figure 2: Surface drainage around Coolnabacky Site (modified from OSI, 2023)

Reference to the GSI database indicates subsoils consisting of Alluvium and Glacial sand and gravel to 3m approx. overlying stiff boulder clay from 3mbgl to approximately to 9mbgl (refer to Figure 3). The gravels are derived from Carboniferous limestones. The GSI maps mineral alluvium as the soils beneath the site and shallow poorly drained mineral (mainly basic) (BminSP) to the north, west, and south of the site (Teagasc, 2022). This was confirmed, as evidenced in the borehole logs completed by Causeway Geotech from borehole logs of from 2018. Bedrock was not encountered in the boreholes with depths of 6.5mbgl for BH01 and BH02; 8.5mbgl for BH03; 9.5mbgl for exploratory hole BH04 located adjacent to monitoring borehole BH04; and 6.5mbgl for exploratory hole BH01 adjacent to BH05 (refer to Appendix I and III for Logs). Additionally, the following ground types were encountered more generally on site per Report No. 17-0439 prepared by Causeway Geotech, based on exploratory boreholes, trial pits, soil sampling etc., carried out on the site, and listed in approximate stratigraphic order:

- Topsoil: encountered at approximately 300-500mm thickness across the site.
- Alluvium/glacial gravels: typically, soft to firm sandy gravelly clay/silt or medium dense sandy gravel/gravelly sand. Encountered to a depth of 3.8m in BH09, located in the middle south west of the site (see Appendix II, Figure 2). Reworked topsoil was encountered to a depth of 700mm in TP10; located in the south of the site (see Appendix II, Figure 3).
- Glacial Till: sandy gravelly clay, frequently with low cobble content, typically firm or stiff in upper horizons, becoming very stiff with increasing depth greater than 9.5m.

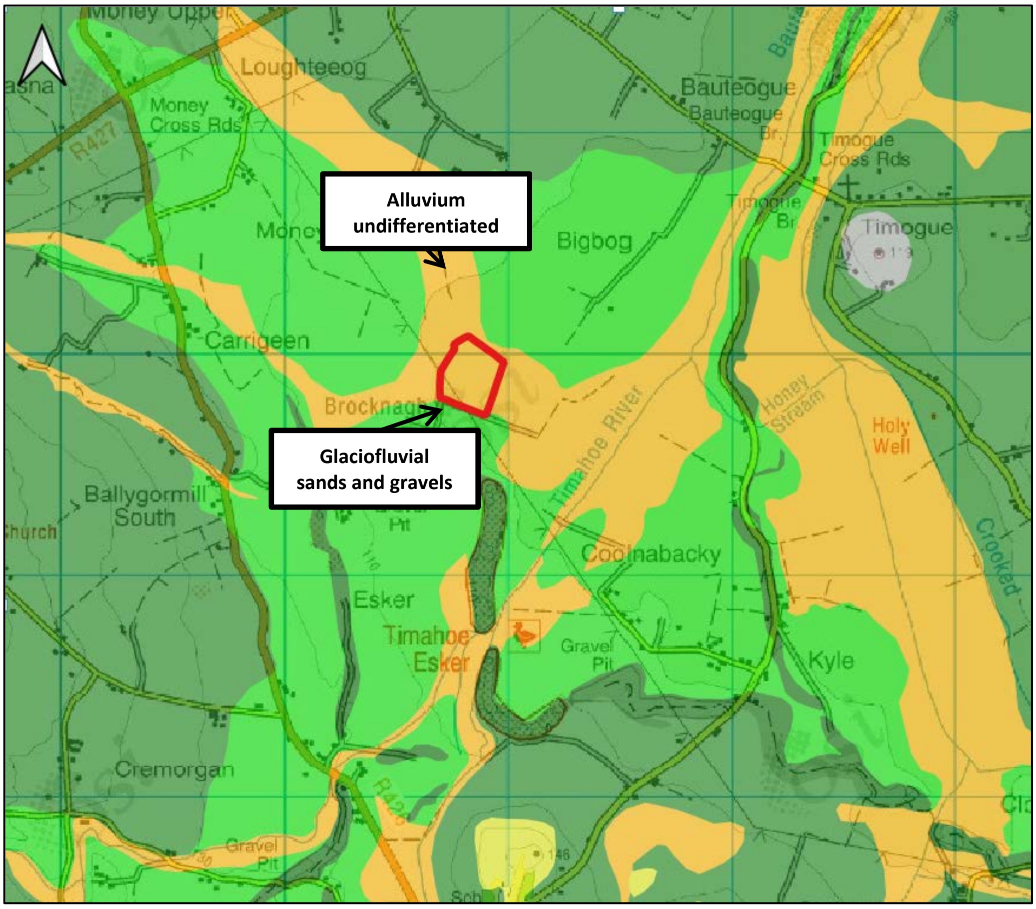


Figure 3: Subsoils in the vicinity of the Coolnabacky site (modified from GSI, 2023)

The underlying bedrock geology of the site comprises limestone of the Ballyadams Formation which is described as thick bedded to massive wackestones and packstones (GSI, 2023 (refer to Figure 4). Bedrock was not encountered in any of the historic boreholes on the site and it is not anticipated to be encountered in the upper 10m.

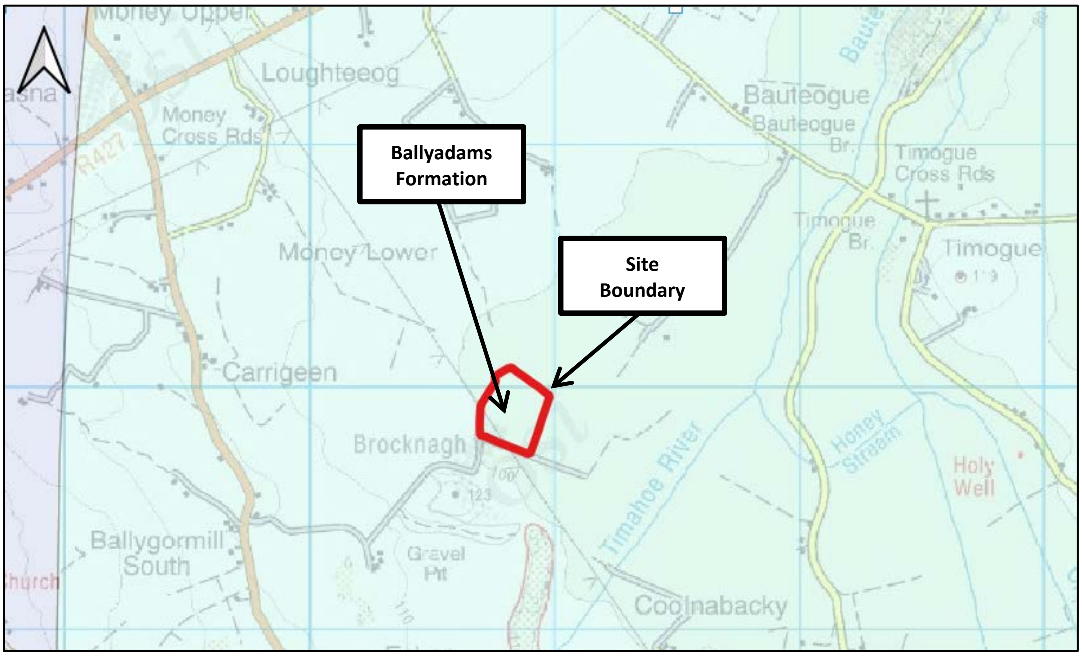


Figure 4: Underlying bedrock geology at Coolnabacky site (modified from GSI, 2023)

A survey carried out by IE Consulting in 2022, of all perimeter drains and the main stream encountered evidence of tufa deposits in the watercourses as shown in Figure 5, which suggests that many of the surface water features are groundwater fed.

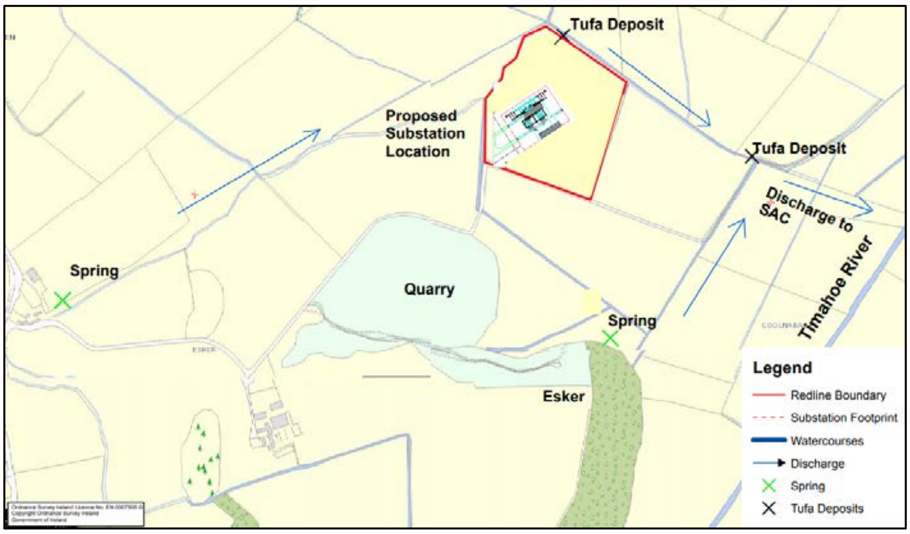


Figure 5: Tufa Deposits (modified from IE Consulting, 2022)

The bedrock aquifer below the site is mapped as an Rkd (Regionally Important Aquifer – Karstified-diffuse) (Refer to Figure 6). The GSI maps the area as being in a sand and gravel aquifer, but site specific studies have confirmed that the sand and gravel deposits on site do not comprise an aquifer (EIS chapters 9 and 10, 2013; Tobins Report, 2007; SLR, 2018; IE Consulting, 2021).

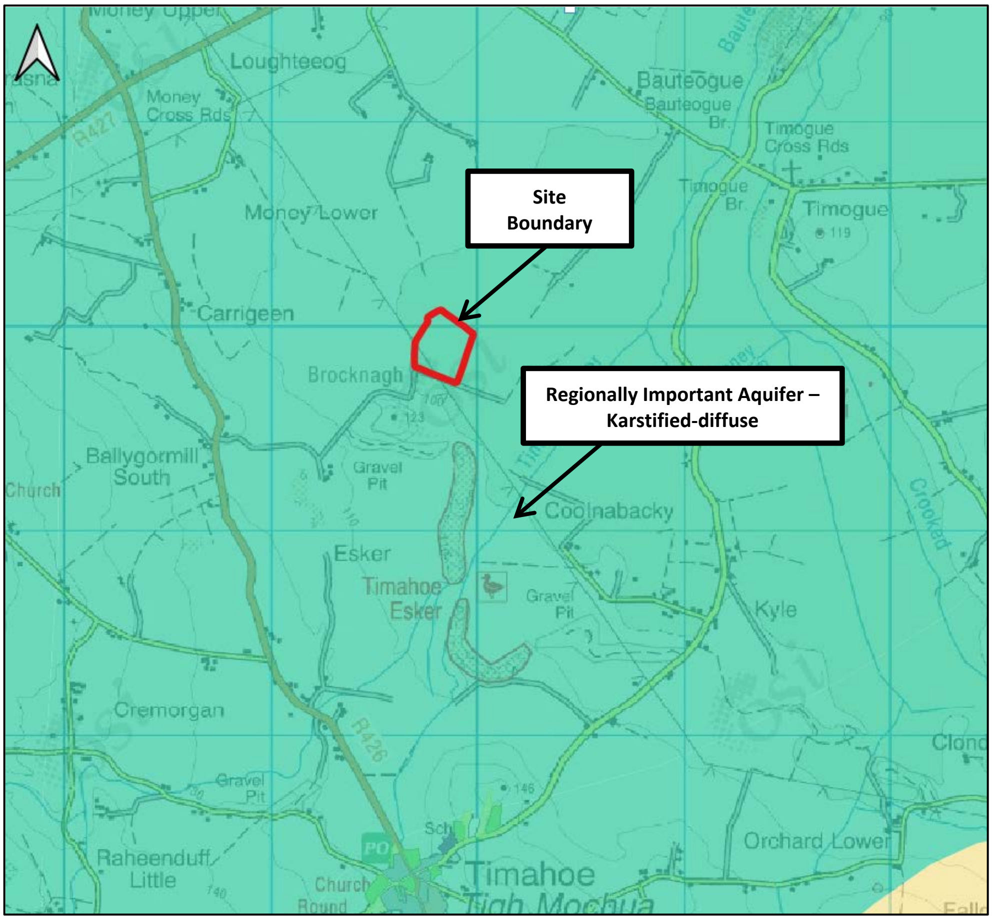


Figure 6: Aquifer Map (GSI, 2023)

4. Borehole Works

4.1. Introduction

It is proposed to re-locate monitoring borehole BH04 to avoid the construction footprint of the proposed substation 110kV building. The existing borehole BH04 will be decommissioned and a new borehole BH04b (replacement monitoring well) will be installed further south of the existing monitoring well. A former site investigation borehole BH05 is also in construction footprint of the substation 110kV building so will therefore also need to be decommissioned.

The borehole log is unavailable for BH05 so the borehole logs for BH01, BH02 and BH03 are provided for information purposes in Appendix I. There are a number of borehole logs from exploratory holes by Causeway Geotech in 2018, these locations and logs are available in Appendices II and III. Refer to Figure 7 for map of current boreholes in relation to footprint of construction. The subsequent sections outline the proposed approach to carry out these works.

Figure 7: Current location of Boreholes BH01 to BH05

4.2. Decommissioning of Wells

4.2.1. Overview

It has been decided to decommission 2 No. Boreholes (BH04 & BH05). At present, the Irish Environmental Protection Agency (EPA) and Geological Survey of Ireland (GSI) do not have guidance documents regarding the decommissioning of wells. BS5930:2015 is Code of practice for ground investigations, containing decommissioning information for water wells specific to site investigation activities.

BS5930 contains decommissioning information for boreholes specific to site investigation activities. In addition, the following guidance document was consulted, specific to water supply wells, when preparing this specification: *Good practice for decommissioning redundant boreholes and wells* – Scottish Environmental Protection Agency (SEPA) (SEPA, 2012).

It is to be noted that the above documents only provides an overview of the general procedure of good practice measures for decommissioning redundant boreholes and wells, issued by the Environmental Protection Agency of Scotland. The decommissioning procedure is to be carried out by a licenced drilling contractor. A detailed procedure, risk assessment and method statement must be site-specific and will be issued to ESB prior to commencement of works.

The guidance document - Good Practice for Decommissioning Redundant Boreholes and Wells, issued by the Environmental Agency of Scotland, strongly advices that a proficient contractor with sufficient experience must be present on site during the decommissioning works. It is suggested that good practice measures such as recording of backfilling and groundwater data must be followed for future reference.

4.2.2. Decommissioning BH04

4.2.2.1. Overview

A site visit was performed on 09th May 2023 to confirm the location of BH04 and to obtain construction details.

Exploration hole BH04 was drilled by Causeway in 2018 selected as the basis for the following procedure for decommissioning. Per the Causeway Geotech Report exploration hole log for BH04 (Appendix III) the monitoring well was documented at coordinates 653775.62 E, 692876.75 N. However on the site visit BH04 was verified as being located 653755.62 E, 692876.75 N. Therefore the location likely has an error in the easting coordinates recorded. Therefore the borehole log recorded in Appendix III is deemed to be an accurate representation of the monitoring well BH04 to be decommissioned.

On the site visit the following parameters were measured for all five monitoring boreholes:

Table 1: Measured Parameters recorded on 09th May 2023

	Total Depth (m) (From top of casing)	**Water Level (m)** (From top of casing)	**Stick up of casing above ground (m)**
BH01	1.71	1.06	0.54
BH02	2.23	1.37	0.36
BH03	2.79	1.67	0.55
BH04	6.55	1.18	0.63
BH05	3.40	1.30	0.61

Figure 8: Location of BH04 (pink) in relation to exploratory holes (orange) completed by Causeway Geotech in 2018

Figure 9: Picture of BH04 (facing south-south-west) on 09th May 2023

Refer to Figure 10 for schematic of the following phases of decommissioning:

4.2.2.2. Step 1

Remove all surface obstructions which may interfere with the sealing of the borehole. Pour wet, low viscosity with specific gravity of 1.1, cement grout into borehole up to the top of the slotted casing to seal both the borehole and the pore space within the permeable material surrounding the base of the gravel. The material should be checked prior to installation and introduced through the 200mm slotted casing. The cement will not migrate further than the borehole annulus.

4.2.2.3. Step 2

Excavate the upper 1mbgl of material in a 1m x 1m area around the borehole

4.2.2.4. Step 3

- The steel well head should be removed and the plastic casing should be cut flush with the ground.
- Place bentonite clay into the upper section and place in base of excavation to a depth of 100mm. This should be added slowly to avoid bridging of bentonite.

4.2.2.5. Step 4

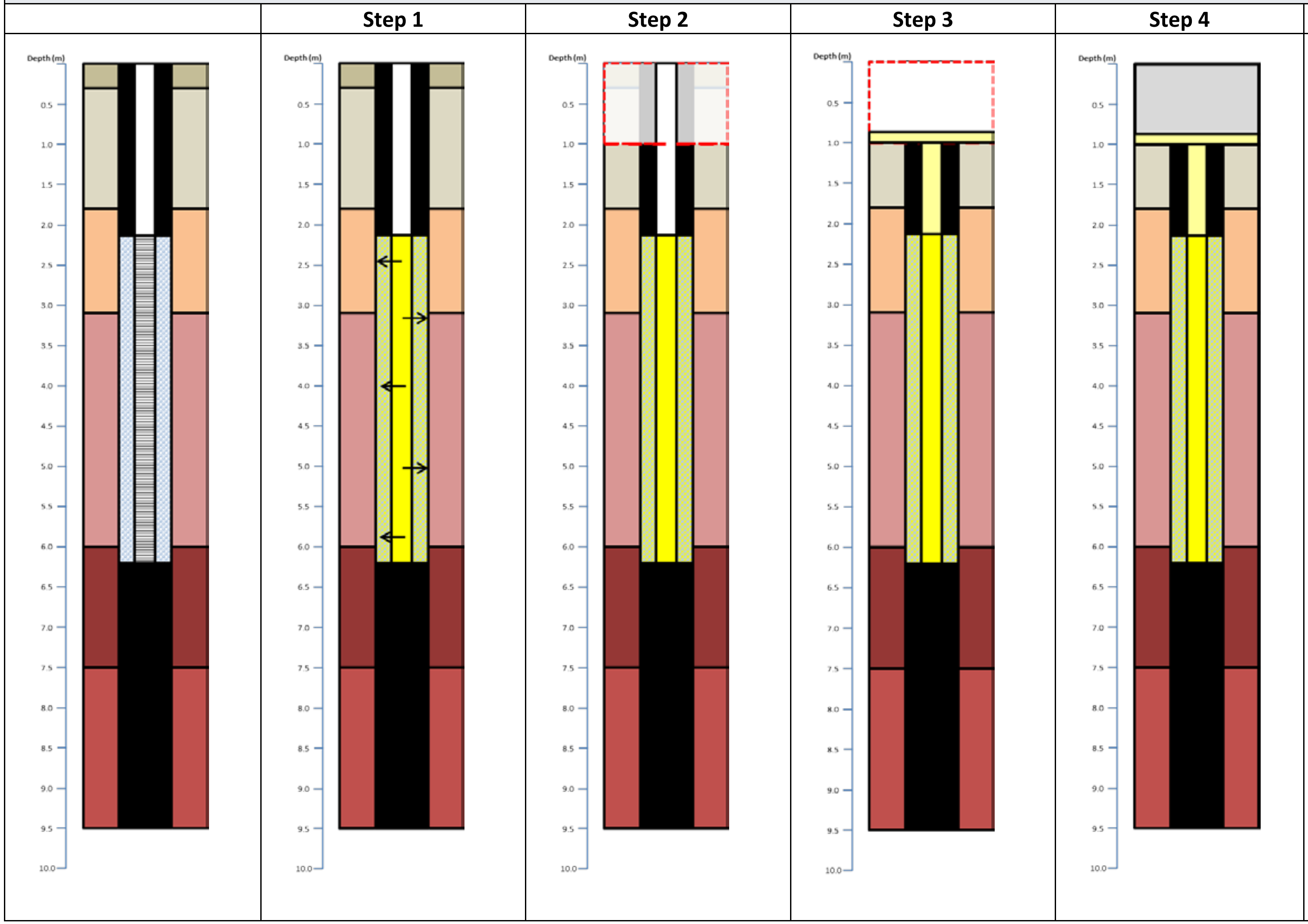
- It is imperative that the fill material be of similar chemistry and rock type to the native bedrock geology, in particular due to the presence of the tufa deposits which require calcium rich conditions. However, in the case of these boreholes they do not penetrate bedrock or the aquifer, they only encounter the subsoil characterised as alluvium and sand and gravel deposits.

- This stockpile on site is an ideal filler for the upper portion of the borehole; i.e. a low permeability material. The fill material will therefore mimic the surrounding strata and be of the same chemistry so as groundwater quality and flow can be protected and restored.

4.2.2.6. Other Actions

- Photographs and records (water levels, diameter, depth of materials installed, type of material used etc.) of the decommissioning should be noted on a decommissioning log. The GPS coordinates and datum of the well should be noted on the log also.
- The abandoned borehole should be marked on all site maps and temporarily on the ground during construction, so that extra care is taken, if any excavations are undertaken.
- The location of the decommissioned borehole should be fenced off to prevent site traffic passing over it during the construction phase. No oils, chemicals or waste concrete should be stored in the immediate vicinity of the decommissioned well.
- The advice of a hydrogeologist should be sought if difficulties are encountered during the decommissioning phase.
- The borehole should be decommissioned prior to the commencement of any construction works in the vicinity of the borehole location to remove any potential preferential pathway for contaminations to enter the bedrock aquifer.

Decommissioning of BH04 & BH05



Legend

🟥	Very stiff grey slightly sandy gravelly CLAY with low cobble content. Sand is fine to course. Gravel is subangular to subrounded fine to coarse. Cobbles are subangular to subrounded.
🟫	Stiff grey slightly sandy gravelly CLAY low cobble content. Sand is fine to course. Gravel is subangular/subrounded fine to coarse. Cobbles are subangular/subrounded.
🟥	Firm grey sandy slightly gravelly CLAY low cobble content. Sand fine to coarse. Gravel subangular/ subrounded fine to coarse. Cobbles subangular/subrounded.
🟧	Soft grey sandy slightly gravelly SILT. Sand is fine to coarse. Gravel is subrounded fine to coarse.
⬜	Medium dense grey sandy cleyey subangular to subrounded fine to coarse GRAVEL. Sand is fine to coarse.
🟫	Topsoil: Firm brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Sand is fine to coarse.
⬛	Backfill
▨	Permeable backfill.
▤	200mm slotted casing.
▨	Permeable backfill, pore space occupied by concrete cement or bentonite clay.
🟨	Cement grout: wet, low viscosity with specific gravity of 1.1.
⬚	Area of extraction (to 1 mbgl)
🟨	Cement grout, including cap allowed to spill over the upper extraction area.
⬜	Stockpile from the site

Figure 10: Schematic for Decommissioning of BH04 & BH05

4.2.3. Decommissioning BH05

4.2.3.1. Overview

The location for BH05 was verified on a site visit on 09th May 2023, confirmed as coordinates 653738.95 E, 692851.67 N. The borehole log for BH05 is unavailable. Therefore a review of the available historic borehole log data for the site was performed. From the exploratory holes by Causeway Geotech in 2018 (see Figure 8), exploratory hole BH01 lies less than 7m south east of BH05 and BH04 is 30m north east of BH05. See appendix III for BH01 exploratory hole log. Generally the site is homogeneous so the same depths can be applied to BH05.

The below phased approach is recommended for decommissioning of BH05.

Figure 11: Location of BH05 (pink) in relation to exploratory holes (orange) completed by Causeway Geotech in 2018

Figure 12: Picture of BH05 (facing south-south-west) on 09th May 2023

Refer to Figure 10 above for schematic of the following phases of decommissioning (note figure 10 is applicable to BH04 decommissioning but the same approach will be employed here):

4.2.3.2. Step 1

Remove all obstructions which may interfere with the sealing of the borehole. If the slotted casing is present, pour wet, low viscosity concrete cement or bentonite clay with specific gravity of 1.1, into the borehole up to the top of the slotted casing to seal both the borehole and the pore space within the permeable material surrounding the base of the gravel. The material should be introduced through the 200mm slotted casing.

4.2.3.3. Step 2

4.2.3.4. Excavate the upper 1mbgl of material in a 1m x 1m area around the borehole. Step 3

- The steel well head should be removed and the plastic casing should be cut flush with the ground.
- Place bentonite clay into the upper section and place in base of excavation to a depth of 100mm. This should be added slowly to avoid bridging of bentonite.

4.2.3.5. Step 4

- It is imperative that the fill material be of similar chemistry and rock type to the native bedrock geology, in particular due to the presence of the tufa deposits which require calcium rich conditions. However, in the case of these boreholes they do not penetrate bedrock or the aquifer, they only encounter the subsoil characterised as alluvium and sand and gravel deposits.

- This stockpile on site is an ideal filler for the upper portion of the borehole; i.e. a low permeability material. The fill material will therefore mimic the surrounding strata and be of the same chemistry so as groundwater quality and flow can be protected and restored.

4.2.3.6. Other Actions

- Photographs and records (water levels, diameter, depth of materials installed, type of material used etc.) of the decommissioning should be noted on a decommissioning log. The GPS coordinates and datum of the well should be noted on the log also.
- The abandoned borehole should be marked on all site maps and temporarily on the ground during construction, so that extra care is taken, if any excavations are undertaken.
- The location of the decommissioned borehole should be fenced off to prevent site traffic passing over it during the construction phase. No oils, chemicals or waste concrete should be stored in the immediate vicinity of the decommissioned well.
- The advice of a hydrogeologist should be sought if difficulties are encountered during the decommissioning phase.
- The borehole should be decommissioned prior to the commencement of any construction works in the vicinity of the borehole location to remove any potential preferential pathway for contaminations to enter the bedrock aquifer.

4.3. Installation of Borehole Monitoring Well

4.3.1. Overview

It is proposed to re-locate BH04 due to the proposed substation 110 kV building as part of the Coolnabacky substation upgrade works. BH04b (replacement monitoring well) will be located further south (see Figure 13) of the existing monitoring well. It will be in a recessed area off the farm-track.

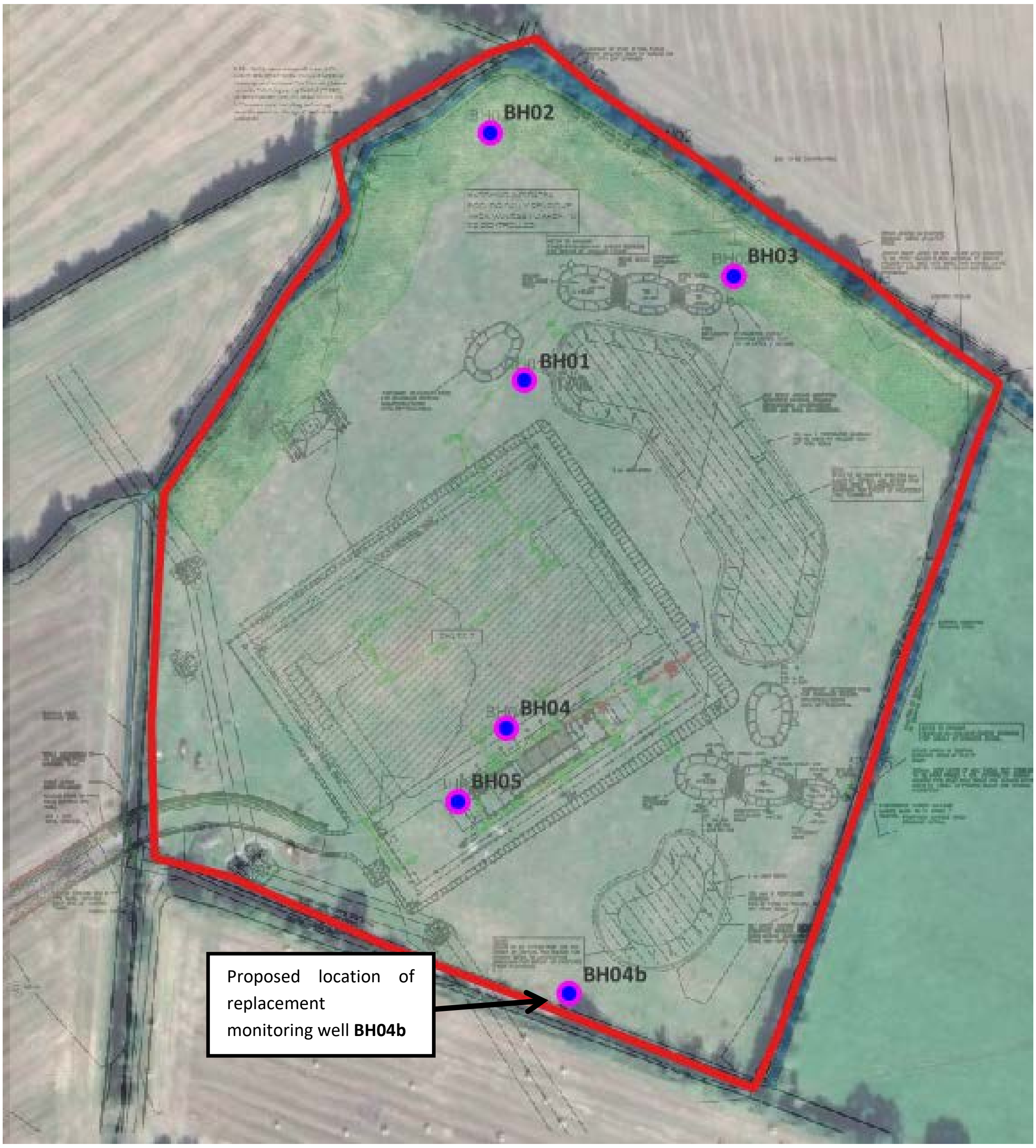


Figure 13: Drawing of BH04b in relation to proposed substation location

A review of the available historic borehole log data for the site was performed. From the exploratory holes by Causeway Geotech in 2018 (see Figure 12), exploratory hole BH01 and Trial Pit TP14 will lie north west of the replacement hole to be installed further 70m and 66m south respectively. See appendix III for Logs of BH01 exploratory hole and TP14 Trial Pit.

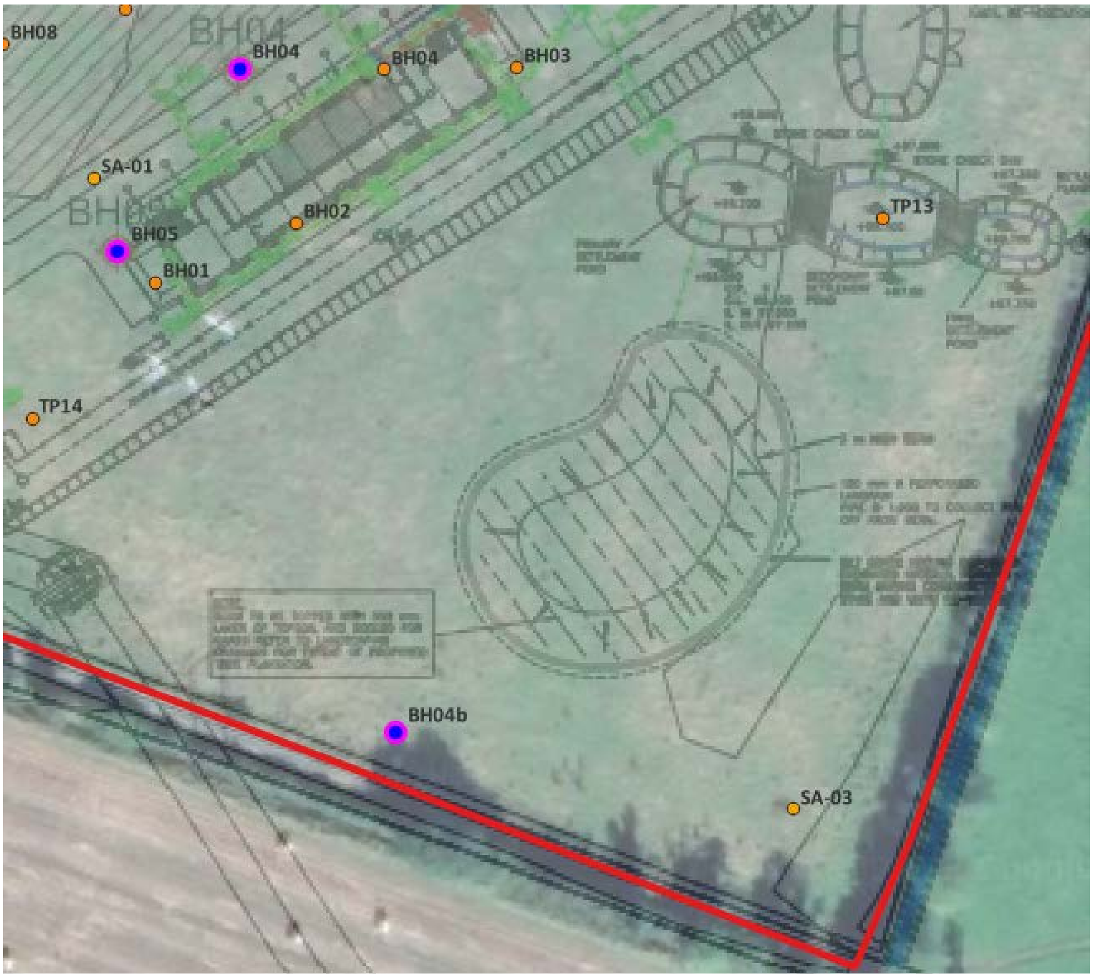


Figure 14: Adjacent exploratory holes to proposed replacement BH04b location

4.3.2. Installation Methodology for BH04b

BH04b will be installed as per available guidelines such as Environment Agency, Institute of Geologists of Ireland (IGI) and EPA. BH04b will be drilled to an approximate depth of 6m. The location is not adjacent to the tufa springs (located to the north of the site), or feeder streams and the target depth is well above the depth of expected bedrock.

The following steps should be included in the final methodology and scope of works submitted by the specialist drilling contractor but not limited to:

- Mobilisation

- Equipment & Supplies to be used
- Drilling methodology
- Monitoring well drilling diameter- minimum 200mm diameter with temporary casing
- Drill to 6.5m, place slotted 50mm diameter well screen with bottom cap, with plain from 1m to surface. The well casing should be wrapped with geotextile to prevent fines entering the borehole.
- Headworks design
- Backfill specification with clean round uniform limestone gravel pack.
- Bentonite seal from 1m to 0.5m
- Install headworks, with lockable cap
- Pour concrete plinth from 0.5m and create a sloping plinth around the borehole.
- Attach name plate BH 4-B
- Supervision by a geotechnical and/or environmental engineer
- Provide a Detailed borehole log with geological units and groundwater level
- Remove any excess concrete, bentonite or well materials off-site. Any uncontaminated drilling spoil can be incorporated with existing subsoil stockpiles enclosed by silt fencing

5. Environmental Method Statement for Works

5.1. Introduction

As part of environmental diligence, ESB EMP, on behalf of ESB Networks has requested that an environmental method statement be prepared for the decommissioning and installation works, as detailed in this document to minimise impacts, primarily on the Tufa deposits identified on the site, also the feeder streams along the perimeter of the site and to ensure there is no impact to the underlying Rkd aquifer.

5.2. Location

The activities involved in the decommissioning and installation, are confined to the south and south-eastern corner of the site, which is the most remote from the Tufa springs or the perimeter drains and feeder streams.

5.3. Interaction with underlying bedrock

The existing boreholes do not penetrate the bedrock so there will be no interaction with the bedrock during the decommissioning works.

Similarly the proposed replacement borehole is designed to mimic the existing ground conditions of BH04 as closely as possible, and is expected to be at least 3m above any potential bedrock, and to be collared in a stiff boulder clay, which will limit the ingress of any shallow groundwater or surface water during the drilling works.

There is no significant risk to the groundwater aquifer beneath the site, due to the proposed works. However, the proposed mitigation measures to protect surface water will by default provide adequate protection to groundwater as well.

5.3.1. Construction sequencing

5.3.1.1. Duration and timing of Works

The works will be undertaken in Summer of 2023 during which time groundwater levels are expected to be low, also no groundwater table was observed in the sand and gravels per the EIS, 2013; Chapters 9 and 10, and other available reports. The expected duration of works from establishment is not expected to exceed 5 working days. The works will be confined to daylight hours.

5.3.1.2. Site Establishment

Vehicular Access will be via the main entrance at the south-western corner of the site.

Safety tape with cones will be erected around the activity. There will be one access point and the area will be confined and small. A briefing on the sensitivity of the site will be undertaken by the geologist who will oversee the works. All staff will be required to present safe pass and manual handling certification where applicable.

This method statement and risk assessment will be discussed with all personnel to highlight the key environmental risk elements and mitigation measures.

All equipment will be cleaned prior to being transported to site to prevent the spread of invasive species and any contamination from other sites and will be inspected to ensure, there are no leaks, drips and that all pipes and connectors are properly fitted and secure.

The equipment proposed by the contractor will include the following;

- Transport Vehicle and Trailer
- Drill rig and associated tools
- Mini digger
- Fuel
- Spill-kits

Set down areas will be identified and cordoned off using cones and signage.

A spotter will assist with the loading and unloading of machinery/equipment to ensure that this is done safely, and to avoid plant to any accidental spillages.

5.3.1.3. General work practices

Re-fuelling of plant will be undertaken offsite. Particular attention will be paid to gradient and ground conditions at the re-fuelling location which could increase any risk of discharge to waters. A drip tray will be used at all times. Other mitigation will include:

- A hydrocarbon spill kit will be available at all times, this will contain as a minimum absorbent pads, oil containment booms and other items for clean-up and containment of spills.
- Daily checks will be made on the plant to ensure there are no signs of leakage
- Oils and fuels will not be stored overnight on site.
- A clean as you go policy will be implemented, and a through clean – up at the end of each day will be required.
- Weather conditions will be monitored and works will be stopped, if the weather conditions might lead to any increased environmental risk.

- The works area will be kept free of debris or waste materials.
- Because no in-stream works are scheduled, there will be no disturbance of in stream substrate, including tufa deposits and no loss of submerged or emergent tufa deposits from the stream.

5.3.1.4. Stage 1 – Decommission Borehole Well BH04

A specific detailed procedure for decommissioning of BH04 is outlined in Section 4.2.2.

5.3.1.5. Stage 2 - Decommission Borehole Well BH05

A specific detailed procedure for decommissioning of BH05 is outlined in Section 4.2.3.

5.3.1.6. Stage 3 – Installation of Borehole Well BH04b

A specific detailed procedure for installation of BH04b is outlined in Section 4.3.

5.3.1.7. Emergency Response Plan

The chain of command with regard to any environmental emergency will be led by a geologist from IE Consulting who will be on site for the duration of the works.

Staff will be informed of the consequences of any fuel spillages or poor control of sediment.

In the event of a fuel spillage, works will be stopped, the source of the spill will be stopped, and all sources of ignition will be removed. The spill will be contained by using a spill kit, and will not be spread and migrate towards the water course or flushed away. Contain and remove any oil contaminated material. Laois County Council will also be informed in the event of a spill.

In the remote chance that material enters a drain or a stream, place boom across the stream to trap the oil, and arrange for recovery of any free product.

A record of the event, including photographs will be prepared by the supervising geologist.

6. Health and Safety Method Statement

6.1. Purpose

The health & safety method statement will present the information compiled about the various hazards and the ways in which they are to be controlled for the decommissioning and installation works.

6.2. Scope

This Method Statement is prepared for the:

- Decommissioning of BH04
- Decommissioning of BH05
- Installation of BH04b

6.3. Risk Assessment

0	1	2	3	4	5
1	1	2	3	4	5
2	2	4	6	8	10
3	3	6	9	12	15
4	4	8	12	16	20
5	5	10	15	20	25

Likelihood			Severity		
1	-	Almost impossible	1	-	No illness or injury
2	-	Not likely but possible	2	-	Minor/first aid injury
3	-	Likely to happen	3	-	Reportable accident/ incident
4	-	Probable	4	-	Major injury or illness
5	-	Certain	5	-	Death

Likelihood x Severity = Risk Rating

Score	Risk Rating	Action
0 to 5	Low	No immediate action required
6 to 12	Medium	Plan to reduce risk where practicable
15 or 16	High	Immediate action to reduce risk
20 or 25	DANGEROUS	ACTIVITY MUST CEASE IMMEDIATELY

*Note the likelihood, Severity and the risk rating are calculated both before and after control measures are put in place.

Table 2 – Health, Safety and Welfare Risk Assessment

Item	Activity / element	Potential hazard	People at risk of harm	Likelihood 1-5	Severity 1-5	Risk rating Likelihood x severity = risk rating	Risk Rating
1	Access and egress to site	Interaction with other vehicles. Collision with other traffic.	Everyone	3	2	6	Low
2	Set up on site and equipment	Creating an obstruction to other traffic Noise	Employees, Contractors	2 2	1 4	2 8	Low Medium
3	Loading and unloading materials	Material falling from vehicle Damage to equipment or property Collision between vehicles and pedestrians and vehicles. Unauthorised persons entering work area.	Employees, Contractors	3 2	4 4	12 8	Medium Medium
4	Manual handling	Lifting heavy items. Lifting awkward or large items. Carry loads over uneven ground.	Employees, Contractors	3 3 1	3 3 3	9 9 3	Medium Medium Low
5	Housekeeping	Slips trips and falls Untidy site	Contractors Employees	3 2	3 3	9 6	Medium Medium
6	Noise	Generating noise levels at or above the exposure action values.	All Operators' and employees near by	2	4	8	Medium

Item	Activity / element	Potential hazard	People at risk of harm	Likelihood 1-5	Severity 1-5	Risk rating Likelihood x severity = risk rating	Risk Rating
7	Use of hand tools	Cuts and abrasions, impacts	All involved	2	1	2	Low
8	Weather Conditions	Slips / Trips Ice, frost, snow, Wind, Cold weather,	All involved	1	4	4	Low
9	Working close to other activities on site	Collision between varying vehicles/vehicles crashing into equipment/slips/trips/ falls	All persons and equipment involved	4	4	8	Medium
10	Working close to other activities Off site	Persons walking along the road outside of the fence, or on the adjoining site.	Passers by	2	3	6	Medium

6.4. Control Measures to Be Implemented

No.	*Name*	*Control Measure*
1	Access & Egress	• All operatives briefed by supervising geologist upon arrival at site. • Working area will be cordoned off with a single access point. Area will be small and confined. • Operatives will follow safe access routes around the site. • Operatives will follow the work Method Statement herein.
2	Use of Machinery	• Observe all safety instructions and warnings attached to the plant. • Loose or baggy clothing can get caught in running machinery. • Where possible when working close to the loud running machinery, wear ear protection.

No.	*Name*	*Control Measure*
		• For reasons of safety, long hair must be tied back or otherwise secured, garments must be close fitting and no jewellery such as rings may be worn. Injury may result from being caught up in the machinery or from rings catching on moving parts. • Always wear correctly fitting (CE approved) personal protective equipment. Recommended Personal Protective Equipment includes: hard Hat, Safety Glasses, Hearing Protection, Safety Boots (steel toe), Nitrile Gloves, High Visibility Vest or jacket. • Never lubricate, clean, service or adjust machinery while it is moving. Keep hands, feet and clothing clear of power-driven parts and in running nip-points. Disengage all power and operate controls to relieve pressure. Stop the engine. Allow the machinery to cool. • Keep all parts in good condition. Ensure that all parts are properly installed. Fix damage immediately. Replace worn and broken parts. Remove any build-up of grease, oil and debris. • Any work on the site must be executed by trained, reliable and authorised personnel only. Statutory minimum age limits must be observed. • ESB shall ensure that local barriers are erected and in place to stop unauthorized entry (if applicable). • Before starting any machinery ensure it is safe to do so.
3	Loading & Unloading material	• Operations should be planned to ensure maximum safety of personnel and property. • Sufficient numbers of trained persons to be available on site before lifting / loading takes place.
4	Manual Handling	• Never lift unless it is safe to do so. • Always use appropriate mechanical aids which are available. • All employees to be trained in safe manual handling techniques. • Remember the safe points of manual handling.
5	Housekeeping	• All operators to ensure site areas are kept clear of obstruction from materials and tools. • Regular checks to be carried out to ensure there are no tools or equipment which may pose a trip hazard. • A clean as you go policy in operation.
6	Noise	• When any operations are being carried out which may produce excessive noise levels, over 85 dBA, operators must wear ear defenders or disposable ear plugs. • Recommended to wear ear defends when working with the loud machinery.
7	Use of Hand Tools	• If using tools, there must be sufficient space to operate the tool. • Personal protective equipment must be used appropriate to the task. • Ensure tools are in good working order. • Do not use if broken or material fatigue is evident.
8	Weather Conditions	• Working in icy conditions may pose a slip risk when working with water. • Monitor weather conditions to ensure it is safe to work.

No.	*Name*	*Control Measure*
9	Working close to other activities on site	• All personnel to report to supervising geologist. • All personnel to review and to sign other site activities RAMS. • Traffic cones will be put around the work site. • High visibility clothing is essential on the site.
10	Working close to other activities on site Working close to other activities Off site	• All visitors to the work area are expected to wear suitable grade PPE.

6.5. Health and Safety Instructions for Persons Involved with Work

- Conduct work in compliance with this work method statement.

- Comply with site safety rules as indicated during induction.

- Obey all instructions from supervising geologist, Civil Contractor and ESB Staff.

6.6. Inspection and Maintenance

All safety critical equipment will be inspected immediately prior to use.

6.7. Training

- Briefing on the sensitivity of the site by supervising Geologist
- Manual Handling Training
- Safe Pass Training
- First Aid Training

6.8. Communication and Information

Before planned work takes place contact the supervising geologist for authorisation to attend site. Upon arrival at site report to supervising Geologist for briefing prior to commencing tasks.

6.9. Oversight

- IE Consulting to oversee works with Geologist onsite during works.

6.10. Specification

All work will be carried out per the current method statement and in accordance with ESB Health and Safety polices.

6.11. Emergency Response

Emergency Procedures:	1. Emergency contact numbers readily at hand with all operatives. 2. Fire extinguishers available locally (in vehicles) 3. First aid kit available in vehicle.
	Emergency Contact details

	Health and Safety Authority	0818 289 389
	Laois Fire & Rescue	112 / (057) 866 4000
	Midland Regional Hospital Portlaoise	112 / (057) 862 1364
	Garda Station Stradbally	112 / (057) 862 5222
First Aid Facilities:	First Aid Box Location:	In designated vehicle
	Location of Nearest Hospital:	Midland Regional Hospital Portlaoise Tel: 112 / (057) 862 1364

7. References

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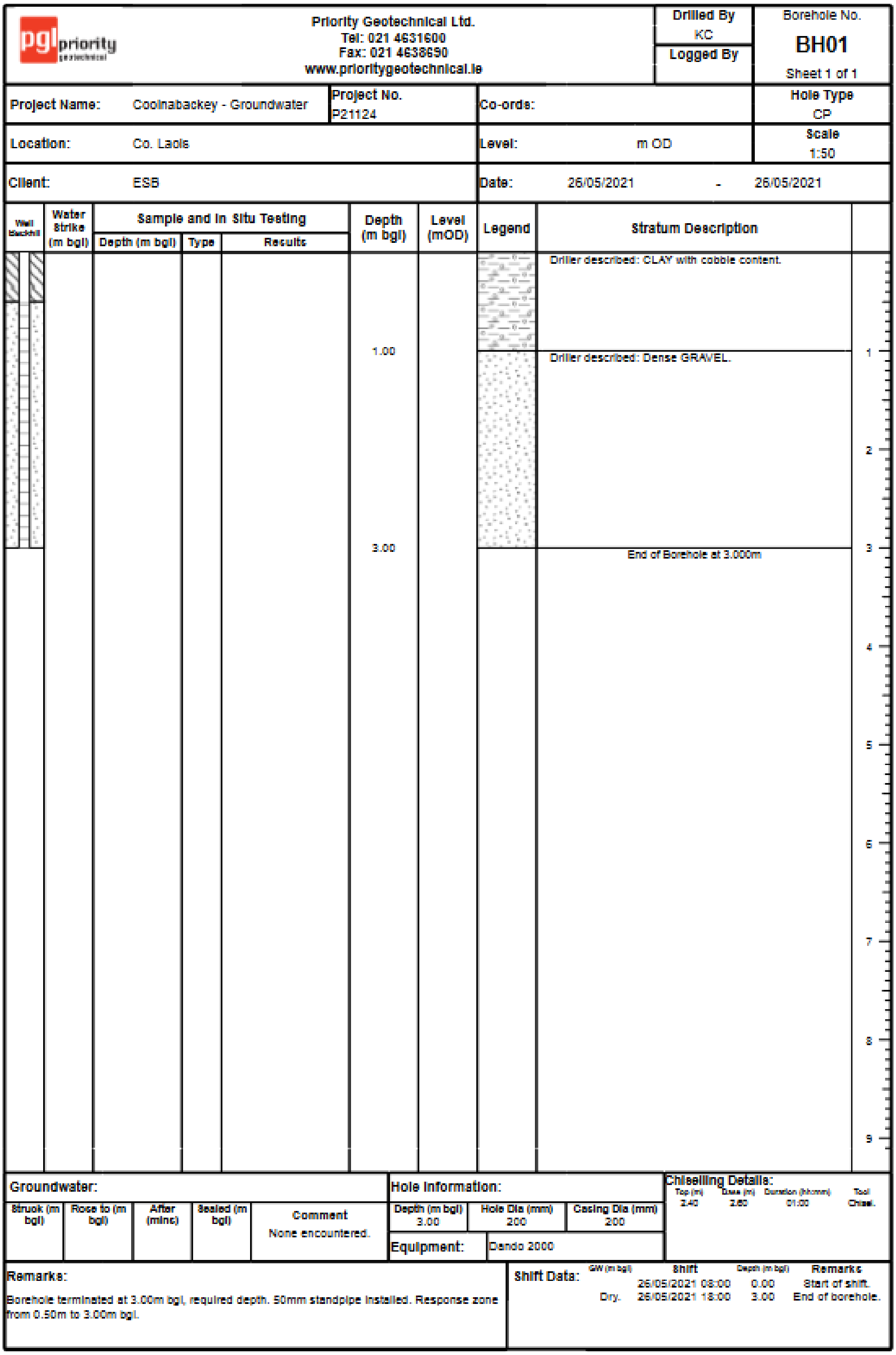
Appendix I – Borehole Logs



Priority Geotechnical Ltd.
Tel: 021 4631600
Fax: 021 4638690
www.prioritygeotechnical.ie

Drilled By: KC
Logged By:
Borehole No. **BH01**
Sheet 1 of 1

Project Name: Coolnabackey - Groundwater	**Project No.** P21124	**Co-ords:**	**Hole Type** CP
Location: Co. Laois		**Level:** m OD	**Scale** 1:50
Client: ESB		**Date:** 26/05/2021 - 26/05/2021	

Well Backfill	Water Strike (m bgl)	Sample and In Situ Testing: Depth (m bgl)	Type	Results	Depth (m bgl)	Level (mOD)	Legend	Stratum Description
					1.00			Driller described: CLAY with cobble content.
					3.00			Driller described: Dense GRAVEL.
								End of Borehole at 3.000m

Groundwater:

Struck (m bgl)	Rose to (m bgl)	After (mins)	Sealed (m bgl)	Comment
				None encountered.

Hole Information:

Depth (m bgl)	Hole Dia (mm)	Casing Dia (mm)
3.00	200	200

Equipment: Dando 2000

Chiselling Details:

Top (m)	Base (m)	Duration (hh:mm)	Tool
2.40	2.60	01:00	Chisel.

Remarks:

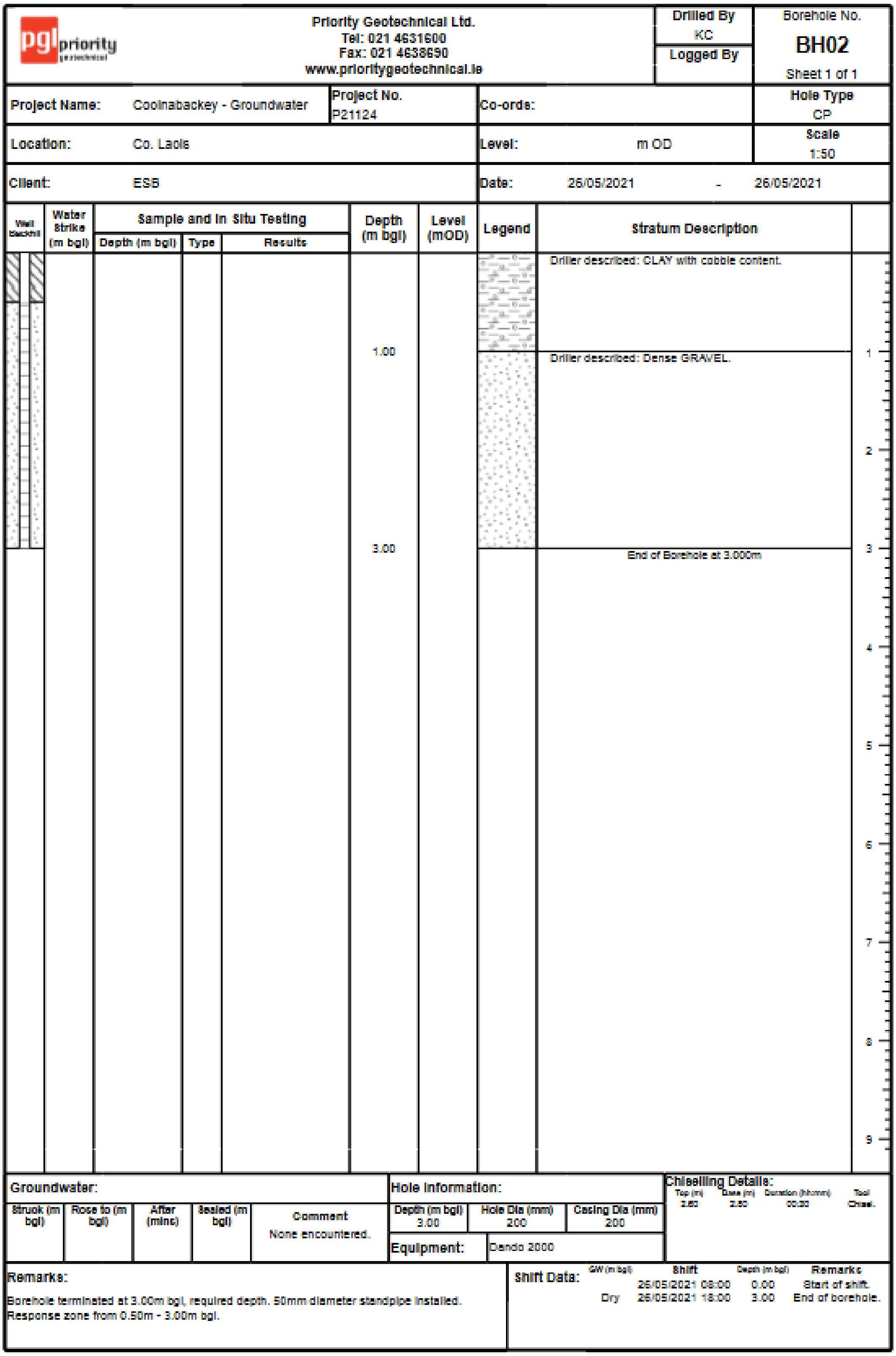
Borehole terminated at 3.00m bgl, required depth. 50mm standpipe installed. Response zone from 0.50m to 3.00m bgl.

Shift Data:

GW (m bgl)	Shift	Depth (m bgl)	Remarks
	26/05/2021 08:00	0.00	Start of shift.
Dry.	26/05/2021 18:00	3.00	End of borehole.

Figure 1: Borehole Log of BH01 (Priority Drilling, 2018)

Appendix I – Borehole Logs



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www.prioritygeotechnical.ie

Drilled By KC	**Logged By**	Borehole No. **BH02** Sheet 1 of 1	
Project Name: Coolnabackey - Groundwater	**Project No.** P21124	**Co-ords:**	**Hole Type** CP
Location: Co. Laois		**Level:** m OD	**Scale** 1:50
Client: ESB		**Date:** 26/05/2021 - 26/05/2021	

Well Backfill	Water Strike (m bgl)	Sample and In Situ Testing: Depth (m bgl)	Type	Results	Depth (m bgl)	Level (mOD)	Legend	Stratum Description
					1.00			Driller described: CLAY with cobble content.
					3.00			Driller described: Dense GRAVEL.
								End of Borehole at 3.000m

Groundwater:

Struck (m bgl)	Rose to (m bgl)	After (mins)	Sealed (m bgl)	Comment
				None encountered.

Hole Information:

Depth (m bgl)	Hole Dia (mm)	Casing Dia (mm)
3.00	200	200

Equipment: Dando 2000

Chiselling Details:

Top (m)	Base (m)	Duration (hh:mm)	Tool
2.80	2.80	00:30	Chisel.

Remarks:

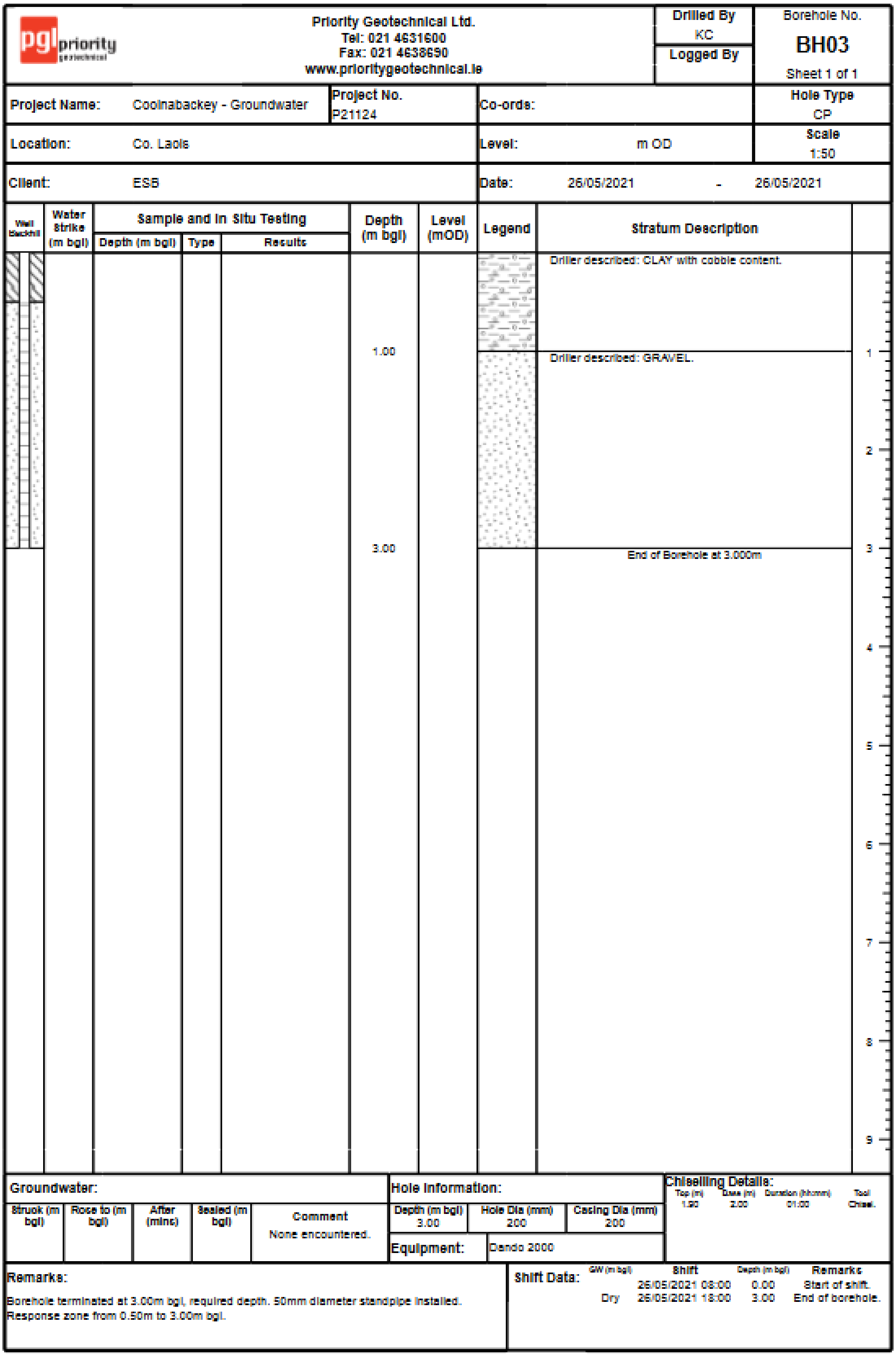
Borehole terminated at 3.00m bgl, required depth. 50mm diameter standpipe installed.
Response zone from 0.50m - 3.00m bgl.

Shift Data:

GW (m bgl)	Shift	Depth (m bgl)	Remarks
	26/05/2021 08:00	0.00	Start of shift.
Dry	26/05/2021 18:00	3.00	End of borehole.

Figure 2 – Borehole Log of BH02 (Priority Drilling, 2018)

Appendix I – Borehole Logs



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Drilled By	KC	**Borehole No.**	BH03
Logged By			Sheet 1 of 1
Project Name:	Coolnabackey - Groundwater	**Project No.**	P21124
Co-ords:		**Hole Type**	CP
Location:	Co. Laois	**Level:**	m OD
Scale	1:50		
Client:	ESB	**Date:**	26/05/2021 - 26/05/2021

Well Backfill	Water Strike (m bgl)	Sample and In Situ Testing: Depth (m bgl)	Type	Results	Depth (m bgl)	Level (mOD)	Legend	Stratum Description
					1.00			Driller described: CLAY with cobble content.
					3.00			Driller described: GRAVEL.
								End of Borehole at 3.000m

Groundwater:

Struck (m bgl)	Rose to (m bgl)	After (mins)	Sealed (m bgl)	Comment
				None encountered.

Hole Information:

Depth (m bgl)	Hole Dia (mm)	Casing Dia (mm)
3.00	200	200

Equipment: Dando 2000

Chiselling Details:

Top (m)	Base (m)	Duration (hh:mm)	Tool
1.90	2.00	01:00	Chisel.

Remarks:

Borehole terminated at 3.00m bgl, required depth. 50mm diameter standpipe installed.
Response zone from 0.50m to 3.00m bgl.

Shift Data:

GW (m bgl)	Shift	Depth (m bgl)	Remarks
	26/05/2021 08:00	0.00	Start of shift.
Dry	26/05/2021 18:00	3.00	End of borehole.

Figure 3 – Borehole Log of BH03 (Priority Drilling, 2018)

Appendix II – Exploratory Hole Locations

CAUSEWAY GEOTECH

Project No.: 17-0439

Project Name: Coolnabacky 400kV GIS Substation

Client: ESB Networks

Client's Representative: Killeen Civil Engineering

Legend Key

🟥 Locations By Type - TP

Title:
Exploratory Hole Location Plan (1 of 3)

Last Revised:	**Scale:**
30/07/2018	1:2500

Figure 1 – Exploratory Hole Locations (1 of 3)

Appendix II – Exploratory Hole Locations

CAUSEWAY GEOTECH

Project No.: 17-0439

Project Name: Coolnabacky 400kV GIS Substation

Client: ESB Networks

Client's Representative: Killeen Civil Engineering

Legend Key

🟥 Locations By Type - TP

Title:
Exploratory Hole Location Plan (2 of 3)

Last Revised: 30/07/2018

Scale: 1:2500

Figure 2 – Exploratory Hole Locations (2 of 3)

Appendix II – Exploratory Hole Locations

CAUSEWAY GEOTECH

Project No.: 17-0439

Project Name: Coolnabacky 400kV GIS Substation

Client: ESB Networks

Client's Representative: Killeen Civil Engineering

Legend Key

- ● Locations By Type - CP
- 🟥 Locations By Type - TP

Title:

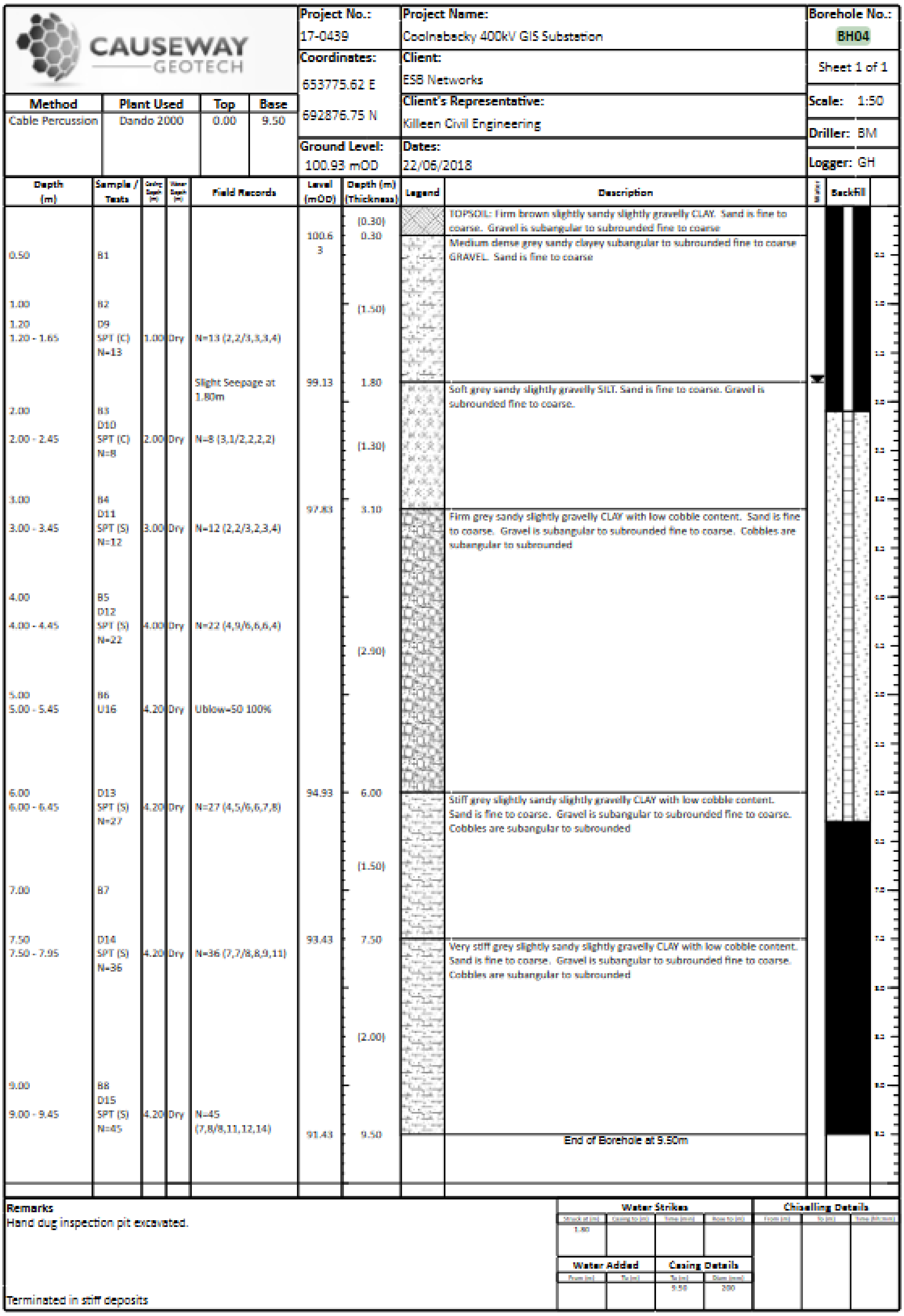
Exploratory Hole Location Plan (3 of 3)

Last Revised: 30/07/2018

Scale: 1:2500

Figure 3 – Exploratory Hole Locations (3 of 3) (Causeway Geotech, 2018)

Appendix III – Exploratory Hole Logs



CAUSEWAY GEOTECH

Project No.: 17-0439
Project Name: Coolnabacky 400kV GIS Substation
Borehole No.: BH04
Coordinates: 653775.62 E 692876.75 N
Client: ESB Networks
Sheet 1 of 1
Client's Representative: Killeen Civil Engineering
Scale: 1:50
Driller: BM
Ground Level: 100.93 mOD
Dates: 22/06/2018
Logger: GH

Method	Plant Used	Top	Base
Cable Percussion	Dando 2000	0.00	9.50

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description
					100.63	(0.30) 0.30	TOPSOIL: Firm brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse
							Medium dense grey sandy clayey subangular to subrounded fine to coarse GRAVEL. Sand is fine to coarse
0.50	B1						
1.00	B2						
1.20 1.20 - 1.65	D9 SPT (C) N=13	1.00	Dry	N=13 (2,2/3,3,3,4)		(1.50)	
				Slight Seepage at 1.80m	99.13	1.80	Soft grey sandy slightly gravelly SILT. Sand is fine to coarse. Gravel is subrounded fine to coarse.
2.00 2.00 - 2.45	B3 D10 SPT (C) N=8	2.00	Dry	N=8 (3,1/2,2,2,2)		(1.30)	
3.00 3.00 - 3.45	B4 D11 SPT (S) N=12	3.00	Dry	N=12 (2,2/3,2,3,4)	97.83	3.10	Firm grey sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subangular to subrounded
4.00 4.00 - 4.45	B5 D12 SPT (S) N=22	4.00	Dry	N=22 (4,9/6,6,6,4)		(2.90)	
5.00 5.00 - 5.45	B6 U16	4.20	Dry	Ublow=50 100%			
6.00 6.00 - 6.45	D13 SPT (S) N=27	4.20	Dry	N=27 (4,5/6,6,7,8)	94.93	6.00	Stiff grey slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subangular to subrounded
						(1.50)	
7.00	B7						
7.50 7.50 - 7.95	D14 SPT (S) N=36	4.20	Dry	N=36 (7,7/8,8,9,11)	93.43	7.50	Very stiff grey slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subangular to subrounded
						(2.00)	
9.00 9.00 - 9.45	B8 D15 SPT (S) N=45	4.20	Dry	N=45 (7,8/8,11,12,14)	91.43	9.50	End of Borehole at 9.50m

Remarks
Hand dug inspection pit excavated.

Terminated in stiff deposits

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
1.80			

Chiselling Details

From (m)	To (m)	Time (hh:mm)

Water Added

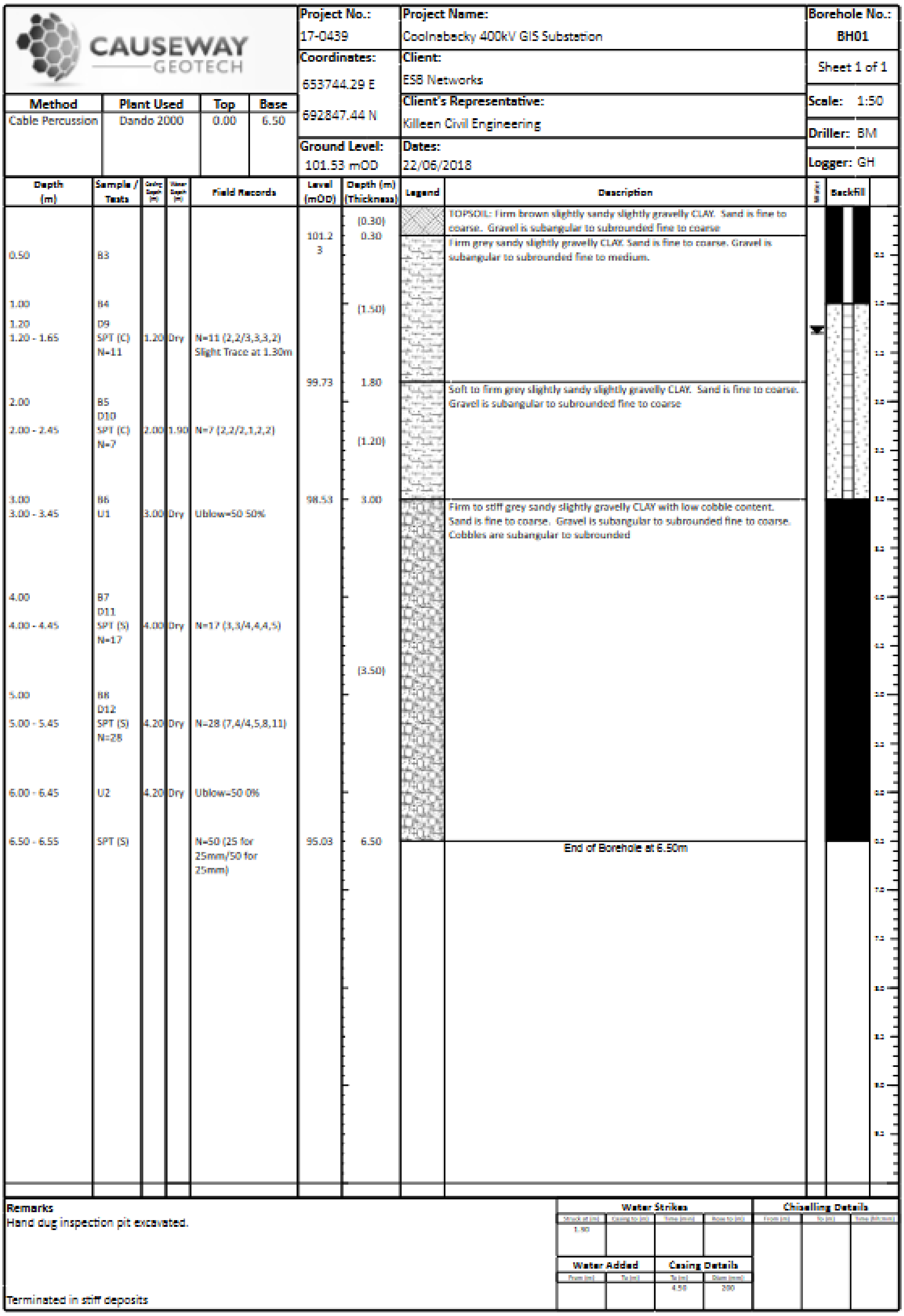
From (m)	To (m)

Casing Details

To (m)	Diam (mm)
9.50	200

Figure 1 - Borehole Log of exploratory hole BH04, located 20m east to BH04 (Causeway Geotech, 2018)

Appendix III – Exploratory Hole Logs



CAUSEWAY GEOTECH

Project No.: 17-0439	**Project Name:** Coolnabacky 400kV GIS Substation		**Borehole No.:** BH01
Coordinates: 653744.29 E 692847.44 N	**Client:** ESB Networks		Sheet 1 of 1
	Client's Representative: Killeen Civil Engineering		**Scale:** 1:50
Ground Level: 101.53 mOD	**Dates:** 22/06/2018		**Driller:** BM
			Logger: GH

Method	Plant Used	Top	Base
Cable Percussion	Dando 2000	0.00	6.50

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description
					101.23	(0.30) 0.30	TOPSOIL: Firm brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse
0.50	B3						Firm grey sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium.
1.00	B4					(1.50)	
1.20	D9						
1.20 - 1.65	SPT (C) N=11	1.20	Dry	N=11 (2,2/3,3,3,2) Slight Trace at 1.30m			
					99.73	1.80	Soft to firm grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse
2.00	B5 D10						
2.00 - 2.45	SPT (C) N=7	2.00	1.90	N=7 (2,2/2,1,2,2)		(1.20)	
3.00	B6				98.53	3.00	Firm to stiff grey sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subangular to subrounded
3.00 - 3.45	U1	3.00	Dry	Ublow=50 50%			
4.00	B7 D11						
4.00 - 4.45	SPT (S) N=17	4.00	Dry	N=17 (3,3/4,4,4,5)			
						(3.50)	
5.00	B8 D12						
5.00 - 5.45	SPT (S) N=28	4.20	Dry	N=28 (7,4/4,5,8,11)			
6.00 - 6.45	U2	4.20	Dry	Ublow=50 0%			
6.50 - 6.55	SPT (S)			N=50 (25 for 25mm/50 for 25mm)	95.03	6.50	End of Borehole at 6.50m

Remarks
Hand dug inspection pit excavated.

Terminated in stiff deposits

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
1.90			

Water Added

From (m)	To (m)

Casing Details

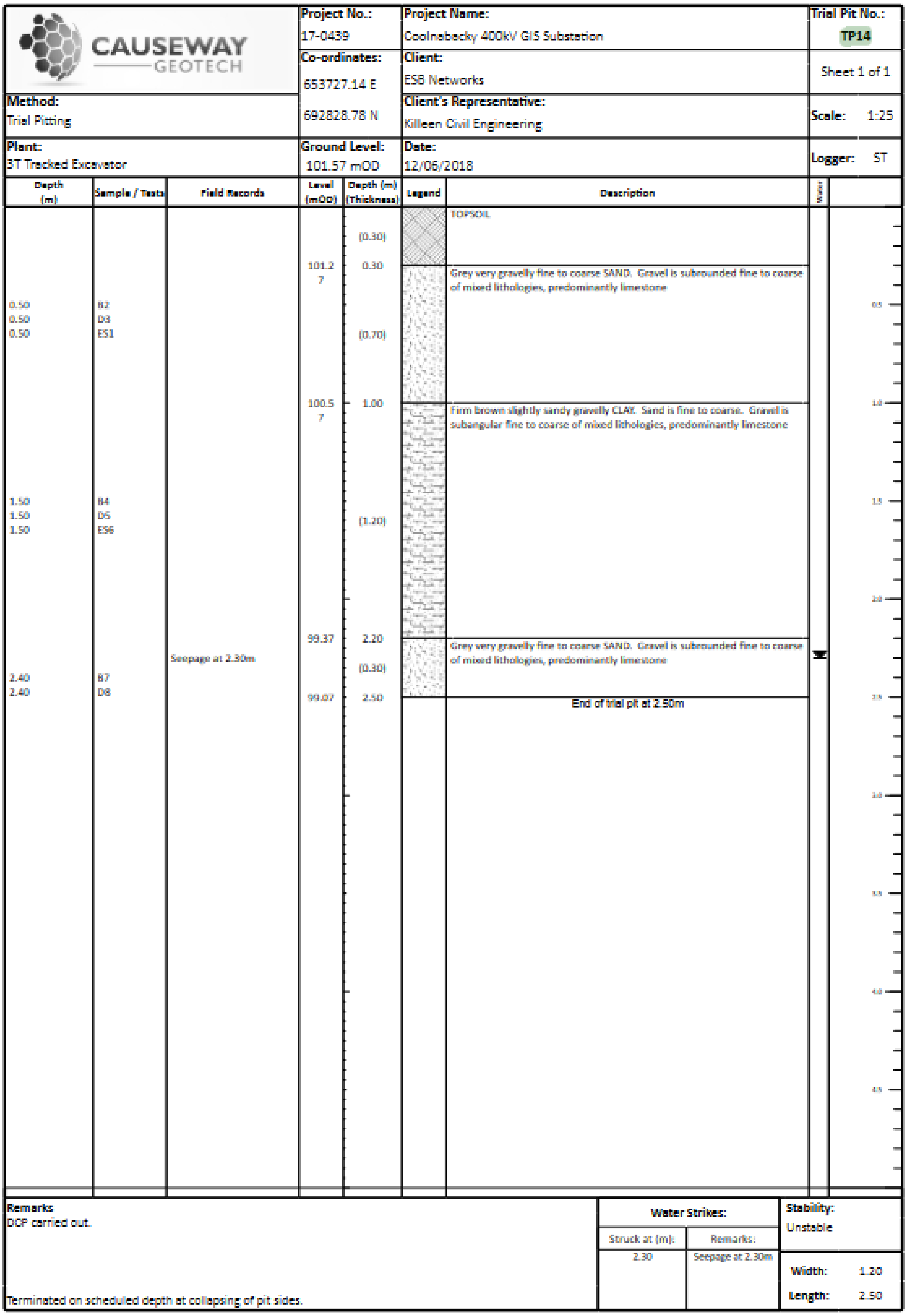
To (m)	Diam (mm)
4.50	200

Chiselling Details

From (m)	To (m)	Time (hh:mm)

Figure 2 - Borehole Log of exploratory hole BH01, located adjacent to BH05 to be decommissioned (Causeway Geotech, 2018)

Appendix III – Exploratory Hole Logs



CAUSEWAY GEOTECH

Project No.: 17-0439
Project Name: Coolnabacky 400kV GIS Substation
Trial Pit No.: TP14
Co-ordinates: 653727.14 E 692828.78 N
Client: ESB Networks
Sheet 1 of 1
Method: Trial Pitting
Client's Representative: Killeen Civil Engineering
Scale: 1:25
Plant: 3T Tracked Excavator
Ground Level: 101.57 mOD
Date: 12/06/2018
Logger: ST

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water
				(0.30)		TOPSOIL	
			101.27	0.30		Grey very gravelly fine to coarse SAND. Gravel is subrounded fine to coarse of mixed lithologies, predominantly limestone	
0.50 0.50 0.50	B2 D3 ES1			(0.70)			
			100.57	1.00		Firm brown slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse of mixed lithologies, predominantly limestone	
1.50 1.50 1.50	B4 D5 ES6			(1.20)			
			99.37	2.20		Grey very gravelly fine to coarse SAND. Gravel is subrounded fine to coarse of mixed lithologies, predominantly limestone	
		Seepage at 2.30m		(0.30)			▼
2.40 2.40	B7 D8						
			99.07	2.50		End of trial pit at 2.50m	

Remarks
DCP carried out.

Terminated on scheduled depth at collapsing of pit sides.

Water Strikes:

Struck at (m):	Remarks:
2.30	Seepage at 2.30m

Stability: Unstable
Width: 1.20
Length: 2.50

Figure 3 - Log of exploratory trial pit TP14, located north-west of BH04b (Causeway Geotech, 2018)

Surface Water Monitoring Database

IE2219

ESB Coolnabackey

Surface Water Parameters	SI272/2009 as amended by SI372/2012; SI386/2015; SI77/2019; SI659/2021	Units	LOD	SW1	SW1	SW1	SW1	SW1	SW1	SW2	SW2	SW2	SW2	SW2	SW2	SW3	SW4	SW4	SW4	SW4	SW4	SW4
				Surface Water	Surface Water	Surface Water	Surface Water	Surface water	Surface water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	surface water	surface water
				30/03/2022	20/06/2022	06/09/2022	09/11/2022	13/02/2023	24/05/2023	30/03/2022	22/06/2022	06/09/2022	09/11/2022	13/02/2023	24/05/2023	24/05/2023	30/03/2022	20/06/2022	06/09/2022	09/11/2022	13/02/2023	24/05/2023
Dissolved Calcium	-	mg/l	<0.2	117.5	129.5	124.8	124.2	123.4	134.8	118.8	124.8	119.4	127.5	126.1	130.6	131.4	117.3	Dry - No Sample	107	117.6	119.7	119.6
Dissolved Magnesium	-	mg/l	<0.1	5.2	5	5.4	6.3	5.9	5.2	5.3	5	5.5	5.9	5.5	5.2	5.2	6.5	Dry - No Sample	7.4	6.8	6.7	6.7
Dissolved Potassium	-	mg/l	<0.1	3.2	2.7	4.4	5.2	3.9	3	3	2.8	5.3	4.7	3.7	2.9	2.9	3	Dry - No Sample	9.1	4.2	2.9	3.0
Dissolved Sodium	-	mg/l	<0.1	6.8	7.2	8.1	8.7	8	6.5	7	7.1	8.4	7.8	6.8	6.4	6.4	9.6	Dry - No Sample	11.7	9.9	9.5	9.3
MTBE	-	ug/l	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	Dry - No Sample	<5	<5	<5	<5
Benzene	10 #	ug/l	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	Dry - No Sample	<5	<5	<5	<5
Toluene	10 #	ug/l	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	Dry - No Sample	<5	<5	<5	<5
Ethylbenzene	-	ug/l	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	Dry - No Sample	<5	<5	<5	<5
m/p-Xylene	10 #	ug/l	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	Dry - No Sample	<5	<5	<5	<5
o-Xylene	10 #	ug/l	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	Dry - No Sample	<5	<5	<5	<5
TPH CWG																						
Aliphatics																						
>C5-C6	-	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	Dry - No Sample	<10	<10	<10	<10
>C6-C8$^{\#}$	-	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	Dry - No Sample	<10	<10	<10	<10
>C8-C10$^{\#}$	-	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	Dry - No Sample	<10	<10	<10	<10
>C10-C12$^{\#}$	-	ug/l	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	Dry - No Sample	<5	<5	<5	<5
>C12-C16$^{\#}$	-	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	Dry - No Sample	<10	<10	<10	<10
>C16-C21$^{\#}$	-	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	Dry - No Sample	<10	<10	<10	<10
>C21-C35$^{\#}$	-	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	Dry - No Sample	<10	<10	<10	<10
>C35-C44	-	ug/l	<10	<10	-	<10	<10	<10	-	<10	-	<10	<10	<10	-	-	<10	Dry - No Sample	<10	<10	<10	-
Total aliphatics C5-44	-	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	Dry - No Sample	<10	<10	<10	<10
Aromatics																						
>C5-EC7	-	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	Dry - No Sample	<10	<10	<10	<10
>EC7-EC8	-	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	Dry - No Sample	<10	<10	<10	<10
>EC8-EC10	-	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	Dry - No Sample	<10	<10	<10	<10
>EC10-EC12	-	ug/l	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	Dry - No Sample	<5	<5	<5	<5
>EC12-EC16	-	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	Dry - No Sample	<10	<10	<10	<10
>EC16-EC21	-	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	Dry - No Sample	<10	<10	<10	<10
>EC21-EC35	-	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	Dry - No Sample	<10	<10	<10	<10
>EC35-EC44	-	ug/l	<10	<10	-	<10	<10	<10	-	<10	-	<10	<10	<10	-	-	<10	Dry - No Sample	<10	<10	<10	-
Total aromatics C5-44	-	ug/l	<10	<10	<10	<10	<10	<10	-	<10	<10	<10	<10	<10	-	-	<10	Dry - No Sample	<10	<10	<10	-
Total aliphatics and aromatics(C5-44)	-	ug/l	<10	<10	<10	<10	<10	<10	-	<10	<10	<10	<10	<10	-	-	<10	Dry - No Sample	<10	<10	<10	-
Sulphate as SO4	-	mg/l	<0.5	22.8	21	21.1	25.7	27.2	23.6	22.4	20.9	21.4	28.4	24.8	23.3	23.5	22.9	Dry - No Sample	22.6	21.9	21.7	21.7
Chloride	-	mg/l	<0.3	23.8	24.1	24.6	25.1	20	17.3	23.8	24.1	25.2	26.2	20.9	17.1	17.1	32.6	Dry - No Sample	31.7	30.2	28.5	25.7
Nitrate as NO3	-	mg/l	<0.2	39.4	40.7	34.6	35.7	33.7	31.7	37.7	37.6	27.1	38.7	40.1	30.7	30.1	38.2	Dry - No Sample	12.5	39	37.7	24.5
Phosphorous	High Status ≤ 0.025 (mean) and ≤ 0.045 (95%ile) Good status ≤0.035 (mean) and ≤ 0.075 (95%ile)	ug/l	<15 / <0.03	<15	<0.03	<0.03	0.06	0.09	0.06	<15	<0.03	0.04	0.04	<0.06	<0.03	<0.03	<15	Dry - No Sample	0.14	0.10	<0.06	0.04
Ammoniacal Nitrogen as NH4	High status ≤ 0.040 (mean) and ≤ 0.090 (95%ile) Good status ≤ 0.065 (mean) and ≤ 0.140 (95%ile)	mg/l	<0.03	<0.03	0.05	0.04	0.05	<0.03	<0.03	0.03	0.05	0.03	<0.03	<0.03	<0.03	<0.03	0.03	Dry - No Sample	0.09	<0.03	0.03	<0.03
Total Alkalinity as CaCO3	-	mg/l	<1	302	298	298	294	270	326	292	262	286	292	270	284	276	290	Dry - No Sample	284	268	272	276
Dissolved Alkalinity as CaCO3				-	-	-	294	258	-	-	-	-	302	266	-	-	-	Dry - No Sample	-	278	270	-
Electrical Conductivity @25C	-	uS/cm	<2	678	701	657	708	693	692	677	653	638	717	699	653	636	699	Dry - No Sample	636	700	696	636
pH	6.0 < pH < 9.0 *	pH units	<0.01	8.14	7.76	8.3	8.25	8.27	7.97	8.31	7.82	8.33	8.17	8.2	8.19	8.16	8.19	Dry - No Sample	8.1	8.12	8.22	8.18

* Water Hardness >100 mg/l CaCO3

\# River Water Body

Groundwater Monitoring Database
ESB Coolnabacky
IE2219

Parameter	SI366/2016 Groundwater Regulations	EPA IGV 2003	Units	LOD	BH1	BH1	BH1	BH1	BH2	BH2	BH2	BH2	BH3	BH3	BH3	BH3	BH4	BH4	BH4	BH4
					Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water
					14/12/2021	09/11/2022	13/02/2023	24/05/2023	14/12/2021	09/11/2022	13/02/2023	24/05/2023	14/12/2021	09/11/2022	13/02/2023	24/05/2023	14/12/2021	09/11/2022	13/02/2023	24/05/2023
Dissolved Calcium	-	200	mg/l	<0.2	191.9	112.3	111.2	137.6	102.1	111.1	103.6	119.8	114.5	111.6	122.8	127.6	111.2	107.2	112.2	114.5
Dissolved Magnesium	-	50	mg/l	<0.1	6.6	6.3	5.5	6.3	2.2	2.6	2.5	2.9	10.8	10.5	10.2	9.8	10	9.5	8.1	7.4
Dissolved Potassium	-	5	mg/l	<0.1	1.1	0.5	0.9	0.7	1.2	1.1	3.1	1.5	1	1.1	2.2	0.9	0.9	0.9	2.3	1.3
Dissolved Sodium	-	150	mg/l	<0.1	14.9	6.6	7.7	7.1	4.3	5.1	4	4.4	6.3	19.6	4.3	4.6	7.3	6.6	4.8	4.7
Sulphate as SO4	187.5	200	mg/l	<0.5	245	20.4	14.7	12.5	4.2	5.5	1.2	2.8	6.7	21.9	6	5.7	13.3	14.8	13.3	10.8
Chloride	24-187.5	30	mg/l	<0.3	6.9	11.6	8.4	8.1	3.7	12.6	4.4	3.3	6	6.5	7.4	6.3	9.6	8.3	8.1	8.2
Nitrate as NO3	37.5	25	mg/l	<0.2	1.1	0.4	0.4	1.9	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.2	<0.2	<0.2	18.3	<0.2
SRP Ortho Phosphate as PO4	0.107	0.09	mg/l	<0.03	0.04	-	-	-	<0.03	-	-	-	<0.03	-	-	-	<0.03	-	-	-
Ortho Phosphate as PO4					-	<0.03	<0.06	0.03	-	<0.03	<0.06	<0.03	-	<0.03	<0.06	<0.03	-	<0.03	<0.06	0.38
Ammoniacal Nitrogen as NH4	0.087	0.15	mg/l	<0.03	0.06	0.03	0.05	<0.03	0.04	<0.03	<0.03	<0.03	0.36	0.11	0.07	0.07	0.12	0.09	0.09	0.06
Dissolved Alkalinity as CaCO3	-	No Abnormal Change	mg/l	<1	-	312	314	380	-	294	286	334	372	386	348	404	-	324	310	324
Total Alkalinity as CaCO3	-	No Abnormal Change	mg/l	<1	846	1936	908	2322	3050	1692	2014	844	17580	585	594	2612	2922	2832	860	540
Electrical Conductivity @25C	800-1875	1000	uS/cm	<2	976	642	640	667	516	593	508	574	638	694	644	631	629	623	597	625
pH	≥ 6.5 and ≤ 9.5	≥ 6.5 and ≤ 9.5	pH units	<0.01	7.71	7.59	7.82	7.62	7.72	7.61	7.79	7.62	8.07	7.44	7.6	7.48	7.65	7.57	7.82	7.49
Methyl Tertiary Butyl Ether (MTBE)	10	30	ug/l	<5	-	<5	<5	<5	-	<5	<5	<5	-	<5	<5	<5	-	<5	<5	<5
Benzene	0.75	1	ug/l	<5	-	<5	<5	<5	-	<5	<5	<5	-	<5	<5	<5	-	<5	<5	<5
Toluene	525	10	ug/l	<5	-	<5	<5	<5	-	<5	<5	<5	-	<5	<5	<5	-	<5	<5	<5
Ethylbenzene	-	300	ug/l	<5	-	<5	<5	<5	-	<5	<5	<5	-	<5	<5	<5	-	<5	<5	<5
m/p-Xylene	-	-	ug/l	<5	-	<5	<5	<5	-	<5	<5	<5	-	<5	<5	<5	-	<5	<5	<5
o-Xylene	-	-	ug/l	<5	-	<5	<5	<5	-	<5	<5	<5	-	<5	<5	<5	-	<5	<5	<5
TPH CWG																				
Aliphatics																				
>C5-C6	-	-	ug/l	ug/l	-	<10	<10	<10	-	<10	<10	<10	-	<10	<10	<10	-	<10	<10	<10
>C6-C8	-	-	ug/l	ug/l	-	<10	<10	<10	-	<10	<10	<10	-	<10	<10	<10	-	<10	<10	<10
>C8-C10	-	-	ug/l	ug/l	-	<10	<10	<10	-	<10	<10	<10	-	<10	<10	<10	-	<10	<10	<10
>C10-C12	-	-	ug/l	ug/l	-	<5	<5	<5	-	<5	<5	<5	-	<5	<5	<5	-	<5	<5	<5
>C12-C16	-	-	ug/l	ug/l	-	<10	<10	<10	-	<10	<10	<10	-	<10	<10	<10	-	<10	<10	<10
>C16-C21	-	-	ug/l	ug/l	-	<10	<10	<10	-	<10	<10	<10	-	<10	<10	<10	-	<10	<10	<10
>C16-C35	-	-	ug/l	ug/l	-	<10	<10	-	-	<10	<10	-	-	<10	<10	-	-	<10	<10	-
>C21-C35	-	-	ug/l	ug/l	-	<10	<10	<10	-	<10	<10	<10	-	<10	<10	<10	-	<10	<10	<10
Total aliphatics C5-35	-	-	ug/l	ug/l	-	<10	<10	<10	-	<10	<10	<10	-	<10	<10	<10	-	<10	<10	<10
Aromatics																				
>C5-EC7	-	-	ug/l	ug/l	-	<10	<10	<10	-	<10	<10	<10	-	<10	<10	<10	-	<10	<10	<10
>EC7-EC8	-	-	ug/l	ug/l	-	<10	<10	<10	-	<10	<10	<10	-	<10	<10	<10	-	<10	<10	<10
>EC8-EC10	-	-	ug/l	ug/l	-	<10	<10	<10	-	<10	<10	<10	-	<10	<10	<10	-	<10	<10	<10
>EC10-EC12	-	-	ug/l	ug/l	-	<5	<5	<5	-	<5	<5	<5	-	<5	<5	<5	-	<5	<5	<5
>EC12-EC16	-	-	ug/l	ug/l	-	<10	<10	<10	-	<10	<10	<10	-	<10	<10	<10	-	<10	<10	<10
>EC16-EC21	-	-	ug/l	ug/l	-	<10	<10	<10	-	<10	<10	<10	-	<10	<10	<10	-	<10	<10	<10
>EC21-EC35	-	-	ug/l	ug/l	-	<10	<10	<10	-	<10	<10	<10	-	<10	<10	<10	-	<10	<10	<10
Total aromatics C5-35	-	-	ug/l	ug/l	-	<10	<10	<10	-	<10	<10	<10	-	<10	<10	<10	-	<10	<10	<10
Total aliphatics and aromatics(C5-35)	-	-	ug/l	ug/l	-	<10	<10	<10	-	<10	<10	<10	-	<10	<10	<10	-	<10	<10	<10
>EC16-EC35	-	-	ug/l	ug/l	-	<10	<10	-	-	<10	<10	-	-	<10	<10	-	-	<10	<10	-

EMERGENCY RESPONSE PLAN

Laois Kilkenny electricity Reinforcement Project – Unit 1: A new 400kV/110kV Substation at Coolnabacky townland, Co. Laois.

Main Works Job No 286.

286-ESB-ERP_01

ISSUE FORM	
Project number	286
Document number	ERP – Reinforcement Project Coolnabacky – R001
Document revision	001
Document title	Emergency Response Plan
Document status	Active
Document prepared by	Daniella O’Neill
Document checked by	Fintan McKeon

Contents

1 Introduction

This Environmental Emergency Response Plan (ERP) has been developed in accordance with the Kilwex Environmental Procedures.

This plan is a working document, clearly stating the arrangements in place to manage the significant environmental aspects and legal requirements of this project. This plan covers Kilwex's activities and that of its subcontractors.

This plan has the commitment of the Project Directors, Project Manager, Site Manager and Engineers to fulfil the requirements of the Plan.

1.1 Purpose of the Plan

This ERP describes how Kilwex will manage environmental emergencies for the ESB Reinforcement 400kV Substation at Coolnabacky.

This ERP has been developed within the framework of the Kilwex Environmental Management System. This Plan will:

- Identify the emergency processes required to take control of an emergency situation.
- Maintain a state of preparedness to prevent or reduce accidental emissions to the environment.
- Minimise loss or damage to the environment.

This procedure will be updated when additional hazards are identified and controls of the same are required.

1.2 Project Overview

The substation will be constructed in a 6.7 hectare field in the townland of Coolnabacky near the village of Timahoe, Co. Laois.

Figure 1: Aerial image of site location

The development consists of the following:

- 2no. steel framed buildings within a 117m x 98m plan area secured by a 2.6m high palisade fence.
- Installation of 2 no. 500MVA transformers, positioned in bunded enclosures between the two steel-framed buildings (plan area 25m x 10m each).
- Eight separate settlement ponds (average area 110m^2) constructed on site at the commencement of the construction phase.
- One group of 4No. settlement ponds will be located northwest of the substation and 4No. settlement ponds located to the east of the compound. These are used to treat surface water being discharged from the compound prior to entry into water courses.

The 400kV substation is a 64m x 15.3m x 12m building equipped with 8 bays consisting of 2No. Lines, 1No. from Moneypoint and 1No. Dunstown, 2No. transformers and 4No. spare bays for future proofing the building.

The following are features included in the building:

- Building will house the 400kV switchgear (electrical equipment)
- The build substructure is a waterproofed cast in-situ raft foundation.
- Walls are constructed from a combination of insitu concrete and insulated cladding. Cavity will be formed with external finish being rubble stone walling and insulated cladding panelling.
- Precast first floor & roof slabs will be installed with screed on top.
- Roof will be constructed with precast concrete panelling with insulation.
- Gantry cranes will be installed.

The 110kV substation building is 50m x 11.5m x 12m with 8 bays consisting of 3 no. lines Athy, Portlaoise and Ballyragget, 2 no. transformers and 3 spare bays for future development.

The following are features included in the building:

- Building will house 110kV switchgear (electrical equipment).
- The build substructure is a waterproofed cast in-situ raft foundation.
- Steel frame structure used to hold precast and insulated panels in place.
- Composite first floor with additional reinforced structural screed on top.
- Walls are constructed from precast insulated concrete sandwich panels with an insulated cladding panel above.
- Precast concrete insulated sandwich panels will be faced with a stone façade system.
- Roof will be constructed with an insulated panel with preformed gutter attached.
- Gantry cranes will be installed.

Working Hours

The normal working hours within the site shall be Monday to Friday between 07:00 hours and 19:00 hours and Saturday between 07.00 and 13.00 hours with no working on Sundays or Public Holidays.

In exceptional circumstances work may be required outside of these hours.

2 Procedure

In the event of an environmental emergency, all personnel will react promptly and adhere to this procedure.

All site personnel and visitors will be inducted in the provisions of the Emergency Response Plan.

The following outlines some of the information, on the types of emergencies, which must be communicated to site staff:

- Release of hazardous substance – Fuel and oil spill
- Concrete spill or release of concrete, silt etc.
- Flood event – extreme rainfall event
- Environmental buffers and exclusion zones breach e.g., ecological exclusion zone for protection of Tufa Springs
- Housekeeping issues or mismanagement of waste storage area
- Potential impact to archaeological or ecological features
- Fire on site (cross-reference site Safety Emergency Plan, as appropriate)

If any of the above situations occur; the particulars of the Emergency Response Plan are activated. The Site Manager will be responsible for overseeing the Emergency Response Plan and will be prepared and ready to implement the plan at all times. The Environmental Manager from Coyle Environmental will be immediately informed and report to the scene. They will be aware of the following;

- Nature of the situation – brief description of what has happened
- Location of the incident
- Whether any spill has been released
- Whether the situation is under control

Procedures in relation to emergency response plan will be included in induction. They will be aware of the following:

- Locations of spill kits will be indicated to all on site. Each person on site will be aware that each piece of construction equipment will carry a spill kit.
- All operators will be aware of the designated locations where they can refuel and who they must contact to undertake. They will be aware of the requirements for spill trays and know when the extents of their work area end.
- All operatives on site will be aware that water cannot be simply discharged into the river, but must be pumped into the settlement ponds prior.
- They will be aware that in the event of a fuel spillage, the site manager must be contacted.
- They will also know the extents of the construction site. All operatives will know where the sensitive area that is fenced off is located and know of the existence of the sensitive tufa on site.
- Site personnel will be educated to know if any issue in regard to pollution on site arises they must contact the site manager immediately.

2.1 Measures to be taken in the event of an Environmental Emergency

The list below presents guidelines on what to do in the event of an environmental emergency;

- IF SAFE (USE PPE), stop the source of the spill and raise the alarm to alert people working in the vicinity of any potential dangers.
- IF SAFE (USE PPE), contain the spill using the absorbent spills material provided.
- Do not spread or flush away the spill. Please refer to appended site plan for the location of nearest spill kit. All plant and machinery should be fitted with a portable spill kit and personnel should be trained in its use.
- Cover or bund off any sensitive areas, where appropriate.
- If possible, clean up as much as possible using the absorbent spills materials.
- Do not hose the spillage down and do not use any detergents.
- Store any used absorbent material in an appropriate container so that further contamination is limited.
- Used absorbent material to be disposed of by a licenced waste contractor only.
- An accident investigation should be performed in accordance with procedures and the report sent to the Environmental Manager. Please see Appendix 2 Incident Report Form Doc. No.: IMS_S035 REV 00.
- Findings of the investigation should be reviewed, and any preventative measures identified and implemented immediately.
- Any changes in procedures as a result of the incident should be disseminated to all personnel including sub-contractors and site visitors.
- Under no circumstances should anyone place themselves in harms way to resolve an issue.
- Personnel with any concerns regarding the potential for an environmental incident, they should discuss this with the Site Manager, and they will bring this issue to the attention of the Environmental Manager (Coyle Environmental).

2.2 Environmental Incidents and Definitions

2.2.1 Major Environmental Incident

Any situation which has resulted in significant pollution requiring high level of resources both inside and outside of site for response and remedy and must therefore be reported to Site/Company Management, the Client and/or any relevant statutory authority.

2.2.2 Minor Environmental Incident

Any situation which has resulted in environmental pollution which requires minimal action to aide recovery from Site/Company Management. Non-reportable to any relevant statutory authority.

2.2.3 Main Environmental Incident Controller

The main environmental incident controller will be the Site Manager with the aid of the Environmental Manager (Coyle Environmental).

They will manage the emergency, contact emergency services if necessary and maintain a continuous review of possible developments. Section 4 provides details of main contact in case of an environmental emergency.

2.2.4 Environmental Incident Examples

An environmental incident may include but is not limited to:

- Spillage of hazardous materials (as defined by the Waste Management Acts,)
- A breach of any specified environmental limits as detailed in contractual documents or NIS documents (noise, vibration, air)

- Uncovering of contaminated land
- Any spillage which cannot be rapidly contained and controlled, these include hydrocarbons such as diesel, oil spills etc
- Inappropriate disposal of waste
- Runoff of sediment-laden or otherwise polluted water to a watercourse
- Spills of fuel, oil or hazardous substances into water or a watercourse
- Concrete waste/washings disposed in a non-designated area
- Working within a protected area.

2.2.5 Emergency response procedure process

In the event of a major or minor environmental incident occurring, the following actions will be immediately undertaken;

- Isolate the source of the pollution
- Clean up spill under the advice of the environmental manager
- Identify and execute measures to prevent / minimise the emissions / malfunction under the advice of the environmental manager
- Evaluate the environmental pollution, if any, caused by the incident and refer to environmental manager for advice
- Corrective actions taken to remedy the situation
- Carry out an investigation to identify the nature, source and cause of the incident and any emission arising from the incident.
- All related information will be documented concerning the environmental incident and photographs gathered.
- Discuss with all relevant parties involved in the matter
- When all the information has been gathered (immediate cause, basic cause and corrective actions etc), it will be added to the Incident Tracking system. If any further actions have to be taken, these will be agreed and timescales set.
- All incidents must be submitted on the Incident Tracking system within 7 days.
- All environmental incidents that are added to the Incident Tracking System are reviewed by the HSE department prior to final approval and are included on the monthly ‘Loss Events Report’.

This ERP will be communicated to all Kilwex Personnel and will be reviewed and updated (where necessary) in conjunction with the CEMP and RWMP.

2.3 **Fuel and Chemical Storage and Management**

Below are some measures which will be implemented onsite with regard to fuel storage and management:

- Any plant being refuelled on site e.g., excavators, dumpers etc., will do so at a designated location.
- Fuel will be transferred to construction equipment using a bunded fuel bowser. This bowser will be filled weekly by a fuelling lorry.
- Drip trays will be used while refuelling with spill kits being deployed, if required.
- Rigid and articulated vehicles will be fuelled off site as would all site vehicles (Jeeps, cars and vans).

- Only designated trained operators will be authorised to refuel plant on site. Records of refuelling of vehicles will be kept on site. These records will contain details of vehicles being refuelled and the personnel responsible.
- Mobile bowsers, tanks and drums will be stored in a secure, bunded, impermeable storage area, away from drains and open water;
- Fuel containers will be stored within a secondary containment system e.g., bund for static tanks or a drip tray for mobile stores;
- Ancillary equipment such as hoses, pipes, valves will be contained within the bund;
- Taps, nozzles or valves will be fitted with a lock system;
- Fuel and oil stores, including tanks and drums, will be regularly inspected for leaks and signs of damage.
- Procedures and contingency plans will be set up to deal with emergency accidents or spills, including availability of specialist 24/7 spill contractor in case of major incident
- An onsite COSHH cabinet will be available for the storage of any hazardous chemicals.

Figure 2: Example of a drip tray arrangement

Figure 3: Example of contents of a spill kit

2.4 Oil, Soil and Concrete Spillages

The following outlines specific measures to be taken in the event of an environmental incident that results in accidental discharges. Please note that this is not an exhaustive list and will be reviewed periodically.

As a result of an environmental incident, changes could be made, or additional measures included:

- Site staff will immediately report the spillage to the Site Manager or Foreman
- The Environmental Manager (Coyle Environmental) will also be informed.
- Depending on the nature of the spill, the Environmental Manager (Coyle Environmental) will report the spillage to Inland Fisheries Ireland and Laois County Council

All incidents regarding environmental issues to be reported immediately to Kilwex on the day of the incident including:

- The source of pollution.
- Status of emission source.
- Any contaminated materials caused by the discharge.
- The steps taken to prevent incident happening again

3 Contacts

Table 1:Key personnel contact numbers

Organisation	Position	Name	Phone Number	Email Address
Kilwex	Site Manager	Philip Holmes	086 0842195	philip.holmes@kilwex.ie
Kilwex	Project Manager	Aaron McEvoy	086 103 4052	aaron.mcevoy@kilwex.ie
Waste Contractor TBC				
Coyle Environmental	Environmental Manager	Daniella O'Neill	0868427748	daniella@coyleenv.ie
Inland Fisheries Ireland	Eastern River Basin District	Dublin Regional Office	(01) 2787022	blackrock@fisheriesireland.ie
National Parks and Wildlife Service	North-eastern Region	District Conservation Officer	(076) 1002594	nature.conservation@chg.gov.ie
ESB	Project Manager	Aoife Heneghan	0879822952	aoife.heneghan@esb.ie
ESB	Environmental Specialist	Lorna Conway	087 9202428	lorna.conway@esb.ie
Local Authority	Laois County Council	Environment Section Anne Marie Callan Rory O'Callaghan	057-8664000 086-7966282 086-1438394	
Health and Safety Authority	Health and Safety Authority	Head Office, Dublin	(01) 6147000	wcu@hsa.ie
Emergency Services	An Garda Síochána	Stradbally Garda	(057) 8625222	-
Emergency Services	Ambulance and Fire Service	Ambulance and Fire Service	999 or 112	-

4 Location of Spill Kits

- A map indicating the location of all emergency spill kits and Booms is appended.
- All plant and fleet will be equipped with emergency spill kits.

These will placed in the welfare facilities on site to ensure all who come to site are aware of the location of spill kits in the event they are needed.

5 Responsibility

- All site personnel will report any spillages of oil, fuel, concrete or accidental emissions to the environment and soil to the adjacent watercourses to the Site Manager and Foreman.
- The Site Manager or Foreman will contact the Environmental Manager (Coyle Environmental). As appropriate, the Environmental Manager (Coyle Environmental) will report the spillage to the Regional Fisheries Board, Laois County Council and any other relevant authority.

6 Pollution Preventative Measures

6.1 Design

In regard to possible pollutant emitters on site, by far the most likely is sediment discharge to local rivers. However, as part of design and CEMP a number of preventative measures are being undertaken from both a design and contractor point of view from the onset.

In regard to design, all storm water discharge is being ran through a sediment pond, unlike existing developments where stormwater is deposited directly into local river. Sediment pond works by the following:

- Sediment ponds aid in the settlement of suspended solids in water, as it will slow the flow of water and allow solids to fall to the bottom of the pond.
- As each building has a drainage system, with settlement ponds treatment systems allowed for in each with the aid of stone check dam, water is filtered by means of settlement and stone filtration.
- To control the rate of water discharge a hydrobrake is then placed. This slows the rate of discharge to the local river and aids in settlement by slowing water, thus causing the suspended solids to fall to the bottom of the settlement pond and solid free water to remain at top of pond.

In conjunction with the sediment pond an interceptor tank is used for paved areas and works by the following:

- All water taken from an impermeable area is ran through an interceptor that will separate any oil from water due to oil being an immiscible liquid, meaning oil will stay on top of the surface of water as it is not as heavy as water and so can be filtered off.

All excavated soil on site will be placed in one of two stockpiles, however both stockpiles will have silt fencing placed all around each stockpile, thus catching sediment run off from it allowing water to separate and be caught by means of a french drain placed around the perimeter and filtered in sediment pond.

Also, to prevent any surface run off from the trafficked areas around site into the local rivers, a berm is to be formed on 3No. sides of the site.

Most likely occurrences of pollution on site will come most likely from failure of 1 of these preventative measures. And so, they will be monitored every day. They will need to be maintained to ensure performance. Sediment ponds will need to be cleaned removing the settled suspended solids and silt trenches cleaned pulling sediment laden material back to stockpile to give adequate space for additional run off.

6.2 Contractor Actions

In regard to fuels and oils storage, these will be stored in bunded locked areas to prevent unauthorised access, with spill trays used during filling and top up procedures.

Pollutants like fuel and oil leaks are the sources of the most spontaneous occurrences on site. This is why spill kits are placed around the site and with each piece of construction equipment to prevent the spread outside of the initial spill. In the event of a large release, where substantial amounts of hydrocarbon have escaped, soils will be removed from site to prevent further migration of contaminants subject to the advice of the environmental manager. This will then have to be sent to a licenced facility for remediation. All spill kit paraphernalia, whether it is absorbent granules or sheets that have been used to control release, they must be removed from site and disposed of with a licenced waste facility.

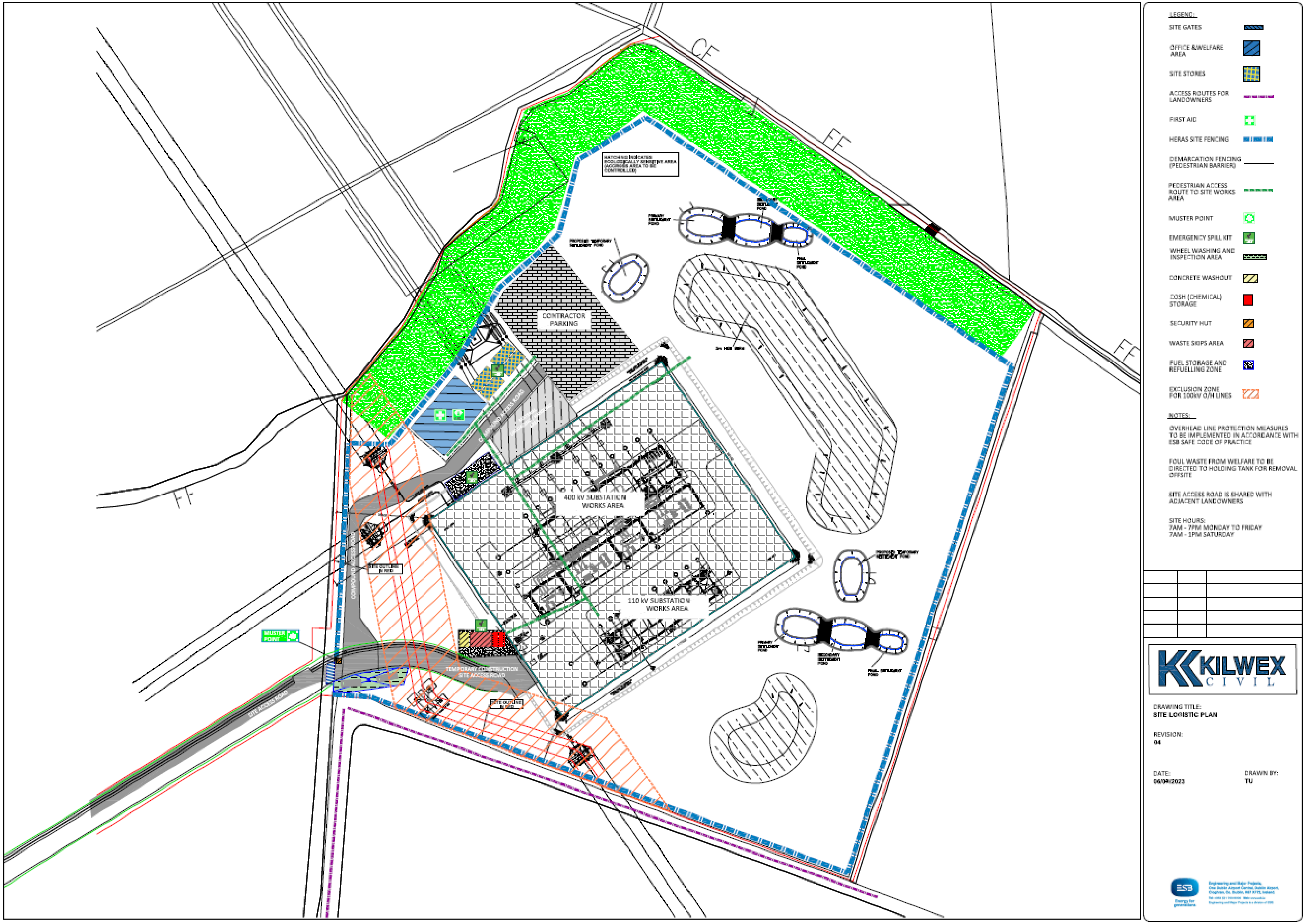
Figure 4: Showing spill clean up using spill kits

In relation to oil and fuel spills in rivers, hydrophobic absorbents are used. This is an oil selective material which repels water and absorbs oil. They come in the form of a long narrow material and are placed across the river. Below is an example.

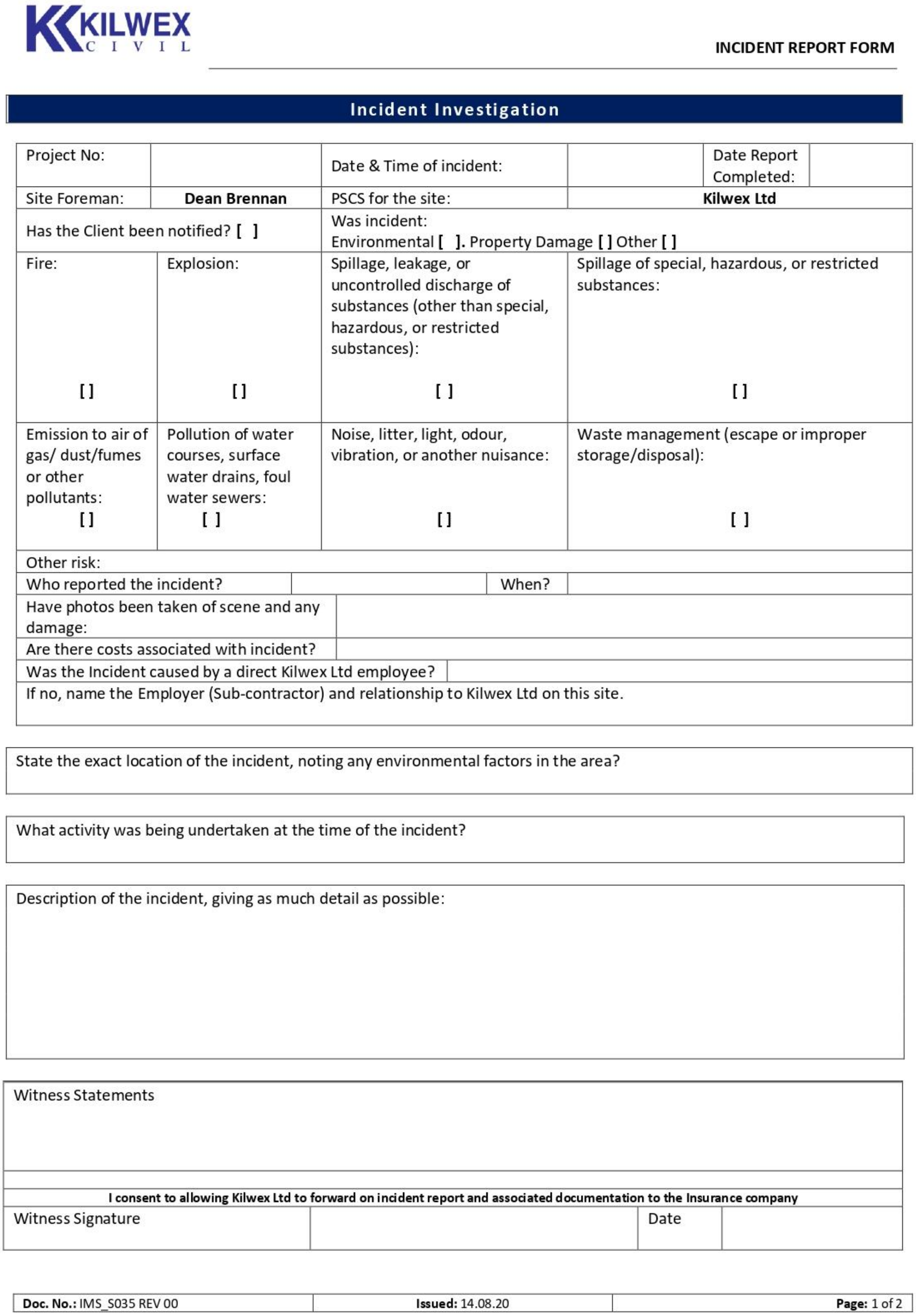
Figure 5: showing in stream silt curtain

7 Appendices

Appendix A – Site Layout with Spill Kit locations identified



Appendix B – Incident Report Form



INCIDENT REPORT FORM

Incident Investigation

Project No:		Date & Time of incident:		Date Report Completed:	
Site Foreman:	**Dean Brennan**	PSCS for the site:	**Kilwex Ltd**		
Has the Client been notified? **[ ]**		Was incident: Environmental **[ ].** Property Damage **[ ]** Other **[ ]**			
Fire: **[ ]**	Explosion: **[ ]**	Spillage, leakage, or uncontrolled discharge of substances (other than special, hazardous, or restricted substances): **[ ]**	Spillage of special, hazardous, or restricted substances: **[ ]**		
Emission to air of gas/ dust/fumes or other pollutants: **[ ]**	Pollution of water courses, surface water drains, foul water sewers: **[ ]**	Noise, litter, light, odour, vibration, or another nuisance: **[ ]**	Waste management (escape or improper storage/disposal): **[ ]**		

Other risk:			
Who reported the incident?		When?	
Have photos been taken of scene and any damage:			
Are there costs associated with incident?			
Was the Incident caused by a direct Kilwex Ltd employee?			
If no, name the Employer (Sub-contractor) and relationship to Kilwex Ltd on this site.			

State the exact location of the incident, noting any environmental factors in the area?

What activity was being undertaken at the time of the incident?

Description of the incident, giving as much detail as possible:

Witness Statements

I consent to allowing Kilwex Ltd to forward on incident report and associated documentation to the Insurance company

Witness Signature		Date	

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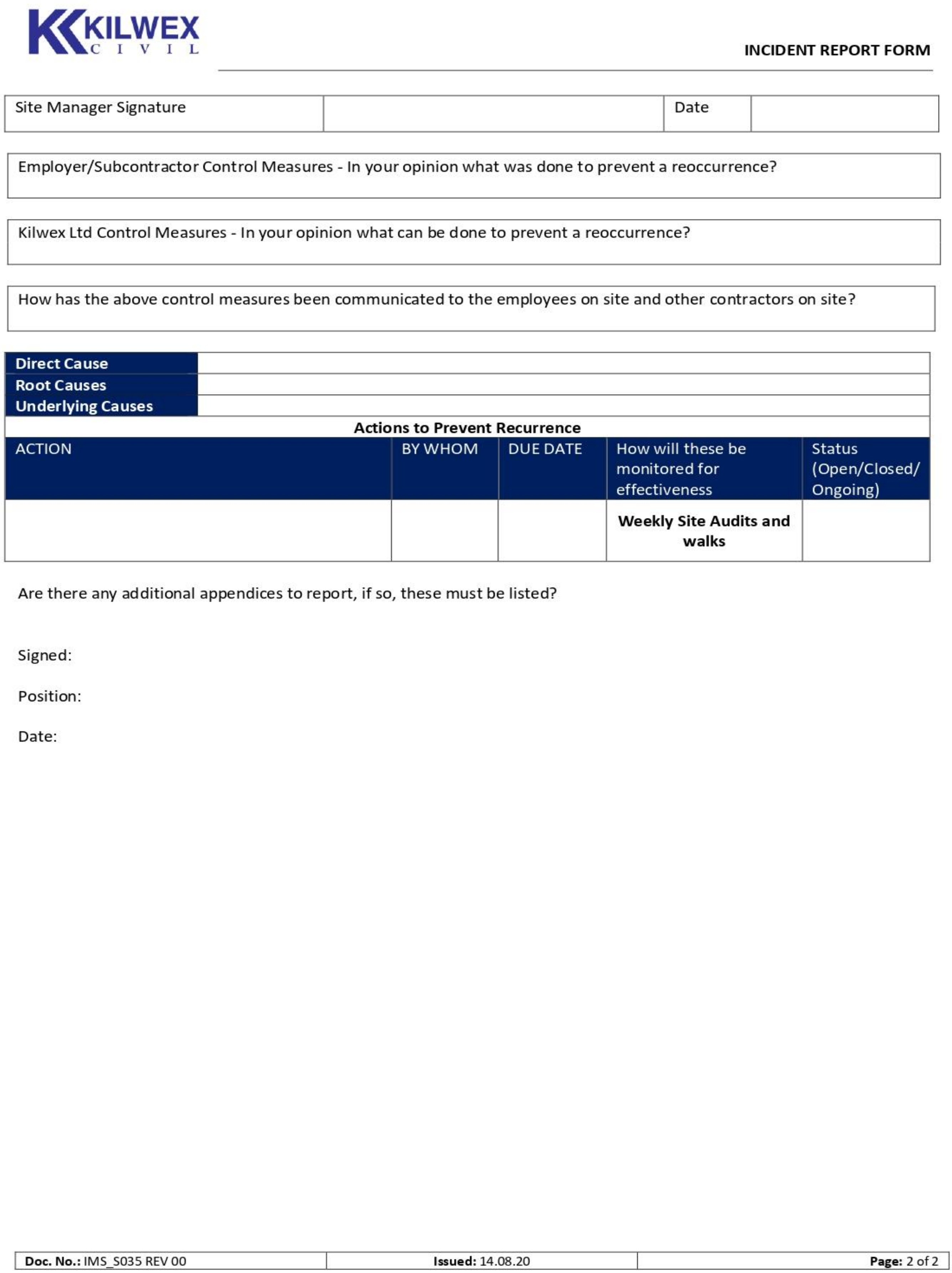

INCIDENT REPORT FORM

Site Manager Signature		Date	

Employer/Subcontractor Control Measures - In your opinion what was done to prevent a reoccurrence?

Kilwex Ltd Control Measures - In your opinion what can be done to prevent a reoccurrence?

How has the above control measures been communicated to the employees on site and other contractors on site?

Direct Cause	
Root Causes	
Underlying Causes	

Actions to Prevent Recurrence

ACTION	BY WHOM	DUE DATE	How will these be monitored for effectiveness	Status (Open/Closed/ Ongoing)
			Weekly Site Audits and walks	

Are there any additional appendices to report, if so, these must be listed?

Signed:

Position:

Date:

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EMP 1 Surface water run-off control

Purpose

To describe measures for the management of all surface water and run-off on the site, for the protection of watercourses and in particular, sediment and erosion control.

General measures

- Implementation of erosion and sediment controls such as silt fencing, French drains and drainage ponds.
- Eight separate settlement ponds will be constructed on site at the prior to excavation works.

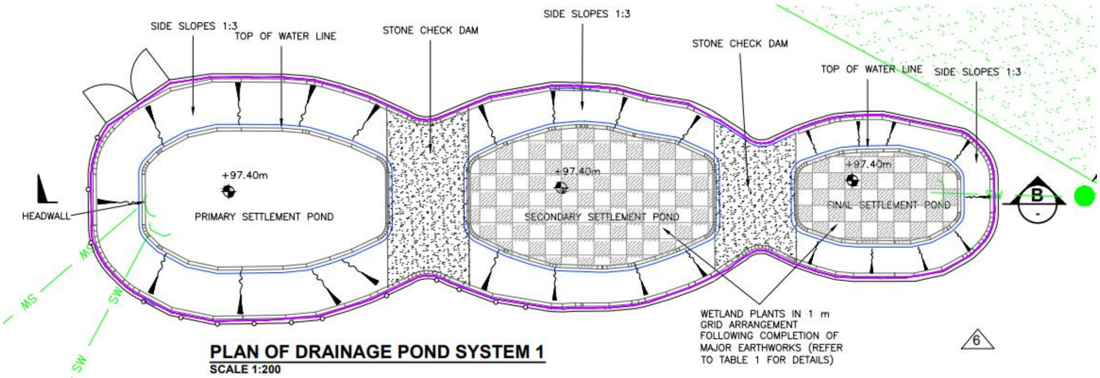


Figure 01 - Example of Drainage Pond Layout

- One group of 4no. ponds, 3 no. permanent and 1 no. temporary, will be located northwest of the substation and 4 no. ponds , 3 no. permanent and 1 no. temporary located to the east of the compound.
- Ponds will be used to treat water arising from dewatering excavations during the construction phase. After major earthworks, the ponds will be upgraded to facilitate operational surface run off.
- Excavation for the entire raft foundation will not be opened on mass but opened and brought to leanmix level, whereby the contractor will only excavate materials that can be backfilled easily to prevent ingress of water and reduce necessity of water pumping.
- Permanent ponds located to the North of the substation will contain rainfall on the 400kV substation building during both construction and post-handover.
- Permanent ponds located to the south will accommodate the rainfall generated from the transformer bund and the 110kV substation building

Figure 02 - Example of Silt Fencing

- The settlement ponds will have a permanent water depth of 300mm, thus eliminating any possibility of dust in dry periods
- The ponds will provide suitable attenuation for a 1 in 100-year rainfall event consisting of 20mm rainfall per hour for the entire complex when complete
- A 2 mm HDPE impermeable liner with welded joints wrapped in a geotextile fleece will be installed and laid across the pond excavation, with a minimum lap length of 300 mm. This will ensure no connection between the settlement ponds and the underlying subsoil and groundwater.
- The pond cells will be lined with an impermeable 2 mm HDPE geomembrane wrapped in a geotextile fleece beneath a 50 mm thick bed of 20 mm single-size clean stone.
- For the limited areas where the base of the settlement pond is below the water table, additional 20mm stone will be added to ensure no buoyancy of the HDPE liner. This will ensure no connection between the settlement ponds and the underlying subsoil and groundwater.
- A 50 mm deep layer of 20 mm single sized clean stone shall be placed across base of excavation
- Drainage of site berms containing the excavated materials will be carried out via French drains until the berms are vegetated. The berms will be surrounded by silt fences until vegetated and stabilised. See example of silt fence in Figure 02.

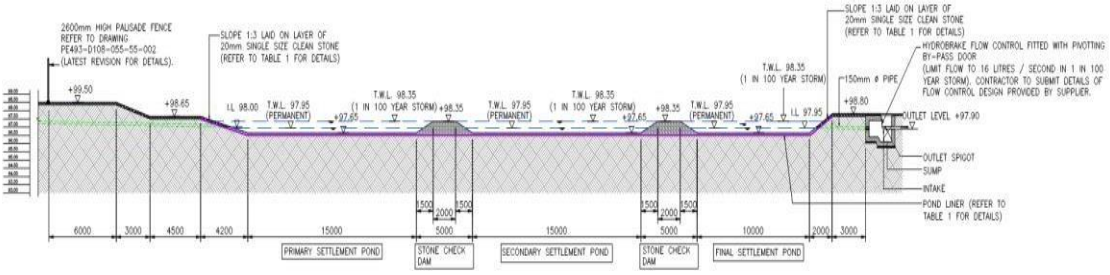


Figure 03 - Example of drainage pond levels shown above

- Sediment ponds and discharge points will be monitored on a daily basis to ensure discharged water is clean
- Sediment control infrastructure will be regularly maintained during the construction phase by cleaning of sediment ponds, repair of silt fences and vegetation in drains. Undertaking this maintenance will ensure the effectiveness of the ponds and ultimately , water quality discharge.
- Monitor access road ensuring it is kept clean to prevent run off entering watercourse.
- Monitor natural water flow paths and redirect to settlement ponds if possible to prevent entry into water course prior to treatment.

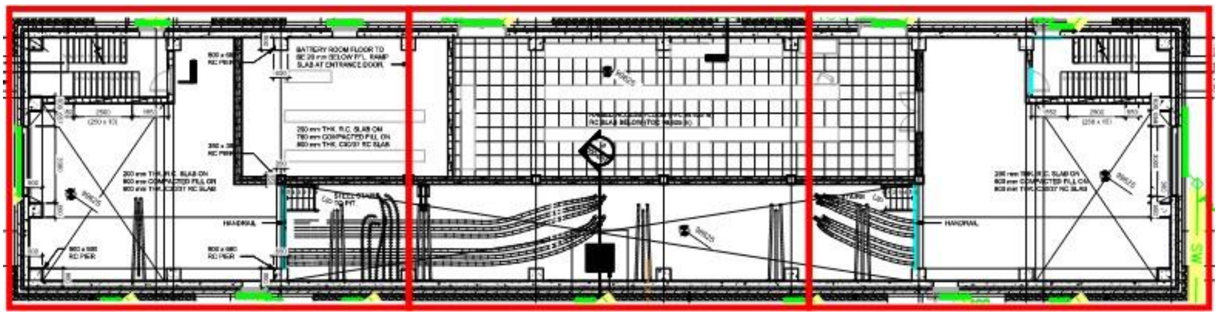
EMP-2 Management of Excavations

Purpose

To describe measures for the management of all excavations and excavated soil and rock on the site.

General measures

- Management of excavations will strictly be adhered to, this will be done by partially opening up building footprints as required without large amounts of stripping being undertaken.



Building foundations will be broken down into segments whereby formation level will be exposed for parts of the build only approximately 30% at a time, with stone build up placed and compacted before another section opened.

Figure 04

- Soils excavated during construction will be stockpiled permanently, formed to no more than 3m height and seeded to prevent erosion.
- Drainage protection measures such as the drainage ponds and French drains will be constructed prior to substation and road construction. This approach will be used in combination with the installation of other drainage protection measures in advance of construction, such as the installation of silt fencing.
- Within and around excavations, pore water pressure will be kept low by avoiding loading the soil/subsoil with cognizance to the existing drainage and how structures could affect it.
- All temporary cuts/excavations will be carried out such that they are stable or adequately supported. Where appropriate and necessary, cuts and excavations will be protected against ingress of water or erosion using cut off drains around the excavation works. Temporary works will be such that they do not adversely interfere with existing drainage channels/regimes.
- Plant and materials will be stored in approved locations only (such as the proposed site compounds) and will not be positioned or trafficked in a manner that would surcharge existing or newly formed slopes.
- Excavated topsoil and subsoil will be stored onsite for reuse, none will leave site.
- Surface vegetated scragh / surface turves will be carefully cut and removed and placed alongside the excavations for temporary storage.
- The scraghs/surface turves will be replaced (vegetated side up) and firmed into place with the back of the excavator bucket.
- Any soil moved off-site will be carried out by contractors licensed under the Waste Management Act of 1996 (as amended 2001), the Waste Management (Facility Permit &

Registration) Regulations of 2007 and the Waste Management (Collection Permit) Regulations of 2007.

- In the event of contaminated soil being identified all works in the area local to the contamination will be stopped immediately. Samples will then be taken and sent for testing to an accredited laboratory. Following on from testing and conformation as to the nature of the contamination, a remediation plan must be developed.
- The potential impact on the land and soils of the site due to excavations will be lower during operation and maintenance, as most excavations will have been reinstated. Some erosion of soil may continue into the operation phase, however as vegetation becomes established and equilibrium is achieved, erosion will cease.

EMP-3 Fuels and Oils Management

Purpose

To describe measures for the management of all fuel and oils on site for the protection of watercourses or groundwater from any spills.

General measures

- The potential for hydrocarbons getting into the existing drains and local watercourses will be mitigated by only refuelling construction machinery and vehicles in a designated refuelling area. A clearly defined documented refuelling procedure shall be implemented. The designated refuelling area shall be located at least 25 metres away from watercourses.
- Refuelling will be carried out using 110% capacity double bunded mobile bowsers. The refuelling bowser will be operated by trained personnel. The bowser will have spill containment equipment which the operators will be fully trained in using.
- To reduce the potential for oil leaks, only vehicles and machinery will be allowed onto the site that are mechanically sound. An up-to-date service record will be available for vehicles and machinery.
- Plant, site vehicles and machinery shall be checked daily and are to be well-maintained. Any machinery leaking fluids must be repaired or removed from site immediately. Any servicing operations shall take place at least 25m from watercourses (unless servicing is required at the point of breakdown) and over drip trays.
- Potential leaks from delivery vehicles will be reduced by visually inspecting all delivery vehicles for major leaks.
- Spill kits will be easily accessible and located close to identified pollution potential sources or sensitive receptors, these locations will be communicated to site personnel during the site induction. Where items have been used or functionality has been compromised, the spill kits would be replaced as necessary.
- The scale of potential impacts on downstream water quality will be reduced by only storing minimum amounts of oils for construction equipment service top up only.
- Oil containers must be stored within a secondary containment system e.g. bund for static tanks or a drip tray for mobile stores.
- Access to oil stores will be controlled within a locked steel container within the site compound. The site compound will be surrounded by a palisade fence and locked when outside of working hours.
- Leakages of oil from oil stores will be prevented by storing on drip trays which have a capacity of 110% of the total volume of the stored oil. Ancillary equipment such as hoses and pipes will be contained within the bunded storage container.
- The potential for leaks will be prevented through monitoring oil storage tanks/drums for leaks and signs of damage. This will be carried out daily by the Environmental Manager.
- Long term storage of waste oils should not be allowed on site only storage of oil to correct construction equipment levels. Waste oils will be collected in leak-proof containers and removed from the site for disposal or re-cycling by an approved service provider/fitter for disposal.
- The Environmental Incident and Emergency Response Plan details arrangements in place to deal with environmental emergency such as a fuel or oil spill on site.
- Appropriate environment incident response will be facilitated by training all vehicle/machinery operators in the use of the spill kits and the correct containment and cleaning up of oil spills or leaks. This training will be provided at site induction.

- Should there be an oil leak or spill, the leak or spill will be contained immediately using oil spill kits. This contaminated material and soil will be properly disposed of in a licensed facility.
- The Environmental Manager will be immediately informed of the oil leak/spill and will assess the cause and the management of the clean-up of the leak or spill. They will inspect nearby drains for the presence of oil and initiate the clean-up if necessary.
- Immediate action will be facilitated by easy access to oil spill kits. An oil spill kit that includes absorbing pads and socks will be kept at the site compound and in site vehicles and machinery.
- In the event of a major oil spill, a nominated company will provide a rapid emergency response service for major spills.

EMP 4- Management of Concrete

Purpose

To describe measures for the management of concrete on site for the protection of watercourses from any spillages.

General measures

- To reduce the potential for cementitious material entering watercourses, concrete pours will be supervised by the Project Manager, a suitably qualified Engineer and the Environmental Manager.
- The construction manager will ensure that the area of the pour is completely drained of water prior to pour commencement.
- Pours will not take place during forecasted rainfall.
- Incidental rainfall from light showers during the period of a pour is typically absorbed into the concrete matrix but heavier showers can result in some run off from the top surface of the concrete pour. If run-off is encountered in great enough volume, the Environmental Manager will block the outflow from the drains to retain or treat the run-off until the pH is neutral before discharge to the drainage network.
- In the event of a spill within the immediate vicinity of drainage ponds or French drains, the Environmental Manager will temporarily block the drains and monitor the pH levels of the water in the associated settlement ponds. Any spillage will be cleared immediately and deposited in the chute wash down area.
- During the pouring of concrete, effective containment measures will be implemented to avoid spilling concrete outside construction areas and to prevent concrete entering any drainage system. To reduce the potential for cementitious material entering watercourses, concrete pours will be supervised by the Site Manager. There will be no washing out of delivery trucks on site only cleaning of concrete chute.
- Pours will not take place during forecasted heavy rainfall.
- Wet concrete operations are not envisaged for this site within or adjacent to watercourses . However, if wet concrete operations are required in such locations, a suitable risk assessment will be completed prior to works being carried out.
- To reduce the volume of cementitious water, washout of concrete trucks will not take place on site. Concrete trucks will be washed out off site at the source quarry, only concrete truck chutes will be washed down on site. The concrete trucks will wash down their chutes at a designated chute wash down area in the site compound.
- The environmental manager will monitor the pH of the water in the chute wash down bund. Once full this will be returned to the concrete batching plant to be re-used via delivery truck bottle.
- Temporary storage of cement bound granular mixtures will be on hardcore areas. Cement products are hazardous and should always be stored in a COSHH store or similar (shipping container), and only be in the open when in use. If cement products are temporarily located in the open, then they will be located within an impermeable bunded area and covered to prevent contact with rainwater. This will prevent direct drainage of cement storage areas to surface waters. Bunding will be in the form of sandbags or silt fencing.

Concrete pouring

Due to the large concrete pours required to construct the substation, the pours will be planned weeks ahead. Special procedures will be adopted in advance of and during all concrete pours to minimise the risk of pollution. These may include:

- Using weather forecast to assist in planning concrete pours and avoiding large pours where prolonged periods of inclement weather conditions are forecast or persist.
- Ensure that excavations are sufficiently dewatered before concrete works commence.
- Ensure that covers are available for freshly placed concrete to avoid runoff to proximal receptors during inclement weather conditions.
- There will be no large-scale batching of concrete on the site. All concrete will come from a certified supplier

Concrete washout

- Kilwex will place a 12-yard skip on a suitable area of hard standing.
- A layer of sand will be placed on the bottom of the skip.
- The skip will then be lined with a layer of heavy-duty polythene.
- Concrete delivery vehicles will then be permitted to reverse up to skip and wash out their chute (only) into the washout skip.
- Water levels in the skip will be monitored daily.
- Skip will be covered as required during periods of heavy rainfall.
- As skip reaches capacity the “Washout water” from will be pumped into an empty concrete delivery vehicle to be returned to the concrete supplier, where this water will be reused in the batching process.

EMP 5 Protection of Habitats and Fauna

Purpose

To describe measures for the management and protection of habitats and fauna on the site.

General measures

- An ecological walkover of the site was taken in March 2022 and December 2022 by ESB ecologists. It was determined that the site has no rare flora and no volant/non-volant mammals were found during those walks. Therefore, no established habitats or protected species of interest were noted during any of the ecological surveys.
- The project ecologist will be employed during the construction phase of the project. Duties will include the review of all method statements, delivery of toolbox talks and monitoring of construction phase to ensure that all environmental controls and mitigation measures are implemented.
- Spraying of vegetation using pesticides is strictly prohibited.
- Habitat disturbance to fauna will be limited by controlling the movement of maintenance vehicles. Construction vehicles will not encroach onto habitats beyond the proposed footprint.
- In the rare event that protected faunal species are found actively using the site for breeding/roosting during the construction phase, works will cease immediately and the area will be cordoned off until advice is sought from a suitable qualified specialist.
- Construction activities will be restricted from 7:00 AM to 7:00 PM, Monday to Friday and between 8AM and 6PM on Saturdays. Construction work will not take place at night unless in exceptional circumstances.
- Should the resting or breeding places of any protected species be discovered within the site during construction works, ESB will be informed.
- Kilwex ensures that prior to entering the site, the equipment would be visually inspected to ensure all adherent material and debris has been removed.

EMP 6 Waste management

Purpose

To describe measures for the management of all wastes associated with the construction of the substation and OHL.

General measures

- A Resource Waste Management Plan has been developed for the Project. This plan details projected Project waste arisings and avenues for disposal. All Project waste is recorded in the Waste manifest which will form part of the Monthly Environmental Monitoring Report. This document will be made available for all personnel and will be in the site compound office.
- Kilwex Ltd. shall ensure that all such waste arising from their own or their subcontractors' activities is promptly disposed of into segregated containers and no extraneous material is discarded on site. All waste products shall be removed off site by a waste contractor with suitable licences and permits to the approval of the Engineer and the relevant local authority. Permit details shall also be supplied by the appointed waste contractor detailing the destination waste handling facility or landfill.
- Recycling shall be implemented across the site and compound with all waste to be segregated onsite into the following categories: timber, metal, general waste, recyclables, canteen, compost and hazardous waste. Separately labelled skips are to be provided for each category of waste and these shall be emptied regularly. Metal containers for inflammable waste shall be provided by the Contractor and arrangements made for regular collection and disposal off the site.
- The waste management hierarchy actions are: prevention, minimisation, reuse, recycling, energy recovery and disposal. Waste prevention is the most favoured option meanwhile disposal the least favoured option. This hierarchy of actions shall be considered during the entire construction process.
- As part of the record keeping procedures, the Environmental Manager should keep records provided by waste contractors of all waste being removed from site. The Environmental Manager should record waste removed from site on a monthly basis. This information should be recorded in a standard format.
- A dedicated storage area will be provided in the site compound for building materials such as blocks, tools, fence posts, booms, wires and others.
- Access to stored materials will be restricted, the site compound will be securely fenced from the outset and will be locked when there are no site personnel present.
- To contain and manage construction phase waste, multiple skips will be provided at the storage compound. These skips will be emptied when required.

EMP 7 Traffic Management

Purpose

To describe measures for the management of all traffic, including construction traffic and oversized loads, for the minimisation of disturbance and nuisance to the local community.

General measures

- The access to the construction site will be via a modification to the existing road that currently serves a farmstead with a dwelling house, located in the townlands of Coolnabacky and Esker. The access road will be approximately 1.2km from the R426(public road) to the substation compound gates.
- Kilwex shall maintain all public roads and site access roads and clear site dirt and debris to the satisfaction of the local authority and EMP.
- Legal speed limits will be emphasised to all staff and contractors during the induction training.
- Kilwex will be required to schedule deliveries in such a way that construction activities and deliveries do not run concurrently such as delivering materials the same day as large concrete pours.
- Kilwex will be required to interact with members of the local community and suspend deliveries on the days of any major events that have the potential to cause larger than normal traffic volumes to the road network in the vicinity of the works.
- A spotter will be put in place to direct construction traffic when multiple vehicles may be entering or exiting from site. Appropriate signage should be placed on both sides of the site access point to warn road users.
- The appropriate authorities will be notified of the movement of abnormal loads and traffic management measures agreed.

EMP 8 Management of Archaeology

Purpose
To describe measures for the management and protection of archaeological and cultural heritage on the site.

General measures

- All topsoil stripping/ground reduction works onto the surface of the underlying geological-derived subsoils will be monitored by a suitably qualified and experienced archaeologist.
- The topsoil will be removed by mechanical excavators fitted with wide, toothless grading buckets.
- In the event that subsurface remains of archaeological interest/potential are uncovered during the course of topsoil stripping, then works in the immediate area will cease, pending investigations by the appointed archaeologist and consultation with the National Monuments Service, Department of Housing, Local Government and Heritage – if required.
- A report describing the results of the programme of Archaeological Monitoring, and any other archaeological interventions that might be required, will be prepared and submitted to the Planning Authority in further compliance with Condition 10 of the Grant of Planning.
- The Site Archaeologist will be responsible for highlighting any new or existing archaeological structures to the Main Contractors Engineers during works.
- Machinery used in association with the construction works will avoid all known recorded archaeological monuments and newly detected sites and should not be operated within proximity to the latter. Construction personnel will follow the direction of the Site Archaeologist in this matter.
- Satisfactory arrangements will be agreed for the recording and removal of any archaeological material considered appropriate to remove.

EMP 9 Construction Noise

Purpose
To describe measures for the management of impacts from construction noise

National Roads Authority Guidelines for the Treatment of Noise

Those are the only guidelines for construction related noise in Ireland. These guidelines are as follows:

Monday to Friday
07.00 to 19.00hrs 70 LAeq (1hr) and 80 dB LpA (Max) slow dB
Monday to Friday
19.00 to 22.00hrs 60 LAeq (1hr) and 65 dB LpA (Max) slow dB
Saturday
08.00 to 16.30hrs 60 LAeq (1hr) and 75 dB LpA (Max) slow dB
Sundays & Bank Holiday
08.00 to 16.30hrs 60 LAeq (1hr) and 65 dB LpA (Max) slow dB

General measures

- Noise nuisance can potentially arise using mechanical tools, general construction activities, and from the movement of vehicles servicing the site. However, due to the temporary and transient nature of construction phase works, the existing noise environment associated with the development site and the surrounding area and distance to the nearest sensitive receptors, the impact is not considered to be significant.
- Ensure machinery is modern, well maintained and working properly.
- Avoid idling engines. Engines will be switched off when not in use.
- Plant will be used in an appropriate manner with respect to minimizing noise emissions.
- Noise and vibration monitoring will be undertaken on an ongoing a nearby landowner property
- Results will be reported as part of the Monthly Environmental Monitoring Report.
- Weather conditions should be considered when reviewing noise levels as high wind speeds can negatively affect noise levels.

EMP 10 Dust Management

Purpose

To describe the measures for the management of nuisance impacts on air quality from construction generated dust.

General measures

The potential for dust to be emitted depends on the type of construction activity being carried out in conjunction with environmental factors including levels of rainfall, wind speeds and wind direction. The potential for impact from dust depends on the distance to potentially sensitive locations and whether the wind can carry the dust to these locations. The majority of any dust produced will be deposited close to the potential source and any impacts from dust deposition will typically be within several hundred metres of the construction area.

- Limit the speed to 15 km/hour throughout the construction site, especially at access/egress locations.
- Importance of respecting speed limits to avoid dust mobilization will be addressed during the toolbox talks.
- In periods of extended dry weather the following shall apply:
    - Dust suppression may be necessary within the site compound and internal access road to minimize the nuisance risk.
    - If necessary, water will be abstracted from settlement ponds in the site construction drainage system and pumped into a bowser or water spreader to dampen down the internal access road and site compounds to prevent the generation of dust.
    - Water bowser movements will be carefully monitored in order to avoid the excessive usage of water which may exceed the requirement.
- Trucks will be covered if they transport dusty material.
- Implement measures to control emissions of fine particulate emissions, in particular particles less than 10 um aerodynamic diameter where drilling, blasting, grinding or similar types of rock or concrete operations are taking place.
- The control measures to minimize dust will be reviewed at regular intervals during the construction phase to ensure the effectiveness of the procedures in place and to maintain the goal of minimisation of dust through the use of best practice and procedures.

EMP 11 Invasive Species Management

Purpose

To describe measures for the management of invasive species on site.

General measures

- There are no signs of invasive plant species within the site boundary or along the peripheral areas during any of the ecological surveys and walkovers. Ecological site walkovers will be conducted on a monthly basis and an inspection for invasive species will form part of this survey. If identified, invasive species will be managed as per the Kilwex Environmental Procedures which will be available for review and reference in the compound office on site.
- The project ecologist will identify access routes where invasive species occur in liaison with the contractor and all site personnel will be trained in the identification of particular invasive species.
- Works will be scheduled so that machinery used in areas identified as invasive species occurrence areas will be brought back to the compound for cleaning, prior to being used at any location where invasive species do not occur.
- Material potentially contaminated with invasive plant seed will be treated in accordance with relevant guidance such as *The Management of Noxious Weeds and Non-Invasive Plant Species on National Roads* (NRA, 2010); Invasive Species Ireland, Best Practice Guidelines and *Managing Japanese Knotweed on Development Sites* (UK Environmental Agency, 2013).
- In areas where alien invasive species are present, vehicles will carry a 'disinfection box'. This will contain Virkon Aquatic or another proprietary disinfectant, a spraying mechanism, cloths or sponges, a scrubbing brush and protective gloves.
- Disinfectants will be used strictly in accordance with the manufacturer's instructions. They will be disposed of safely and never close to open waters such as drains or water streams.
- All equipment that has come in contact with water or soils will be visually inspected for evidence of attached plant material, adherent mud or debris. This will be done before entering and leaving the site. Any attached or adherent material will be removed before leaving the site.
- Prior to arrival on site, contractor's vehicles and equipment will be thoroughly cleaned, preferably using high-pressure steam cleaning where feasible or a normal power hose.
- The Project Ecologist will advise the contractor on the appropriate mitigation measures required.

EMP 12 Emergency Response Plan

Purpose

To describe measures for the management of emergencies which involve people.

Plan of action

- As soon as an employee witnesses an incident, they will raise the alarm and will contact a member of management and the emergency services on either 999 or 112 and provide the GPS Coordinates if required.
- If the person is trapped underneath the vehicle/machine is not in any more danger, no attempt will be made by site personnel to remove the victim until the emergency services arrive on site.
- If, however there is a severe danger that the situation might become worse before the emergency services arrive, the vehicle/ machine shall be secured by means of tying back with adequate ropes and chains attached to other close by machines. Once the vehicle/machine is secure and the scene is safe, a trained first aider can administer first aid to the casualty.
- The onsite emergency co-ordinator will appoint a person to wait at the site entrance or closest point to where the emergency services have been directed to escort the emergency services to the injured person and the scene of the emergency.
- No attempt shall be made to turn an overturned vehicle/machine into its correct position until the victim is removed safely.
- The onsite emergency co-ordinator will appoint a person to go to the hospital if a casualty or casualties are taken there and will keep the company informed.
- The onsite emergency co-ordinator will ensure that the scene is preserved for investigation.

EMP 13 Site environmental Training and Awareness

Purpose

To describe measures for the training of all site personnel in the protection of the environment and the relevant controls.

General measures

- Environmental Manager will ensure that all personnel receive adequate induction training, incorporating environmental awareness, introducing the CEMP particulars, familiarizing the workers in what to do in case of an environmental emergency and prepare them for a promptly response in case of an environmental emergency.
- Toolbox talks on Environmental Control measures will be used as part of mitigation measures. These toolbox talks will be site specific and it will explain topics such as environmental mitigation, nuisance emissions, site speed limits, emergency response procedures, environmental awareness relating to the sensitivity of the watercourses, ecological exclusion zone, among others.
- Site environmental inspections will be carried out and documented regularly to ensure that work is being carried out in accordance with the Environmental Control Measures.
- Notify the relevant statutory authority about environmental incidents and carry out investigations, reporting incident and remedial actions details taken to the relevant authority.

EMP 14 Monitoring and Auditing

Purpose

To describe measures for environmental monitoring during the construction works and audit of control measures to ensure environmental protection.

Plan of action

- All mitigation measures, any planning conditions and relevant construction methods will be monitored on site. The construction phase of the project will be supervised and monitored by ESB, ESB-EMP and suitably qualified contractor personnel.
- Routine inspections of construction activities will be carried out daily by the contractor's construction management team to ensure all control measures to prevent environmental impact, relevant to the construction activities taking place at the time are in place.
- Environmental inspections will ensure that the works are undertaken in compliance with this CEMP and any subsequent updates to this document.
- Environmental site inspections will be carried out by suitable trained staff. Those environmental records will be made available to the Local Authority when requested.

Noise and Vibration monitoring

- Construction noise at all locations will arise but will be limited in intensity and duration by the nature of the construction activity. The NRA Guidelines (EMP 9) for construction noise will not be exceeded at any stage during the construction process.
- Noise and vibration monitoring will be undertaken on an ongoing basis at a nearby landowner property and will be reported as part of the Monthly Environmental Monitoring Report.
- Weather conditions would be considered as high wind speeds can negatively impact noise levels.

Dust monitoring

- Excavation will potentially be a primary source of dust, especially during periods of dry weather.
- The public roads will be subject to regular inspection for cleanliness and it will be checked that trucks are covered during the transport of spoil material. Again this should not occur as all excavated material is remaining on site.
- Water will be used as dust suppressant if cutting equipment is used or if there is risk of dust emissions from the roads, this will happen more often during dry weather.
- Dust monitoring will be set up at the nearby landowner property
- Dust pots will be lifted every 30 days and dust samples analysed using the Bergerhoff Method
- Dust levels will be measured against current EPA License threshold limits (350 mg/m2/day).. Results will be reported in the Monthly Environmental Monitoring Report.

Water monitoring

- Boundary watercourse will be monitored upstream and downstream of the site boundary, outlet of tufa spring and outlet from settlement ponds (SW01 – SW05)
- The groundwater monitoring points comprise of boreholes specially constructed within the shallow sediments (BH01 – BH4) and will inform condition of hydrogeological environment
- Surface water will be **visually inspected daily** - any turbidity or discolouration should be reported.
- The environmental manager will undertake **weekly measurements** in-situ, at surface water sampling locations. Dissolved oxygen, pH, EC – Conductivity, Turbidity and Temperature will be measured using handheld calibrated equipment.

- Coyle Environmental on behalf of Kilwex will undertake **monthly sampling** at surface water sampling locations. The following parameters will be analysed –pH, Calcium, Magnesium, Potassium, Ammonia NH4, Nitrate, Alkalinity, Phosphorus, Total TPH & Suspended Solids. Results will be measured against current EQS standards for water quality - SI272/2009 as amended by SI372/2012; SI386/2015; SI77/2019; SI659/2021

- Coyle Environmental on behalf of Kilwex will undertake **monthly sampling** at groundwater sampling locations. The following parameters will be analysed –pH, Calcium, Magnesium, Potassium, Ammonia NH4, Nitrate, Alkalinity, Phosphorus, Total TPH & Suspended Solids - Results will be measured against current European standards for groundwater quality SI366/2016 Groundwater Regulations

All sampling will be taken in accordance with BS EN ISO 5667 for surface water. Analysis will be at an INAB accredited laboratory.

EMP 15 Environmental Accidents, Incidents and Corrective Actions

Purpose

To describe measures for the recording, investigating and close-out of any environmental accidents or incidents on the site.

General measures

- Assess each on-site operation separately to identify all potential risks that could cause an environmental accident.
- Identify points in your operations where you can eliminate or control these risks.
- Discuss with the Project Ecologist and Site Engineer to agree environmental risks and control points.
- Implement agreed control measures at these control points.
- After agreed period, the project Ecologist should carry out an audit to check if control measures have been correctly implemented.

Plan of action

- The Environmental Manager or Construction Manager will be contacted as soon as possible where there is any incident that carries the possibility of negative environmental consequences.
- The Emergency Response Plan and standard procedures will be applied to get the incident under control and prevent injury or loss of life in the first instance.
- Work in the area will be halted and the Environmental Manager will be called to the scene to assess the situation and to decide on initial responses and remedial measures.
- Once the situation is under control, the environmental accident or incident will be recorded, and the cause investigated.
- Any remedial action required will be taken to mitigate any damage and prevent a reoccurrence.
- Corrective actions will be communicated to personnel and sub-contractors where relevant-particularly where it results to a change in procedure.

EMP 16 Environmental Complaints

Purpose

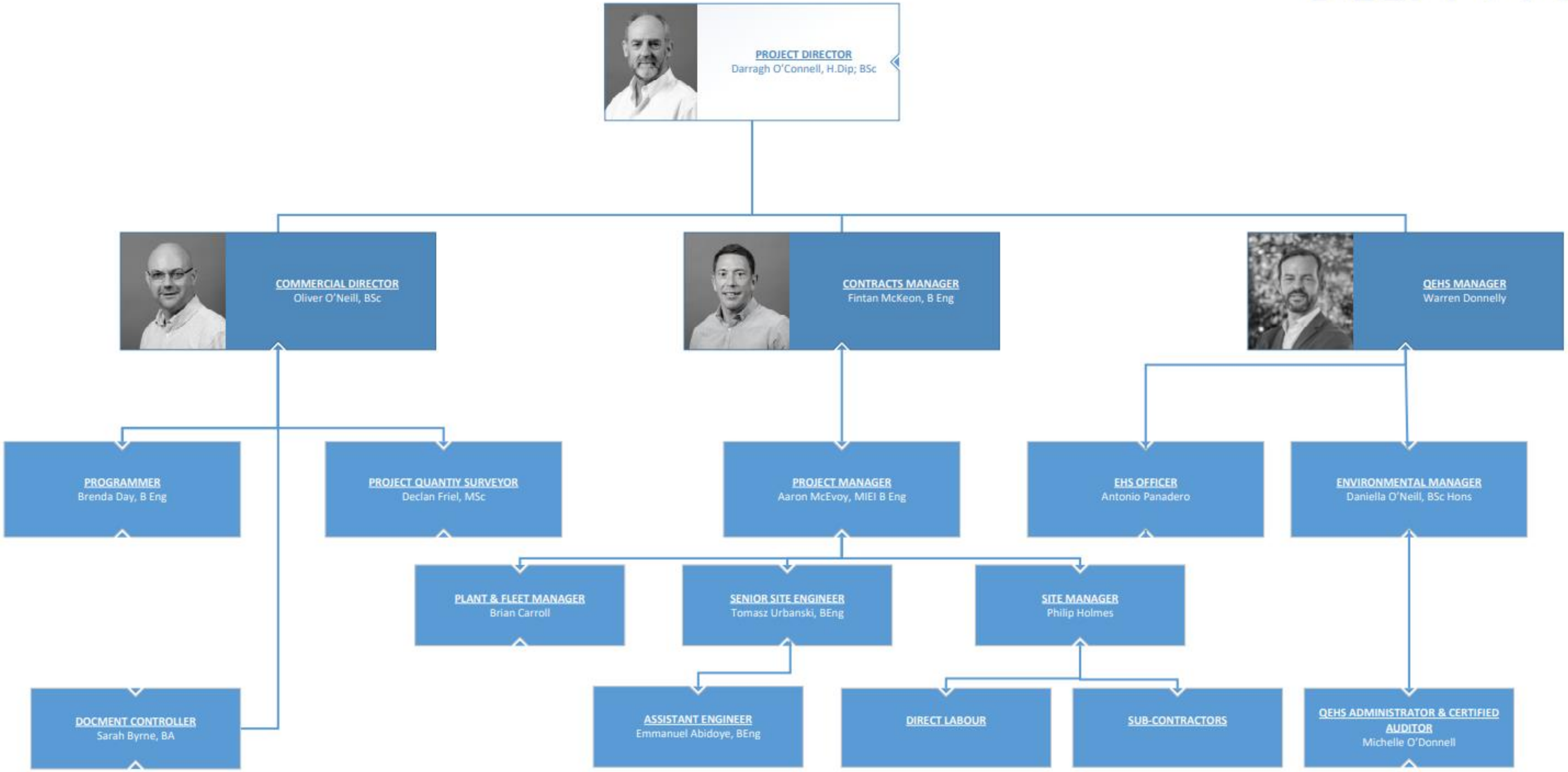
To describe measures for the recording and resolving complaints by third parties, including residents or members of the public.

General measures

- Any internal or external environmental complaints received will be recorded and investigated.
- Immediate action is recommended to resolve environmental complaints to avoid any nuisance to the local community or any environmental damage.

Plan of action

- Record of any complaints.
- Follow up by the relevant site representative (Project Ecologist or Environmental Manager).
- Apply remedial measures if required.
- Ongoing communication with complainant to confirm the resolution.
- Reassess the task, training, communication with site personnel as required.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Ecological Clerk of Works Report
Kilwex at Coolnabacky ESB site
Pre-construction Ecological Survey

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Castlerea, Co. Roscommon

Document Production and Approval			
	Name	**Date**	**Position**
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Approved by	Daniella O'Neill	14/02/23	Environmental Consultant

Revision History		
Rev	**Status**	**Date**
0	Draft	20/02/23
	Final	27/03/23

Contents

1. STATEMENT OF AUTHORITY

Cian Ó Ceallaigh (BSc (Hons), MSc) is an Associate member of the Chartered Institute of Ecology and Environmental Management (ACIEEM) who has extensive botanical and habitat knowledge (FISC Level 4, 2018) and has worked as a professional ecologist in Ireland and Britain since 2017. He also holds a Great Crested Newt (GCN) Level 1 (Class Licence). Cian has experience undertaking Appropriate Assessment (AA) screening reports and Natura Impact Statements (NIS's) in Ireland as well as Preliminary Ecological Appraisals (PEAs), Ecological Site Management Plans (ESMP's) and other species-specific survey reports in Britain.

2. INTRODUCTION

Coyle Environmental Ltd. Were instructed by Fintan McKeon of Kilwex Limited in January 2023 to undertake an ecological survey of a site in Coolnabacky, Timahoe, Co. Laois. It is proposed to develop the site into a 400/110kV ESB substation. The site is located approximately 8km southeast of Portlaoise, county Laois (Ordnance Survey Grid Reference: S 53819 92872). The Site comprises mainly grassland and is enclosed by watercourses and hedgerows. A gravel track is present along the southern boundary as well and from the southwest corner of the site up along the western boundary. The wider area is dominated by agricultural land (mainly improved grassland). The location of the site and its boundary is shown in Figure 1 and is hereafter referred to as the **Site**.

The survey aimed to determine habitats on Site and whether there was any evidence of protected species (such as badgers *Meles meles* or otter *Lutra lutra*) as a pre-construction baseline update survey. This was a requirement set out by An Bord Pleanála:

3. SCOPE OF WORKS

The objective of the survey was to identify the habitats present on Site, whether these have changed since last being surveyed (AOS planning Ltd., 2012; Denyer Ecology, 2022), classify them following the standard scheme for classifying habitats in Ireland (Fossitt, 2000) and determine whether habitats qualify, or could qualify, as corresponding Annex 1 habitats. Consideration was also given to species/species groups, such as the protected and/or notable species/species groups outlined below:

- Amphibians
- Badger *Meles meles*;
- Bats;
- Birds;
- Invertebrates;
- Otter *Lutra lutra*;
- Viviparous lizard *Zootoca vivipara*; and
- Invasive non-native species (INNS), both plant and animalThe findings of the above are included within this report.

4. NOTES AND LIMITATIONS

The survey was undertaken outside of the optimal period for surveying flowering plants (May – October inclusive). Therefore, there is a chance some species may not have been recorded during the survey for this reason. However, the detail collected is considered sufficient considering the Site has already been surveyed (AOS planning Ltd., 2012; Denyer Ecology, 2022) and the surveyor is also competent in vegetative identification of vascular plants.

The survey was undertaken outside the main breeding bird season (March – September inclusive). As such the survey does not represent the extent the Site would be used for breeding and nesting birds.

The survey was undertaken over the course of a few hours in a single day. This means species identified and recorded are limited to those that were visible and/or audible over the course of this period.

Additionally, where observed and identifiable by the surveyor, taxonomic groups such as bryophytes and invertebrates have been recorded. It should be noted that any lists provided within this report are not exhaustive (i.e. bryophytes listed likely only represent a small proportion of those present on Site).

5. METHODOLOGY

SITE WALKOVER

An ecological survey of the Site was carried out on the 30th January 2023, in cool (9°C), dry conditions with a moderate breeze and a clear sky (1/8 Otkas). Towards the end of the survey conditions became overcast and it began to rain although this did not limit the survey.

Habitats were described following the standard scheme for classifying habitats in Ireland (Fossitt, 2000) (see Figure 1). The dominant plant species were recorded, and habitats were classified according to their vegetation types. Where appropriate consideration was given to whether habitats qualify, or could qualify, as corresponding Annex 1 habitats. Relative plant species abundance was estimated using the DAFOR scale[1] . The scientific names for plant species use nomenclature given in An Irish Flora (Parnell, J. & Curtis, T., 2012)

During the walkover observations of birds, whether heard and/or seen, were recorded. Throughout the walkover the surveyor stopped, observed and listened for approximately five to ten minutes to improve the chances of seeing/hearing birds. Incidental sightings of other taxonomic groups were also recorded.

Sections of the watercourse present on Site were also inspected for signs of invasive species and mammals such as otters, where accessible. Although the surveyor has been made aware of tufa formations on Site it was not considered appropriate to re-survey areas that have already been surveyed in 2022 by Ireland's leading Annex I habitat priority petrifying spring specialist (Denyer Ecology, 2022). Increased sedimentation in the streams (which surveyor trampling can create) could alter stream chemistry and affect tufa formation (Denyer Ecology, 2022).

6. RESULTS

HABITATS

The following habitats were identified during the survey:

BL3 – Buildings and artificial surfaces

A gravel track runs along the Sites southern boundary. In addition, and presumably more recently for a related pylon development project, access tracks have been built from the Sites southwest corner up along the Sites western boundary (Plates 1 and 2).

ED2 – Spoil and bare ground

A number of spoil heaps are now present throughout areas of the Site which are being developed. These are mainly located along the Sites southern boundary and another area is located along the western boundary. Silt fencing encloses these heaps presumably to reduce/prevent sedimentation run off in the direction of watercourses along the western and northern boundaries. A number of ruderal species associated within this disturbed ground habitat were recorded. These included

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[1] The DAFOR scale has been used to estimate the frequency and cover of the different plant species as follows: Dominant

(D) - >75% cover, Abundant (A) – 51-75% cover, Frequent (F) – 26-50% cover, Occasional (O) – 11-25% cover, Rare (R) – 1-10% cover., The term 'Locally' (L) is also used where the frequency and distribution of a species are patchy and 'Edge' (E) is also used where a species only occurs on the edge of a habitat type.

Cardamine sp., scentless mayweed *Tripleurospermum inodorum*, annual meadow grass *Poa annua*, common field speedwell *Veronica persica*, cut-leaved cranes bill *Geranium dissectum*, shephard's purse *Capsella bursa-pastoris*, red dead-nettle *Lamium purpureum*, creeping cinquefoil *Potentilla reptans*, corn spurrey *Spergula arvensis*, and common chickweed *Stellaria media.*

GS1 – Dry Calcareous and neutral grassland

This habitat was previously classified as improved grassland (AOS planning Ltd., 2022). However, due to agricultural abandonment the grassland has since developed into rough grassland with a layer of flattened thatch about 30cm deep in places (Plates 3 & 4). It is dominated by creeping bent *Agrostis stolonifera* with occasional cock's foot *Dactylis glomerata*. The habitat is species poor and the forbs recorded are mainly indicative of high nutrient levels – frequent creeping buttercup *Ranunculus repens*, occasional dandelion *Taraxacum* agg., common mouse-ear *Cerastium fontanum* and rare curly dock *Rumex crispus*. Bryophytes were occasional with common species such as *Rhytidiadelphus squarrosus, Kindbergia praelonga, Calliergonella cuspidatum,* and *Brachythecium rutabulatum* recorded.

Around the field edges scrub (**WS1**) was beginning to develop in places. Here *bramble Rubus fructicosus* agg. and blackthorn *Prunus spinosa* became locally abundant.

FW2 - Depositing/lowland rivers

Streams are present along portions of the western boundary as well as the entire northern boundary. These were assessed for the presence of invasive species and protected species such as signs of otter. A detailed habitat assessment was completed in 2022 (Denyer Ecology, 2022) within the optimal survey period. Please refer to this report for further information.

WL1 - Hedgerows

A number of hedgerows are present throughout the Site. They are not considered to have changed significantly since the were surveyed in in 2012 (AOS planning Ltd., 2022).

FAUNA

Amphibians

No signs of amphibians were recorded during the survey although the Site has the potential to support species such as common frog *Rana temporaria* and common newt *Triturus vulgaris*.

Badgers

No signs of badgers were recorded during the survey although the Site has potential to support the species.

Bats

Although a detailed preliminary roost assessment (PRA) of the trees on Site none of the trees within the Site are likely to have the potential to support roosting bats due to their size and lack of roosting features (such as cavities or tear outs). However, it is very likely that bats use the Site for foraging and commuting.

Birds

No nesting birds were identified within the Site. Hedgerows throughout the Site offers suitable habitat for nesting birds. Grassland on Site also offers potential for ground nesting birds such as skylark and lapwing.

During the course of the walkover the following bird species were recorded. These included;

- a single wren *Troglodytes troglodytes* was spotted near the Sites north western corner;
- a blackbird *Turdus merula* was heard from a tree at the Sites southeastern corner;
- multiple wood pigeons *Columba palumbus* were observed flying over the Site; and
- Poo, assumed to belong to a species of geese, was observed in a number of areas throughout the Site.

Viviparous/common lizard

No signs of lizard were recorded during the survey although the Site has potential to support the species.

Otters

No signs of otters were recorded during the survey although the Site has potential to support the species due to the presence of streams and suitable terrestrial habitat.

INNS

No invasive plant or animal species were identified within the Site

Other incidental sightings

Evidence of fox *Vulpes vulpes* was recorded near the Sites north-western corner (**Figure 1 – Target note (TN) 1, Plate 7**). The evidence comprised a large entrance to a den and a strong smell of fox. The den entrance was on the western side of the stream within dense hedgerow/scrub. Additionally a number of mammal trails were present within the Site as well as signs of digging/snuffling, considered likely to be fox.

7. CONCLUSIONS, EVALUATION AND RECOMMENDATIONS

HABITATS

The entire Site was walked to assess whether any ecological conditions on Site have changed since the baseline surveys (AOS planning Ltd., 2012; Denyer Ecology, 2022) and if protected species constraints have developed, such as highly mobile species like badger that readily create new setts in previously unoccupied territory.

Although certain habitats have changed on Site such as areas of spoil, dry neutral grassland and gravel tracks now occupying areas that were formerly improved grassland, none of these changes are considered significant considering the former habitat was considered of 'low ecological importance' (AOS planning, 2022). The area which has now transitioned into dry neutral grassland, although species poor, offers suitable habitat for mammals, invertebrates, etc. due to the development of a thatch layer. As per Denyer Ecology's recommendations, alternating late summer cutting of this area would likely boost sward diversity also.

Linear habitats around the Site, hedgerows and streams, are not considered to have changed significantly since the baseline surveys. The stream habitat was noted as having affinities with the **Annex I habitat priority petrifying springs.** Recommendations given in Denyer Ecology's report should be adhered to in order to benefit the condition of this habitat (Denyer Ecology, 2022).

SPECIES

No major constraints were identified in regard to protected species.

Evidence of fox was identified near the Sites north-western boundary. It is understood no works will be undertaken in this place and considering the den entrance is on the western side of the stream there is likely little chance of disturbance to the species. If any excavation works are to be undertaken in this location an ecologist should be consulted in advance.

The following general precautionary working measures should be adhered to for the below species/species groups:

Table 1 - Summary of further surveys/Precautionary methods of working

Species	Description	Timing
Bats	Removal of hedgerows, sections of hedgerows should be avoided so as to maintain flight corridors. Use of lighting during the night should also be avoided	All-year round
Birds	No vegetation clearance to be undertaken in nesting bird season	Outside of March – September (inclusive)
Badgers, otters, other mammals	Pre-work commencement site walkover for new setts, holts etc.	All-year round

As per An Bord Pleanála's condition regular ecology surveys should be undertaken prior to and during works to ensure no ecological constraints have developed.

8. ENVIRONMENTAL BEST PRACTICE

General environmental protection measures should be implemented as part of the proposed works. Such measures include best environmental practice guidance outlined by the Construction Industry Research and Information Association guidance (CIRIA, 2015). The following minimum standards should be followed to prevent ecological impacts occurring outside the works area:

- Measures taken to prevent the spread of suspended solids (including vegetative material) into the watercourse from the proposed works;
- Measures should be taken to prevent dust and other emissions from construction affecting land/water beyond the proposed works area;
- Chemicals and fuels should be stored in secure containers located away from watercourses or water bodies. Spill kits should be available;
- Noise and vibration should be controlled and kept to the minimum necessary; and
- Lighting used for construction should be switched-off when not in use and positioned so as not to spill on to adjacent land or retained vegetation within the Site.

Cian Ó Ceallaigh
Ecological Consultant

Cian Ó Ceallaigh.

FIGURES

Figure 1. Site Location

Plan and notes

TN1 – location of fox den; **blue hatch** - approx. extent of works area (spoil mounds, access tracks, pylons and silt fencing)

REFERENCES

AOS Planning Ltd. (2012), Environmental Report for Laois-Kilkenny Reinforcement Project.

CIEEM (2016) Institute of Ecology and Environmental Management Guidelines for Ecological Impact Assessment. (9) EC (2001) Methodological guidance on the provisions of Article 6 (3) and (4) of the Habitats Directive 92/43/EEC

CIRIA (2015) Environmental good practice on site (fourth edition) (C741) Charles, P., Edwards, P (eds). CIRIA, London.

Denyer Ecology (2022), PETRIFYING SPRING SURVEY AND ASSESSMENT COOLNABACKY, CO. LAOIS

Fossitt, J.A. (2000), A Guide To Habitats In Ireland, *The Heritage Council*

Parnell, T. & Curtis, T. (2012), Webb’s An Irish Flora, *Cork University Press*, Ed. 8

Wildlife Act 1976 and Wildlife (Amendment) Act 2000.

Websites accessed:

Irish grid reference finder: https://irish.gridreferencefinder.com/ (accessed 02/03/2023)

APPENDIX A. PLATES

Plate	
Plate 1 & 2 access track into Site from SW corner, and pylons	

Plate 3 & 4 – dry neutral grassland	 
Plate 5 – geese poo	

Plate 6 – silt fencing around spoil areas	
Plate 7 – presumed fox den	

Plate 8 – tufa formations (white substrate) within stream along northern boundary	

Proposed Water Monitoring Programme – June 2022

Coolnabacky, Timahoe, Co. Laois

ESB NETWORKS

IE CONSULTING
WATER-ENVIRONMENTAL-CIVIL

Proposed Water Monitoring Programme – June 2022

Client: Electricity Supply Borad Networks (ESB)

Location: Coolnabacky, Timahoe, Co. Laois

Date: 17th June 2022

Document Control

PROJECT NUMBER: IE2219		DOCUMENT REF: IE2219-5340			
2.0	ISSUE	J Keohane	W O'Dwyer	W O'Dwyer	17/06/2022
1.0	Draft	J Keohane	W O'Dwyer	W O'Dwyer	14/06/2022
Revision	Purpose Description	Originated	Checked	Reviewed	Date

Contents

List of Figures

Appendices

1. Introduction

IE Consulting have been engaged by ESB Networks to provide water monitoring services, related to the construction of a sub-station at Coolnabacky, Timahoe, Co. Laois.

This document sets out the context, proposed monitoring locations, parameters measured in-situ and by laboratory analysis, and the frequency and reporting of monitoring.

It is acknowledged that any monitoring programme needs to be adaptable and flexible to conditions prevailing on the site at any one time and provision for this flexibility is built into the programme.

2. Environmental Setting

2.1. Topography

The site lies in a low lying, mostly flat area which extends east and north of the site, although the surrounding land to the south and west becomes hummocky within 150m to 200m of the site. The geomorphology is glacio-fluvial in origin. There is higher ground to the south of Timahoe and east of the site, toward Stradbally, as shown below in Figure 1.

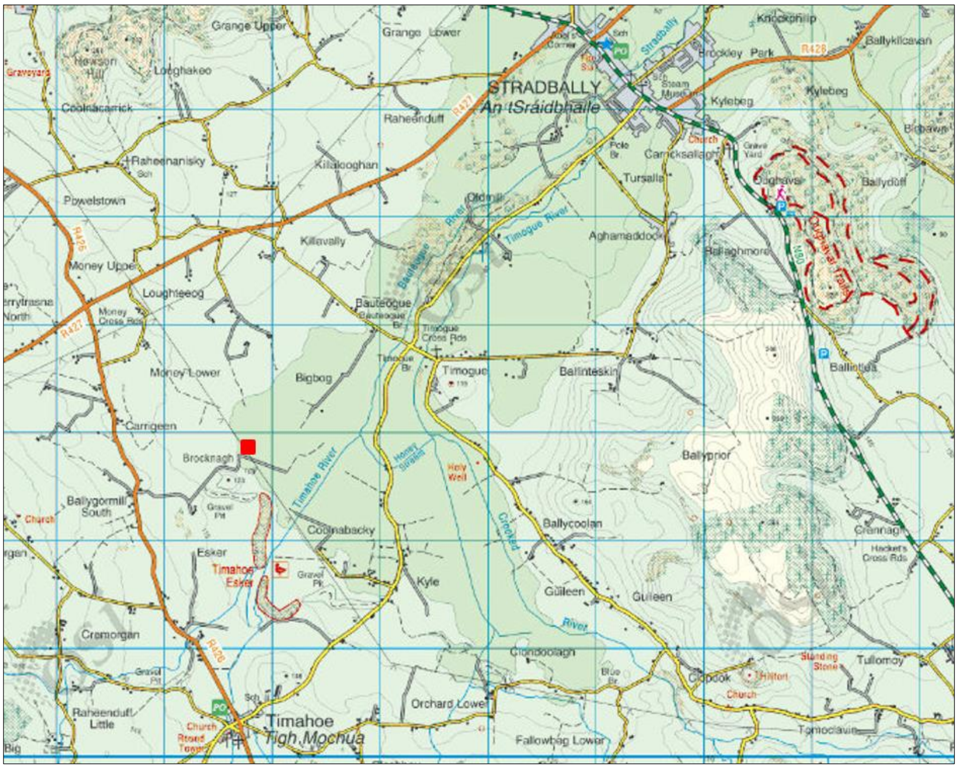


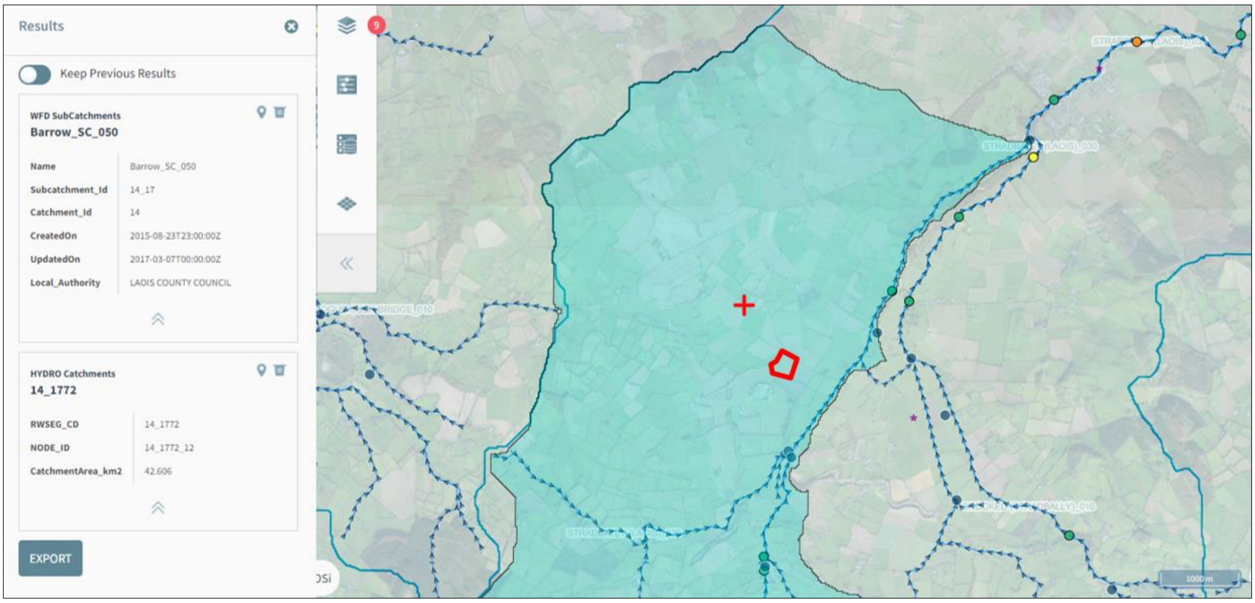
Figure 1 – Site Location

2.2. Hydrology

The site lies on the western side of the Timahoe River, which is a tributary of the River Barrow, as shown in Figure 2.

Figure 2 – Hydrology

The contributing catchment of this watercourse in the vicinity of the site is shown in Figure 3.



WFD SubCatchments
Barrow_SC_050

Name	Barrow_SC_050
Subcatchment_Id	14_17
Catchment_Id	14
CreatedOn	2015-08-23T23:00:00Z
UpdatedOn	2017-03-07T00:00:00Z
Local_Authority	LAOIS COUNTY COUNCIL

HYDRO Catchments
14_1772

RWSEG_CD	14_1772
NODE_ID	14_1772_12
CatchmentArea_km2	42.606

Figure 3 – Catchment

The Timahoe River flows in an approximately northerly direction 500m east of the site. The Timahoe River in turn joins the Honey Stream which flows in from the east and the combined flow becomes the Bauteoge River.

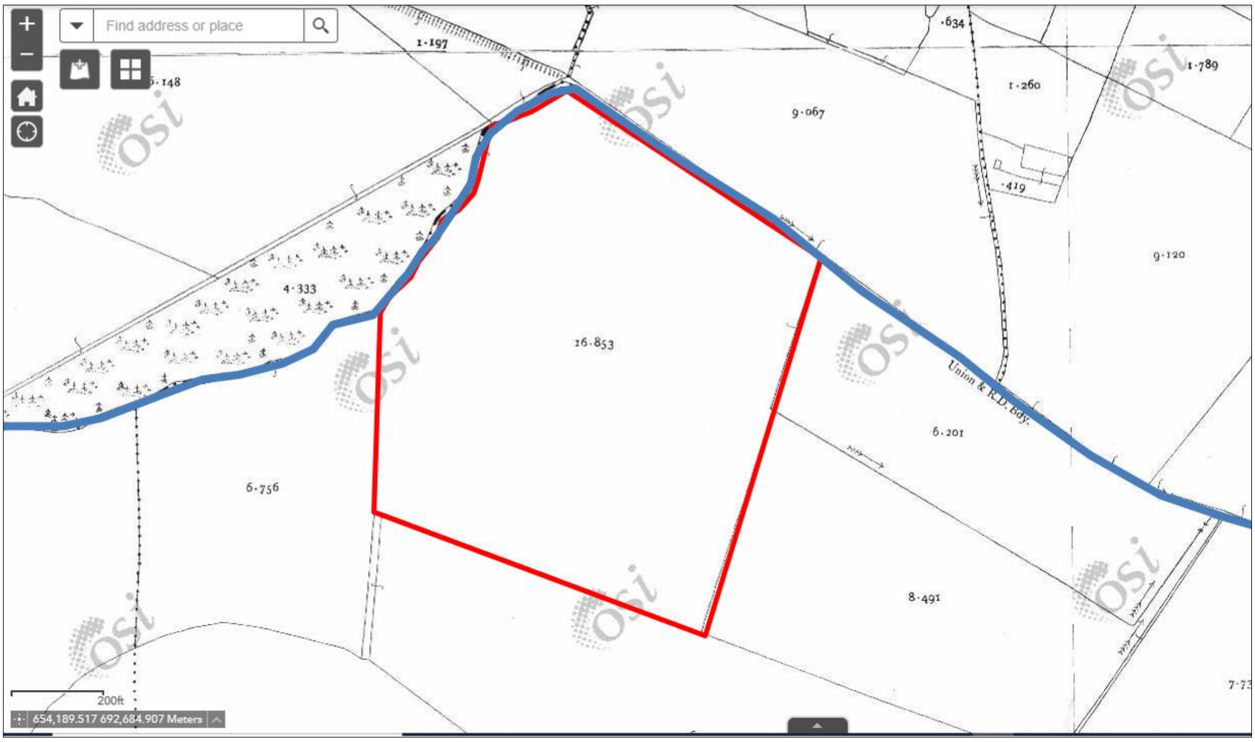


Figure 4 – Local Hydrological Mapping

Watercourses in the area have been modified and canalised in places, and arterial drainage has been used to improve the land and direct run-off towards the streams and rivers.

A natural unnamed watercourse skirts the northern, western and north-eastern boundary of the site flowing from west to east meeting the Timahoe River approximately 500m east of the site.

There are perimeter field drains along the western, southern and eastern boundaries of the site. The perimeter drains are typically 1.0m to 1.5m deep, and run mainly to the North towards the stream, as shown in Figure 5.

The key water features on the site, comprise (i) the main stream described above (ii) man made perimeter field drains that flow north into the main stream (iii) outflow from a tufa spring, that flows inside the north-western site boundary and exits the site through a gap in the perimeter ditch approximately 40m from the field corner. The outfall (not yet constructed) from the proposed settlement ponds will exit the site downstream of the Tufa Springs.

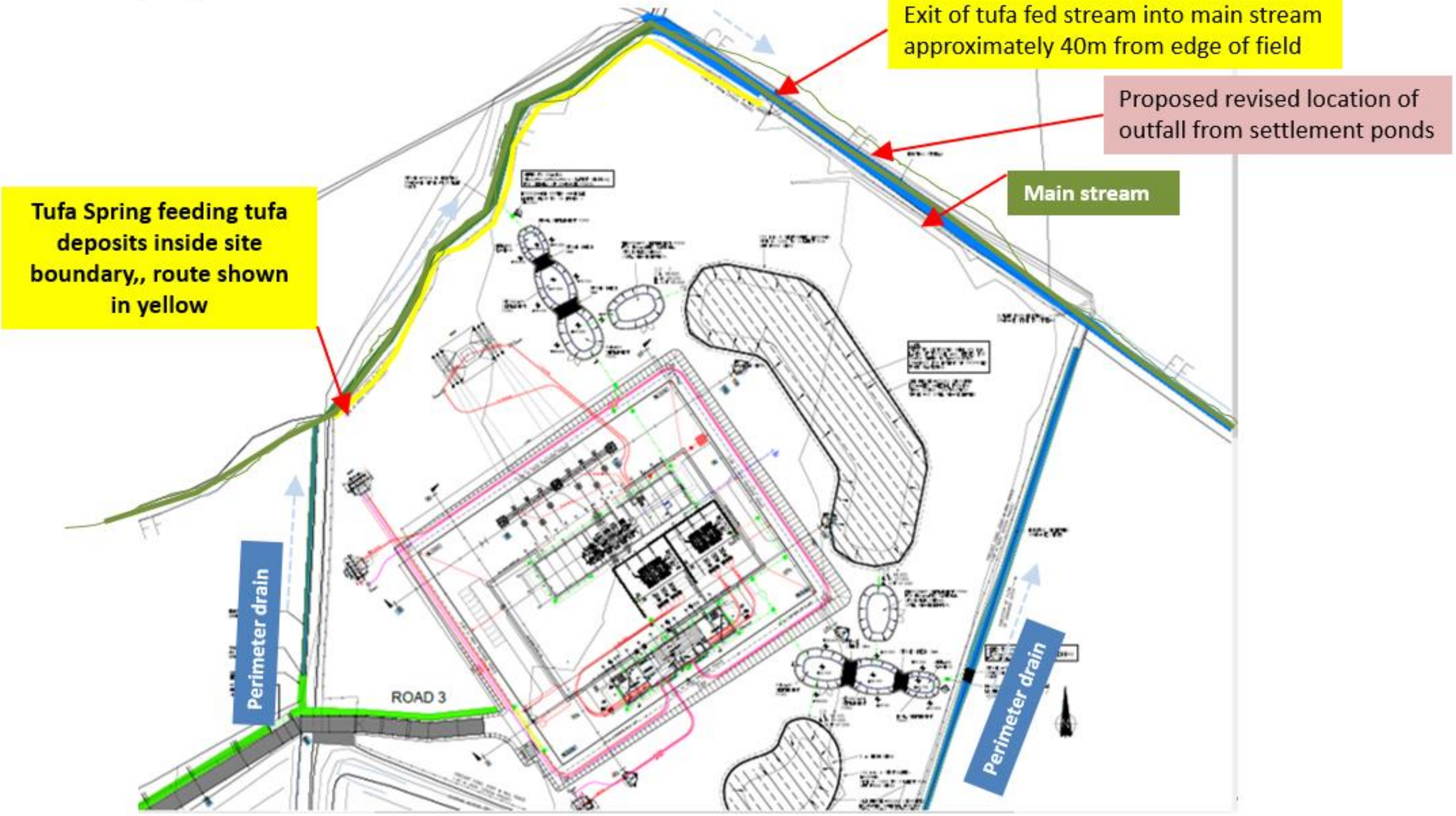


Figure 5 – Site Hydrology & Drainage

2.3. Hydrogeology

The underlying bedrock geology of the site comprises limestone of the Ballyadams Formation. Rock is approximately 9m below ground level on the site.

Subsoils consist of Alluvium (sand silt and gravels) to 3m approx. overlying stiff boulder CLAY from 3m approx. to 9m.

The bedrock aquifer beneath the site is mapped as an Rkd (Regionally Important Aquifer – Karstified-diffuse). The GSI also maps the area as being in a sand and gravel aquifer, but site specific studies have confirmed that the sand and gravel deposits on site do not comprise an aquifer.

A survey of all perimeter drains and the main stream encountered evidence of tufa deposits in the watercourses as shown in yellow below, which suggests that many of the surface water features are groundwater fed.

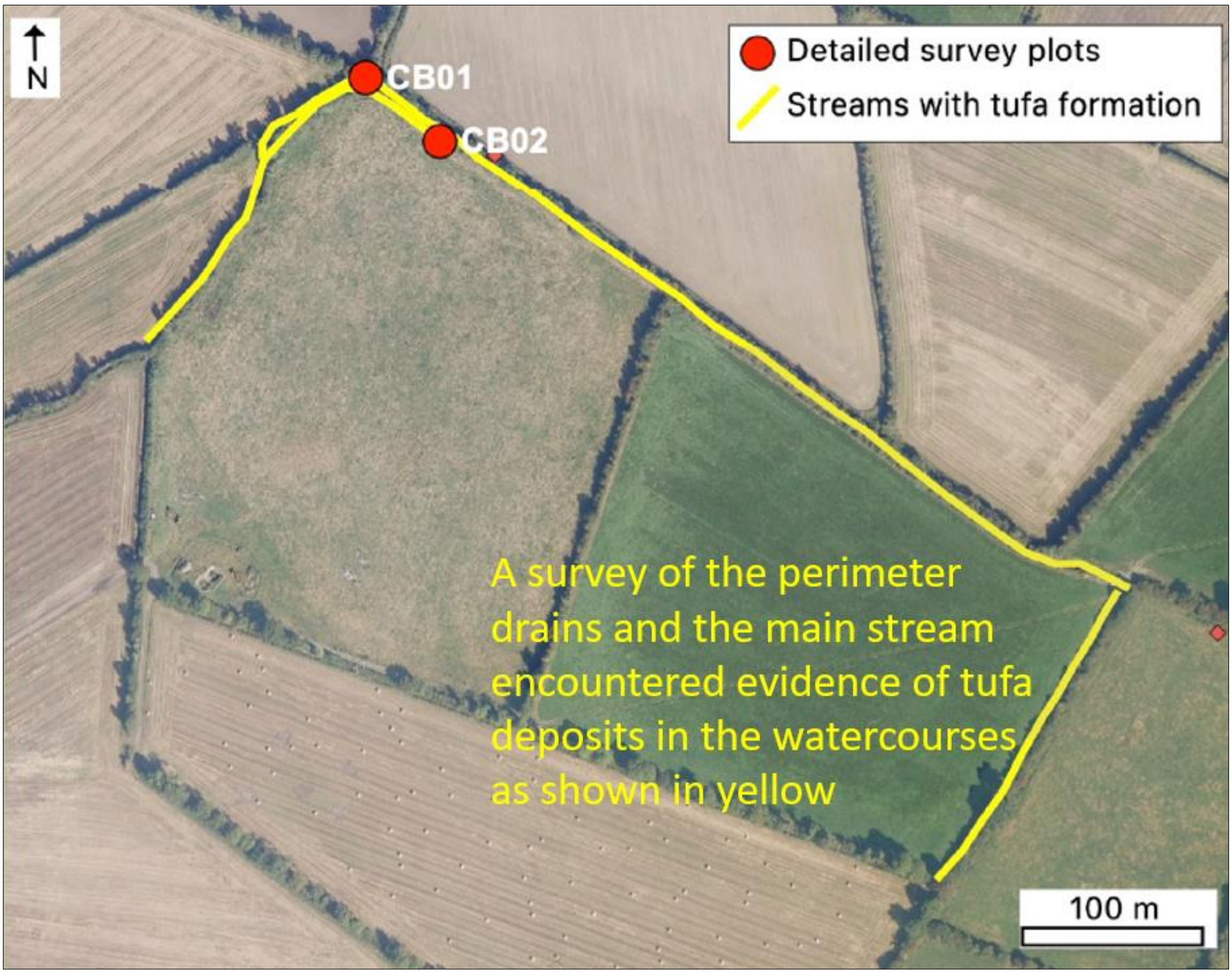


Figure 6 – Tufa Springs

3. Monitoring

3.1. Proposed Monitoring Locations

Five surface water monitoring locations are proposed, labelled SW1-SW5 as shown on Figure 7.

The proposed groundwater monitoring points comprise 3 boreholes specially constructed within the shallow sediments (1-3) in the Tufa spring area. A borehole that extends 9m through the sediments as far as rock (BH4), and the proposed water supply well (yet to be drilled)

Groundwater monitoring points are shown on Figure 8.

Further details are shown on ESB Networks Drawing No. PE493-D108-098-001-003 in Appendix A.

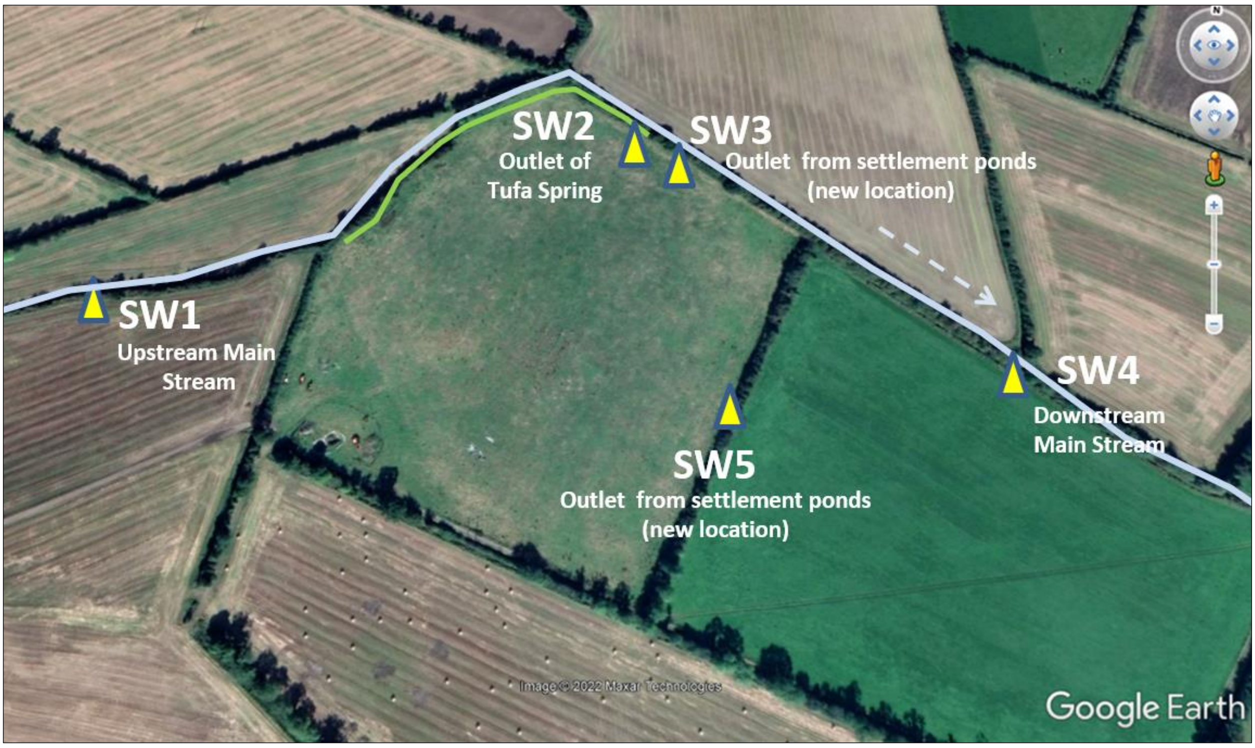


Figure 7 – Surface Water Monitoring

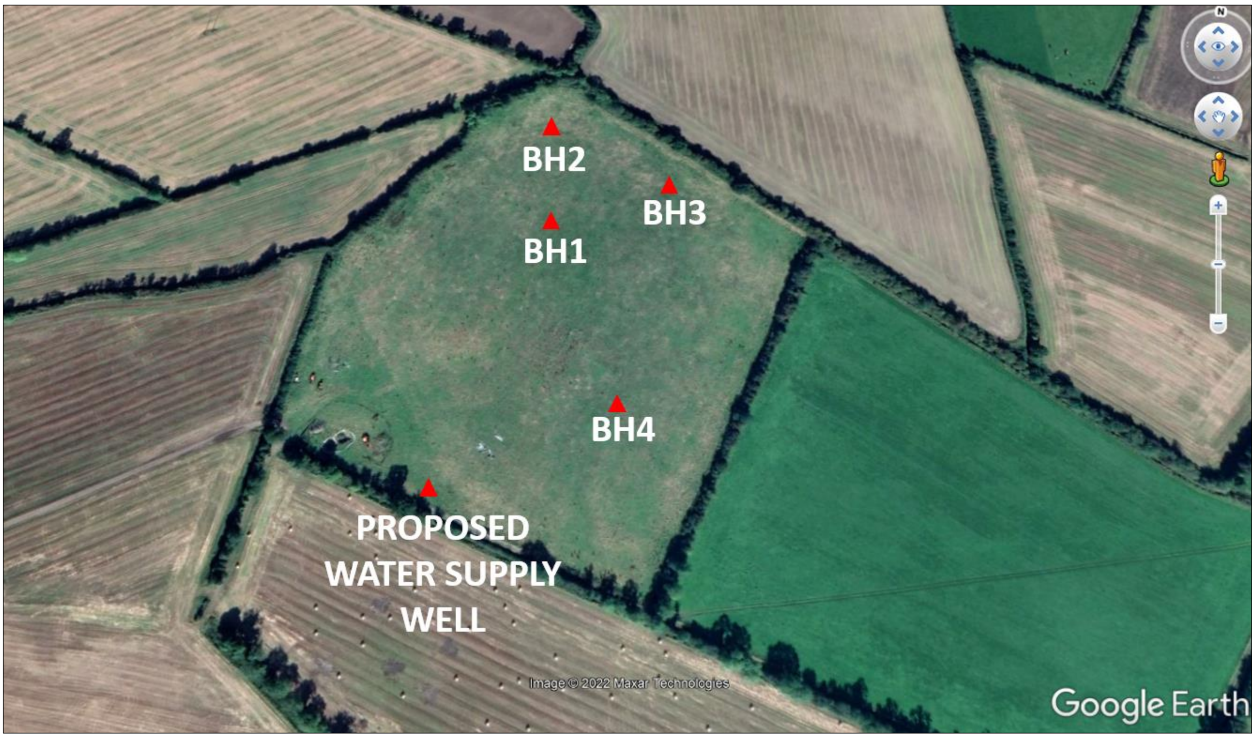


Figure 8 – Groundwater Monitoring Plan

3.2. Proposed Monitoring Approach

Method

The proposed approach to monitoring on the site will involve the following:

- Visual, to examine for oil sheen, excess suspended solids or discolouration, turbidity
- In situ measurement: DO, pH, EC, Turbidity, Temperature, and groundwater level monitoring
- Sampling and analysis:
  - pH, Conductivity, Chloride, Sodium, Sulphate, Calcium, Magnesium, Potassium, Ammoniacal N-NH_4, Alkalinity, Nitrate and Phosphorous, Total TPH
  - To standards BS EN ISO 5667 for Surface Water and BS EN ISO 19458 for Groundwater.
  - Analysis will be at an INAB or UKAS accredited laboratory

Frequency

The frequency of monitoring will be as follows:

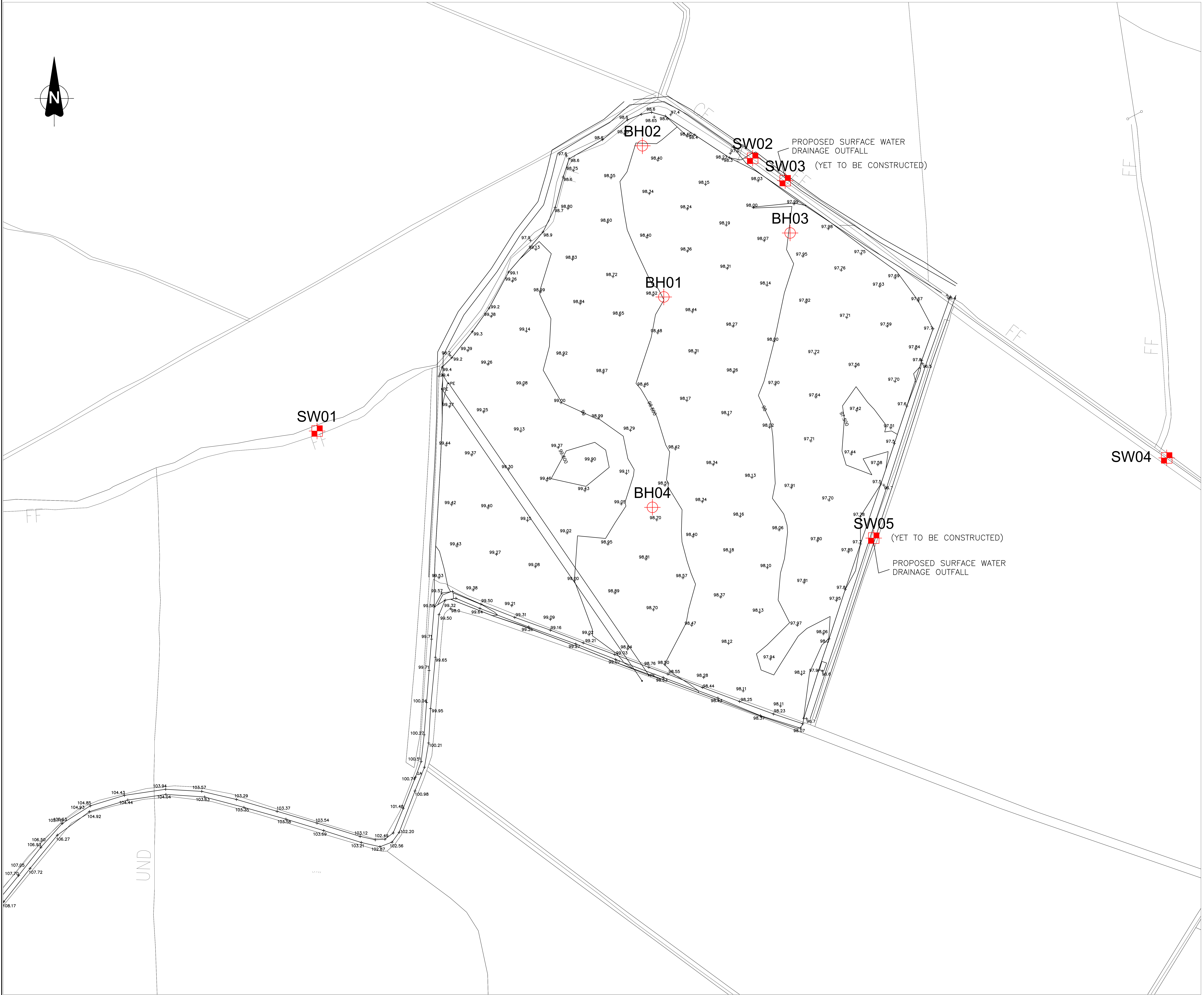
- Visual daily of all watercourses and outfall from settlement pond by site Engineer. The Ecological Clerk of Works (when appointed) will monitor all waterbodies on site and manage same. Contact details will be forwarded to Laois C. C, when appointed.
- Monthly visual and in-situ measurement only
- Quarterly surface water sampling
- Quarterly groundwater sampling
- Higher frequency if warranted by more intense construction activity or heavy rainfall
- Reduced frequency as main civils works decline
- Reduced frequency monitoring through commissioning until hand over to O&M

Reporting

- All incidents regarding environmental issues to be reported immediately to Laois County Council Environment Section (057-8664000) on the day of the incident, or Ann Marie Callan (086-7966282) or Rory O'Callaghan (986-1438394)
- IE Consulting will perform a QA/QC check on the results of analysis
- A Monthly report will be prepared
- IE Consulting will maintain a database of water quality and water levels,
- Monitoring results will be shared with Laois C.C each quarter

Appendix A

Drawings



NOTES:

1. NO EXCAVATION SHALL TAKE PLACE WITHOUT A PERMIT TO EXCAVATE UNDER CMP13.
2. NO EXCAVATION WORK SHALL COMMENCE UNTIL THE CONTRACTOR HAS CONSULTED UP TO DATE SERVICE DRAWINGS AND CARRIED OUT AN ELECTROMAGNETIC (EML) SCAN. (TO INCLUDE CENTRAL SITE DRAWING)
3. EXCAVATIONS WITHIN 500 m OF SUSPECTED OR KNOWN BURIED SERVICES SHALL BE CARRIED OUT BY HAND.
4. ACCESS TO TEST LOCATIONS REQUIRES TRAVELING UNDER LIVE OVERHEAD LINES AND EQUIPMENT. ACCESS ROUTES, EXCAVATION METHODOLOGIES AND RISK REDUCTION MEASURES SHALL BE IN ACCORDANCE WITH ESBN CODE OF PRACTICE "AVOIDANCE OF ELECTRICAL HAZARDS WHEN WORKING BENEATH OVERHEAD LINES" IN CONJUNCTION WITH DRAWING No. PG406–D100–051–001
5. THIS DRAWING TO BE READ IN CONJUNCTION WITH DOCUMENT REFERENCE DRA
6. CONDITIONS OF PLANNING PERMISSION SHALL BE DISCHARGED PRIOR TO COMMENCEMENT OF WORKS.
7. COMPLIANCE OF PLANNING PERMISSION SHALL BE CONFIRMED PRIOR TO COMMENCEMENT OF WORKS.
8. COORDINATES REFER TO ITM.
9. THE LOCATION OF THE WATER SUPPLY BOREHOLE (BH04) IS PROVISIONAL. EXACT LOCATION SHALL BE CONFIRMED.

BH-XX ⊕	BOREHOLE
SW-XX ⊕	WATER SAMPLING POINT

COORDINATES

	COORDINATE (A)	
	EASTING	NORTHING
BH01	653762.000	692995.000
BH02	653750.000	693080.000
BH03	653833.000	693031.000
BH04	653755.620	692876.750
SW01	653567.155	692919.644
SW02	653811.956	693072.980
SW03	653830.259	693060.418
SW04	654044.694	692904.551
SW05	653880.025	692859.447

REV	DATE	REVISION DESCRIPTION	DRN	PROD	VER	APP
3	JUN. '22	MINOR REVISIONS				
2	JUN. '22	WATER SAMPLING LOCATIONS SW3 & SW5 & BOREHOLE BH5 ADDED	JB	JB	BM	MP
1	MAY. '22	WATER SAMPLING LOCATIONS ADDED	JB	JB	BM	MP
0	JUN.'21	ISSUED FOR CONSTRUCTION	JB	JB	BM	JM

PURPOSE OF ISSUE - PRELIMINARY UNLESS INDICATED

CLIENT APPROVAL ☐ PLANNING ☐ TENDER ☐ CONSTRUCTION ☒ AS-BUILT ☐

CLIENT: ESB NETWORKS

PROJECT: Coolnabacky 400 kV Station

CONTRACT: ENABLING WORKS

DRAWING TITLE
COOLNABACKY 400 kV SUBSTATION
CIVIL
SITE BOREHOLES & WATER SAMPLING LOCATIONS

PRODUCTION UNIT: Civil & Environmental Engineering

Energy for generations
Engineering and Major Projects,
One Dublin Airport Central, Dublin Airport,
Cloghran, Co. Dublin, K67 XF72, Ireland.
Tel: +353 (0)1 703 8000 Web: www.esb.ie
Engineering and Major Projects is a division of ESB.

DRAWN	PRODUCED	VERIFIED	APPROVED	APPROVAL DATE
J.Byrne	J.Byrne	B.Murphy	M.Pull	17/06/2022
CLIENT REF		NO. OF SHTS	SIZE	SCALE
TC224903		1	A1	1:1000

DRAWING NUMBER	SHEET	REV
PE493-D108-098-001-003		

Hydrological Mitigation & Monitoring during Construction

Baseline Vibration and Noise Monitoring Report 2023

for

Kilwex Ltd

at

Timahoe, Coolenabacky, Co. Laois.

Prepared By:

1st & 2nd Floor Kilmurry House

Main Street,

Castlerea,

Co. Roscommon,F45 DK58

Tel. 094 - 9621258

Email: info@coyleenv.ie

www.coyleenv.ie

Project Title:	Baseline Vibration and Noise Monitoring Report 2023
Project Reference No.:	22-224
Project Description:	Baseline Noise and Vibration Monitoring at Nearest sensitive location for Kilwex Ltd.
Status:	Final
Client Details:	Kilwex Ltd
Issued By:	Coyle Environmental Ltd. 1st & 2nd Floor Kilmurry House, Main Street, Castlerea, Co. Roscommon

Document Production Approval			
	Name	**Date**	**Position**
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Revision no 1		Status and date	

Contents

1.0 Introduction

This report presents the findings of the baseline vibration and noise monitoring undertaken at the Nearest Sensitive location to the *Kilwex site at Coolnabacky, Co. Laois.*

This report summarises the results of the vibration and noise monitoring undertaken during the period 20th February 2023 to the 25th February 2023.

Monitoring was carried out by setting down a vibration meter and a noise meter at a previously agreed location by a Coyle Environmental Technician. Noise and vibration data was analysed by a technician.

1.1 Guidelines

1.1.1 Vibration

The NRA has published Guidelines on the management of Noise and Vibration on construction works[1].

- The NRA's *Guidelines* point out that there are two separate considerations for vibration during the construction phase: that which affects human comfort and that which affects cosmetic or structural damage to buildings. The *Guidelines* suggest that human tolerance for daytime blasting and piling, two of the primary sources of construction vibration, limits vibration levels to a peak particle velocity (ppv) of 12mm/s and 2.5mm/s respectively.
- The NRA's *Guidelines* sets out the following indicative levels of acceptability for construction, "To avoid the risk of even cosmetic damage to buildings, the *Guidelines* suggest that vibration levels should be limited to 8mm/s, to 12.5mm/s for frequencies of 10 to 50Hz, and to 20mm/s at frequencies of 50Hz and above".

Table 1 Ground Vibration Limits

Table 1 Ground Vibration Limits

Frequency	**Peak Particle Velocity (ppv) mm/s**
at frequencies of less than 10Hz	8
at frequencies of between 10Hz and 50Hz	12.5

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[1] Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes March 2014

Vibration measurements are undertaken in accordance with **BS 7385-1:1990, (ISO 4866:1990) Evaluation and measurement for vibration in buildings. Guide for measurement of vibrations and evaluation of their effects on buildings.**

Ground vibration can be defined as regularly repeated movement of a physical object about a fixed point. The parameter most commonly utilised to evaluate ground vibration is the peak particle velocity (ppv) expressed in millimetres per second (mm/s). Further the amplitude and frequency of the motion are measured in the three orthogonal directions generally in terms of velocity which is considered to be the best descriptor for assessing human comfort and the potential damage response of structures. Vibration can cause varying degrees of damage in buildings and affect vibration-sensitive machinery or equipment. Its effect on people may be to cause disturbance or annoyance or, at higher levels, to affect a person's ability to work. The potential negative effects of ground vibration are a function of the intensity and the frequency.

1.1.2 Noise

- The survey was carried out in accordance with ISO 1996 Part 1 (Description and Measurement of Environmental Noise - Part 1: Basic Quantities and Procedures) The noise monitoring equipment was positioned proximal to NSRs correctly located at 1.5m above ground level and away from reflecting surfaces.
- Acoustic instrumentation was field calibrated before and after the survey
    - No drift of calibration was observed (calibration level 114 dB at 1000 Hz).

Defining the Existing Noise Environment

Step 1 Quiet area screening of the development location

It was determined at the preliminary screening stage that the proposed site does not meet the necessary criteria and is therefore not considered to be a quiet area as per the EPA definition.

Step 2 Baseline Environmental Noise Survey

- An Environmental noise survey was carried out to establish the existing ambient and background noise levels in the area.
- the baseline noise monitoring survey was carried out in accordance with ISO 1996 Part 1 (Description and Measurement of Environmental Noise - Part 2: Determination of environmental noise levels).
- The survey was carried out at a single strategically chosen noise sensitive receptors (NSR) proximal to the proposed development.

Traditionally environmental noise limits have been stated over daytime and night-time periods only.

With this in mind the baseline noise data has been divided into these distinct time categories[2].

- Daytime Period 07:00 – 22:00
- Night Period 22:00 – 07:00

The existing ambient (LAeq) and background noise (LA90) levels in the areas of the proposed development were established during a period of continuous monitoring at a single representative location over the period 20th to the 25th February 2023.

At the measurement positions, the following noise level indices were recorded:

- LAeq,T is the A-weighted equivalent continuous noise level over the measurement period, and effectively represents an "average" value.
- LA90,T is the A-weighted noise level exceeded for 90% of the measurement period. This parameter is often used to describe the background noise.
- LA10,T is the A-weighted noise level exceeded for 10% of the measurement period. This parameter is often used to describe traffic noise.

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[2] ISO 1996-1. Acoustics — Description, measurement and assessment of environmental noise - Part 1: Basic quantities and assessment procedures

2.0 Monitoring location

Kilwex- Nearest Sensitive Location 1

Table 2 Monitoring Location details

Table 2 Locations

Location	Eastings	Northings	Address
N01	52.979443	-7.208092	Esker, Timahoe, Coolnabacky Co. Laois
V01	52.979238	-7.207673	Esker, Timahoe, Coolnabacky Co.Laois

Figure 1 Location map

Figure 1 Area Location

Figure 2 Vibration meter location

Figure 2 Vibration meter pin drop

Figure 3 Noise Meter Location

Figure 3 Noise Meter pin drop

3.0 Methodology

3.1 Vibration

- Vibration measurements were taken during calm and good weather conditions.

- A Micromate vibration monitor, and protection case was set down at a previously agreed area at the Nearest Sensitive Location proximal to the proposed development.
- Ground conditions were analysed and a ground level check was carried out before measurement started.
- Monitoring location for vibration were selected to coincide with local residence
- Measurements were undertaken during weekday and weekend periods

3.2 Noise

- A noise meter was set up. Apparatus include a Larson Davis LXT Precision integrating Sound Level Analyser, wind shield and microphone stand.
- Measurement of ambient noise levels were taken during good weather conditions using instruments of Class 1 specification.
- Weather variables including rainfall and wind speed were recorded for the duration of the survey.
    - Wind speeds <3 m/s
    - No precipitation
- Monitoring locations were selected to coincide with local residence
- Measurements were undertaken during weekday and weekend periods

3.3 Instrumentation

Table 3 Instrumentation used

Table 3 instrumentation used

Location	Vibration
V01	*One no. Instantel MicroMate (20th February to 25th February 2023)*
	Noise
N02	*One no. Larson Davis LXT Precision Integrating Sound Level Analyser/Data logger* *Wind Shields Type: Larson Davis 2120 Windscreen* *(20th February to 25th February 2023)*

4.0 Results

4.1 Vibration Monitoring Results

- During the period 20th February to 25th February an Instantel MicroMate instrument was installed to monitor vibration at the side of a farm shed at the nearest sensitive location reference NSL01.
- The vibration monitor was set to measure any vibration detection in 5 minute intervals.

- During the period between 20th – 25th February there have been no instances of vibration that have exceed the following indicative levels of acceptability for construction of 8 ppv mm/s or 12.5 ppv mm/s respectively.

- It was noted that most vibration was detected between the hours of 10 and 11:30 am during this period.

- All vibration measured and detected is well within the maximum allowable limit for vibration.

- Summary data is illustrated in figure 4. The vibration technician report is available in appendix 1. The full data set data is available in appendix 2

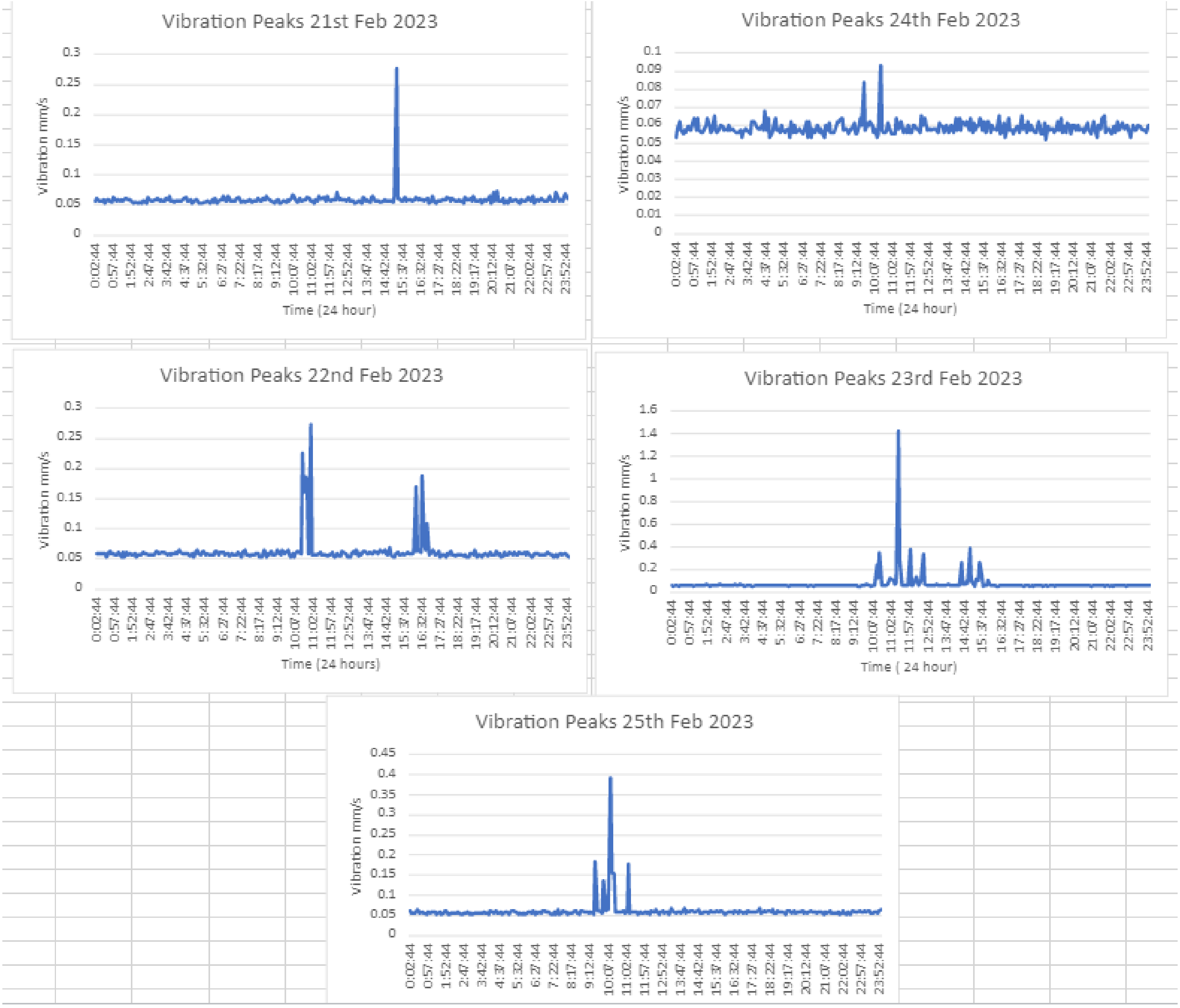


Figure 4 Kilwex V01 Vibration data 20th-25th February 2023

4.2 Noise results

The complete dataset from the baseline study is presented in appendix 3.

A summary of the interval (mean & modal values) measurements is given in Table 4 and illustrated in figure 5 below.

Table 4 Baseline noise levels

Table 4 Baseline Noise Levels

Monitoring Location id		Day-time Noise levels dB(A)			Night-time Noise levels dB(A)		
		LeqT	L_{10}	L_{90}	LeqT	L_{10}	L_{90}
NM01	Mean	42	44	33	30	33	25
	Mode	41	44	33	29	33	25

Figure 5 Survey noise levels

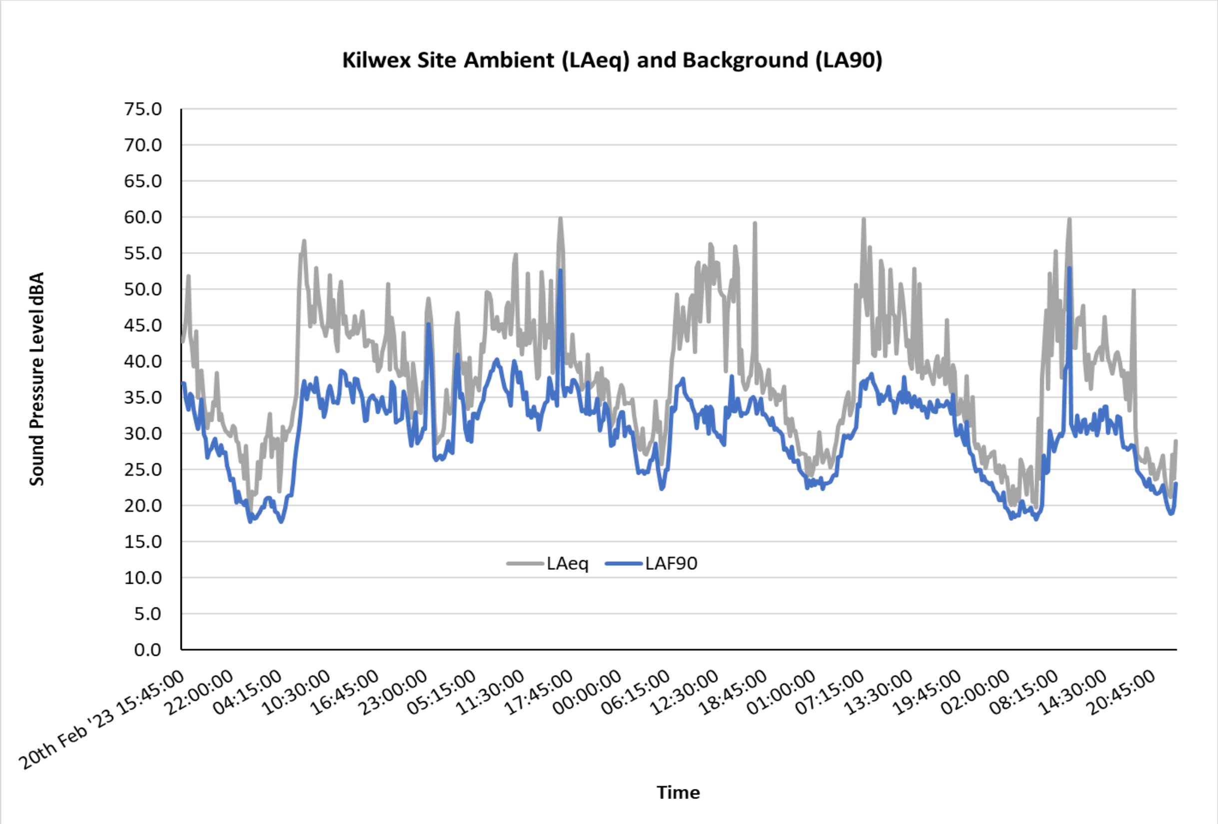


Figure 5 V01 Baseline Noise 20th-25th February 2023

5.0 Conclusion

Monitoring data demonstrates baseline noise and vibration activity prior to construction commencement.

The results conclude that there is minimal noise and vibration activity at this location prior to construction during the period of monitoring. It is expected that noise and vibration levels at this location may fluctuate seasonally due to farm operations.

Appendices

Appendix 1 – Vibration data

Event Report

Histogram Start Time	15:52:44 February 20, 2023
Histogram Finish Time	15:34:59 February 28, 2023
Number of Intervals	2300.45 at 5 minutes
Range	Geo:254.0 mm/s
Sample Rate	1024sps
Operator/Setup:	Operator/SITE.MMB

Serial Number	UM18157 V 10-90 Micromate ISEE
Battery Level	3.8 Volts
Unit Calibration	June 21, 2022 by
File Name	UM18157_20230220155244.IDFH

Notes

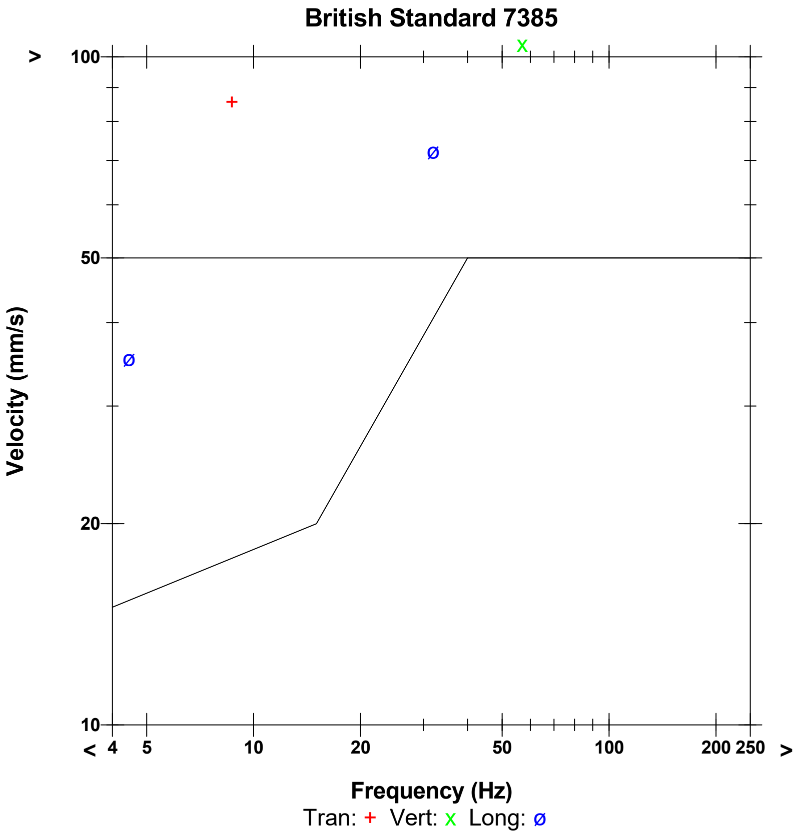
Location:
Client:
User Name:
General:

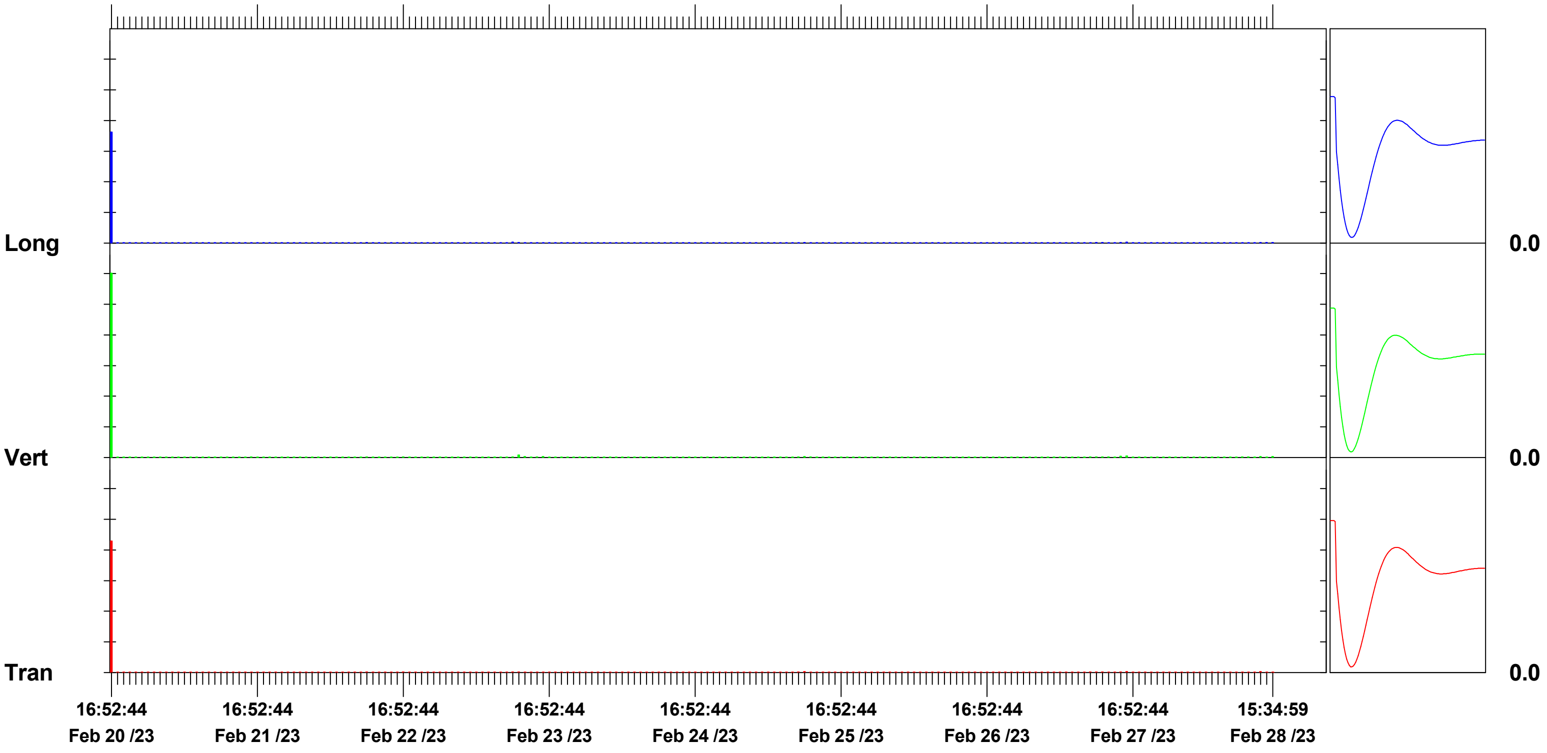
Post Event Notes

Coolnabackey, County Laois
User: Coyle Environmental

	Tran	**Vert**	**Long**	
PPV	85.62	120.2	72.33	mm/s
ZC Freq	8.7	57	32	Hz
Date	Feb 20 /23	Feb 20 /23	Feb 20 /23	
Time	16:02:44	16:02:44	16:02:44	
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.3	Hz
Overswing Ratio	4.0	4.6	4.5	

Peak Vector Sum 138.7 mm/s on February 20, 2023 at 16:02:44





Time Scale: 1 hour /div **Amplitude Scale:** Geo: 20.00 mm/s/div

Sensor Check

Appendix 2 – Vibration data set

Vibration over 24 hours 20-25th Feb 2023

	Time	mm/s	Time	mm/s	Time	mm/s
20th	20th		21st		22nd	
15:57:44	36.2		00:02:44	0.057	00:02:44	0.058
16:02:44	138.7		00:07:44	0.06	00:07:44	0.058
16:07:44	0.057		00:12:44	0.056	00:12:44	0.058
16:12:44	0.056		00:17:44	0.056	00:17:44	0.058
16:17:44	0.475		00:22:44	0.057	00:22:44	0.058
16:22:44	0.057		00:27:44	0.059	00:27:44	0.058
16:27:44	0.058		00:32:44	0.053	00:32:44	0.053
16:32:44	0.056		00:37:44	0.058	00:37:44	0.061
16:37:44	0.062		00:42:44	0.058	00:42:44	0.062
16:42:44	0.055		00:47:44	0.056	00:47:44	0.058
16:47:44	0.056		00:52:44	0.055	00:52:44	0.059
16:52:44	0.058		00:57:44	0.062	00:57:44	0.056
16:57:44	0.062		01:02:44	0.058	01:02:44	0.057
17:02:44	0.056		01:07:44	0.057	01:07:44	0.061
17:07:44	0.056		01:12:44	0.058	01:12:44	0.058
17:12:44	0.057		01:17:44	0.056	01:17:44	0.053
17:17:44	0.057		01:22:44	0.058	01:22:44	0.061
17:22:44	0.058		01:27:44	0.057	01:27:44	0.053
17:27:44	0.059		01:32:44	0.06	01:32:44	0.061
17:32:44	0.064		01:37:44	0.06	01:37:44	0.056
17:37:44	0.062		01:42:44	0.058	01:42:44	0.059
17:42:44	0.059		01:47:44	0.058	01:47:44	0.056
17:47:44	0.057		01:52:44	0.056	01:52:44	0.056
17:52:44	0.065		01:57:44	0.053	01:57:44	0.058
17:57:44	0.056		02:02:44	0.055	02:02:44	0.053
18:02:44	0.062		02:07:44	0.055	02:07:44	0.056
18:07:44	0.058		02:12:44	0.053	02:12:44	0.057
18:12:44	0.058		02:17:44	0.055	02:17:44	0.056
18:17:44	0.058		02:22:44	0.053	02:22:44	0.061
18:22:44	0.059		02:27:44	0.056	02:27:44	0.058
18:27:44	0.059		02:32:44	0.057	02:32:44	0.058
18:32:44	0.053		02:37:44	0.053	02:37:44	0.057
18:37:44	0.057		02:42:44	0.062	02:42:44	0.057
18:42:44	0.057		02:47:44	0.058	02:47:44	0.057
18:47:44	0.057		02:52:44	0.056	02:52:44	0.056
18:52:44	0.064		02:57:44	0.057	02:57:44	0.057
18:57:44	0.064		03:02:44	0.059	03:02:44	0.063
19:02:44	0.058		03:07:44	0.058	03:07:44	0.06
19:07:44	0.06		03:12:44	0.06	03:12:44	0.058
19:12:44	0.062		03:17:44	0.056	03:17:44	0.061
19:17:44	0.058		03:22:44	0.058	03:22:44	0.06
19:22:44	0.059		03:27:44	0.056	03:27:44	0.06
19:27:44	0.06		03:32:44	0.057	03:32:44	0.058
19:32:44	0.058		03:37:44	0.06	03:37:44	0.056
19:37:44	0.06		03:42:44	0.058	03:42:44	0.058
19:42:44	0.058		03:47:44	0.064	03:47:44	0.056
19:47:44	0.057		03:52:44	0.056	03:52:44	0.058

19:52:44	0.062	03:57:44	0.057	03:57:44	0.058
19:57:44	0.059	04:02:44	0.055	04:02:44	0.06
20:02:44	0.057	04:07:44	0.057	04:07:44	0.059
20:07:44	0.053	04:12:44	0.056	04:12:44	0.064
20:12:44	0.06	04:17:44	0.056	04:17:44	0.06
20:17:44	0.058	04:22:44	0.057	04:22:44	0.058
20:22:44	0.057	04:27:44	0.059	04:27:44	0.058
20:27:44	0.058	04:32:44	0.06	04:32:44	0.058
20:32:44	0.062	04:37:44	0.062	04:37:44	0.059
20:37:44	0.058	04:42:44	0.057	04:42:44	0.057
20:42:44	0.058	04:47:44	0.056	04:47:44	0.055
20:47:44	0.057	04:52:44	0.058	04:52:44	0.058
20:52:44	0.058	04:57:44	0.053	04:57:44	0.053
20:57:44	0.057	05:02:44	0.057	05:02:44	0.062
21:02:44	0.056	05:07:44	0.058	05:07:44	0.064
21:07:44	0.056	05:12:44	0.058	05:12:44	0.058
21:12:44	0.058	05:17:44	0.052	05:17:44	0.057
21:17:44	0.056	05:22:44	0.053	05:22:44	0.06
21:22:44	0.056	05:27:44	0.053	05:27:44	0.062
21:27:44	0.058	05:32:44	0.055	05:32:44	0.056
21:32:44	0.058	05:37:44	0.055	05:37:44	0.059
21:37:44	0.056	05:42:44	0.056	05:42:44	0.057
21:42:44	0.058	05:47:44	0.055	05:47:44	0.057
21:47:44	0.061	05:52:44	0.053	05:52:44	0.057
21:52:44	0.058	05:57:44	0.058	05:57:44	0.056
21:57:44	0.056	06:02:44	0.055	06:02:44	0.062
22:02:44	0.061	06:07:44	0.061	06:07:44	0.062
22:07:44	0.056	06:12:44	0.053	06:12:44	0.056
22:12:44	0.059	06:17:44	0.056	06:17:44	0.061
22:17:44	0.06	06:22:44	0.058	06:22:44	0.06
22:22:44	0.053	06:27:44	0.058	06:27:44	0.061
22:27:44	0.062	06:32:44	0.064	06:32:44	0.056
22:32:44	0.057	06:37:44	0.057	06:37:44	0.059
22:37:44	0.06	06:42:44	0.056	06:42:44	0.059
22:42:44	0.056	06:47:44	0.064	06:47:44	0.055
22:47:44	0.058	06:52:44	0.057	06:52:44	0.058
22:52:44	0.059	06:57:44	0.056	06:57:44	0.057
22:57:44	0.058	07:02:44	0.056	07:02:44	0.056
23:02:44	0.056	07:07:44	0.057	07:07:44	0.056
23:07:44	0.06	07:12:44	0.06	07:12:44	0.061
23:12:44	0.057	07:17:44	0.062	07:17:44	0.057
23:17:44	0.056	07:22:44	0.058	07:22:44	0.053
23:22:44	0.056	07:27:44	0.055	07:27:44	0.061
23:27:44	0.056	07:32:44	0.056	07:32:44	0.065
23:32:44	0.053	07:37:44	0.055	07:37:44	0.057
23:37:44	0.06	07:42:44	0.056	07:42:44	0.056
23:42:44	0.06	07:47:44	0.057	07:47:44	0.055
23:47:44	0.057	07:52:44	0.059	07:52:44	0.056
23:52:44	0.057	07:57:44	0.055	07:57:44	0.056
23:57:44	0.053	08:02:44	0.057	08:02:44	0.057

08:07:44	0.057	08:07:44	0.058
08:12:44	0.056	08:12:44	0.058
08:17:44	0.061	08:17:44	0.053
08:22:44	0.056	08:22:44	0.053
08:27:44	0.056	08:27:44	0.058
08:32:44	0.06	08:32:44	0.064
08:37:44	0.058	08:37:44	0.053
08:42:44	0.065	08:42:44	0.059
08:47:44	0.06	08:47:44	0.057
08:52:44	0.058	08:52:44	0.062
08:57:44	0.056	08:57:44	0.057
09:02:44	0.055	09:02:44	0.057
09:07:44	0.053	09:07:44	0.058
09:12:44	0.056	09:12:44	0.065
09:17:44	0.058	09:17:44	0.059
09:22:44	0.053	09:22:44	0.057
09:27:44	0.053	09:27:44	0.064
09:32:44	0.056	09:32:44	0.058
09:37:44	0.056	09:37:44	0.061
09:42:44	0.055	09:42:44	0.064
09:47:44	0.059	09:47:44	0.056
09:52:44	0.056	09:52:44	0.053
09:57:44	0.061	09:57:44	0.059
10:02:44	0.066	10:02:44	0.053
10:07:44	0.065	10:07:44	0.058
10:12:44	0.056	10:12:44	0.062
10:17:44	0.055	10:17:44	0.06
10:22:44	0.06	10:22:44	0.058
10:27:44	0.057	10:27:44	0.226
10:32:44	0.057	10:32:44	0.16
10:37:44	0.059	10:37:44	0.185
10:42:44	0.058	10:42:44	0.164
10:47:44	0.062	10:47:44	0.058
10:52:44	0.06	10:52:44	0.273
10:57:44	0.056	10:57:44	0.056
11:02:44	0.056	11:02:44	0.056
11:07:44	0.053	11:07:44	0.056
11:12:44	0.058	11:12:44	0.056
11:17:44	0.056	11:17:44	0.058
11:22:44	0.065	11:22:44	0.06
11:27:44	0.061	11:27:44	0.057
11:32:44	0.061	11:32:44	0.057
11:37:44	0.062	11:37:44	0.056
11:42:44	0.056	11:42:44	0.055
11:47:44	0.064	11:47:44	0.056
11:52:44	0.058	11:52:44	0.056
11:57:44	0.056	11:57:44	0.061
12:02:44	0.058	12:02:44	0.055
12:07:44	0.058	12:07:44	0.053
12:12:44	0.058	12:12:44	0.058

12:17:44	0.071	12:17:44	0.055
12:22:44	0.059	12:22:44	0.055
12:27:44	0.061	12:27:44	0.062
12:32:44	0.058	12:32:44	0.06
12:37:44	0.058	12:37:44	0.059
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13:27:44	0.056	13:27:44	0.056
13:32:44	0.053	13:32:44	0.062
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15:07:44	0.055	15:07:44	0.053
15:12:44	0.064	15:12:44	0.059
15:17:44	0.278	15:17:44	0.061
15:22:44	0.06	15:22:44	0.057
15:27:44	0.061	15:27:44	0.057
15:32:44	0.056	15:32:44	0.058
15:37:44	0.056	15:37:44	0.056
15:42:44	0.062	15:42:44	0.059
15:47:44	0.057	15:47:44	0.061
15:52:44	0.059	15:52:44	0.059
15:57:44	0.059	15:57:44	0.058
16:02:44	0.058	16:02:44	0.059
16:07:44	0.057	16:07:44	0.06
16:12:44	0.059	16:12:44	0.169
16:17:44	0.062	16:17:44	0.062
16:22:44	0.058	16:22:44	0.064

16:27:44	0.06	16:27:44	0.06
16:32:44	0.059	16:32:44	0.188
16:37:44	0.059	16:37:44	0.071
16:42:44	0.057	16:42:44	0.064
16:47:44	0.058	16:47:44	0.108
16:52:44	0.06	16:52:44	0.057
16:57:44	0.053	16:57:44	0.058
17:02:44	0.056	17:02:44	0.064
17:07:44	0.064	17:07:44	0.061
17:12:44	0.056	17:12:44	0.056
17:17:44	0.053	17:17:44	0.058
17:22:44	0.056	17:22:44	0.063
17:27:44	0.057	17:27:44	0.053
17:32:44	0.056	17:32:44	0.056
17:37:44	0.058	17:37:44	0.057
17:42:44	0.059	17:42:44	0.053
17:47:44	0.058	17:47:44	0.059
17:52:44	0.062	17:52:44	0.057
17:57:44	0.061	17:57:44	0.062
18:02:44	0.056	18:02:44	0.056
18:07:44	0.06	18:07:44	0.057
18:12:44	0.059	18:12:44	0.055
18:17:44	0.057	18:17:44	0.056
18:22:44	0.057	18:22:44	0.056
18:27:44	0.059	18:27:44	0.056
18:32:44	0.056	18:32:44	0.056
18:37:44	0.056	18:37:44	0.055
18:42:44	0.053	18:42:44	0.056
18:47:44	0.062	18:47:44	0.053
18:52:44	0.058	18:52:44	0.053
18:57:44	0.058	18:57:44	0.058
19:02:44	0.06	19:02:44	0.058
19:07:44	0.056	19:07:44	0.056
19:12:44	0.064	19:12:44	0.064
19:17:44	0.057	19:17:44	0.053
19:22:44	0.057	19:22:44	0.056
19:27:44	0.057	19:27:44	0.056
19:32:44	0.059	19:32:44	0.053
19:37:44	0.053	19:37:44	0.056
19:42:44	0.058	19:42:44	0.058
19:47:44	0.059	19:47:44	0.056
19:52:44	0.057	19:52:44	0.055
19:57:44	0.061	19:57:44	0.06
20:02:44	0.065	20:02:44	0.057
20:07:44	0.052	20:07:44	0.056
20:12:44	0.07	20:12:44	0.056
20:17:44	0.056	20:17:44	0.062
20:22:44	0.072	20:22:44	0.057
20:27:44	0.057	20:27:44	0.059
20:32:44	0.056	20:32:44	0.053

20:37:44	0.057	20:37:44	0.055
20:42:44	0.06	20:42:44	0.06
20:47:44	0.053	20:47:44	0.056
20:52:44	0.056	20:52:44	0.056
20:57:44	0.053	20:57:44	0.061
21:02:44	0.061	21:02:44	0.058
21:07:44	0.056	21:07:44	0.056
21:12:44	0.057	21:12:44	0.06
21:17:44	0.058	21:17:44	0.056
21:22:44	0.058	21:22:44	0.057
21:27:44	0.056	21:27:44	0.061
21:32:44	0.053	21:32:44	0.058
21:37:44	0.059	21:37:44	0.059
21:42:44	0.056	21:42:44	0.06
21:47:44	0.056	21:47:44	0.056
21:52:44	0.057	21:52:44	0.06
21:57:44	0.062	21:57:44	0.056
22:02:44	0.059	22:02:44	0.055
22:07:44	0.056	22:07:44	0.053
22:12:44	0.064	22:12:44	0.059
22:17:44	0.053	22:17:44	0.058
22:22:44	0.058	22:22:44	0.059
22:27:44	0.058	22:27:44	0.057
22:32:44	0.056	22:32:44	0.057
22:37:44	0.06	22:37:44	0.056
22:42:44	0.058	22:42:44	0.057
22:47:44	0.057	22:47:44	0.056
22:52:44	0.057	22:52:44	0.06
22:57:44	0.057	22:57:44	0.058
23:02:44	0.065	23:02:44	0.056
23:07:44	0.058	23:07:44	0.057
23:12:44	0.057	23:12:44	0.053
23:17:44	0.056	23:17:44	0.056
23:22:44	0.07	23:22:44	0.053
23:27:44	0.066	23:27:44	0.056
23:32:44	0.056	23:32:44	0.058
23:37:44	0.058	23:37:44	0.056
23:42:44	0.056	23:42:44	0.058
23:47:44	0.064	23:47:44	0.058
23:52:44	0.069	23:52:44	0.057
23:57:44	0.061	23:57:44	0.052

Time	mm/s	Time	mm/s	Time	mm/s
23rd		24th		25th	
00:02:44	0.059	00:02:44	0.053	00:02:44	0.06
00:07:44	0.053	00:07:44	0.058	00:07:44	0.056
00:12:44	0.056	00:12:44	0.062	00:12:44	0.055
00:17:44	0.057	00:17:44	0.057	00:17:44	0.055
00:22:44	0.053	00:22:44	0.055	00:22:44	0.064
00:27:44	0.058	00:27:44	0.057	00:27:44	0.06
00:32:44	0.058	00:32:44	0.056	00:32:44	0.056
00:37:44	0.061	00:37:44	0.059	00:37:44	0.057
00:42:44	0.057	00:42:44	0.058	00:42:44	0.056
00:47:44	0.056	00:47:44	0.057	00:47:44	0.055
00:52:44	0.056	00:52:44	0.062	00:52:44	0.053
00:57:44	0.057	00:57:44	0.064	00:57:44	0.057
01:02:44	0.055	01:02:44	0.057	01:02:44	0.056
01:07:44	0.053	01:07:44	0.064	01:07:44	0.058
01:12:44	0.058	01:12:44	0.057	01:12:44	0.058
01:17:44	0.055	01:17:44	0.056	01:17:44	0.057
01:22:44	0.061	01:22:44	0.056	01:22:44	0.053
01:27:44	0.062	01:27:44	0.057	01:27:44	0.056
01:32:44	0.056	01:32:44	0.06	01:32:44	0.057
01:37:44	0.056	01:37:44	0.064	01:37:44	0.053
01:42:44	0.057	01:42:44	0.059	01:42:44	0.056
01:47:44	0.064	01:47:44	0.056	01:47:44	0.06
01:52:44	0.057	01:52:44	0.057	01:52:44	0.061
01:57:44	0.053	01:57:44	0.065	01:57:44	0.053
02:02:44	0.06	02:02:44	0.058	02:02:44	0.053
02:07:44	0.055	02:07:44	0.056	02:07:44	0.056
02:12:44	0.058	02:12:44	0.058	02:12:44	0.056
02:17:44	0.056	02:17:44	0.06	02:17:44	0.055
02:22:44	0.056	02:22:44	0.059	02:22:44	0.056
02:27:44	0.069	02:27:44	0.057	02:27:44	0.057
02:32:44	0.057	02:32:44	0.058	02:32:44	0.056
02:37:44	0.056	02:37:44	0.057	02:37:44	0.053
02:42:44	0.058	02:42:44	0.06	02:42:44	0.053
02:47:44	0.058	02:47:44	0.057	02:47:44	0.055
02:52:44	0.056	02:52:44	0.058	02:52:44	0.056
02:57:44	0.058	02:57:44	0.057	02:57:44	0.058
03:02:44	0.06	03:02:44	0.056	03:02:44	0.052
03:07:44	0.056	03:07:44	0.056	03:07:44	0.056
03:12:44	0.065	03:12:44	0.056	03:12:44	0.053
03:17:44	0.056	03:17:44	0.057	03:17:44	0.056
03:22:44	0.057	03:22:44	0.053	03:22:44	0.056
03:27:44	0.068	03:27:44	0.056	03:27:44	0.056
03:32:44	0.062	03:32:44	0.058	03:32:44	0.055
03:37:44	0.061	03:37:44	0.057	03:37:44	0.056
03:42:44	0.053	03:42:44	0.056	03:42:44	0.055
03:47:44	0.057	03:47:44	0.055	03:47:44	0.059
03:52:44	0.055	03:52:44	0.062	03:52:44	0.056

03:57:44	0.056	03:57:44	0.062	03:57:44	0.056
04:02:44	0.053	04:02:44	0.061	04:02:44	0.053
04:07:44	0.053	04:07:44	0.059	04:07:44	0.061
04:12:44	0.059	04:12:44	0.058	04:12:44	0.057
04:17:44	0.058	04:17:44	0.058	04:17:44	0.056
04:22:44	0.057	04:22:44	0.06	04:22:44	0.061
04:27:44	0.059	04:27:44	0.057	04:27:44	0.056
04:32:44	0.056	04:32:44	0.068	04:32:44	0.056
04:37:44	0.056	04:37:44	0.057	04:37:44	0.057
04:42:44	0.057	04:42:44	0.064	04:42:44	0.053
04:47:44	0.058	04:47:44	0.053	04:47:44	0.056
04:52:44	0.056	04:52:44	0.055	04:52:44	0.058
04:57:44	0.057	04:57:44	0.058	04:57:44	0.058
05:02:44	0.061	05:02:44	0.064	05:02:44	0.053
05:07:44	0.055	05:07:44	0.057	05:07:44	0.057
05:12:44	0.055	05:12:44	0.058	05:12:44	0.06
05:17:44	0.058	05:17:44	0.056	05:17:44	0.06
05:22:44	0.055	05:22:44	0.06	05:22:44	0.057
05:27:44	0.058	05:27:44	0.057	05:27:44	0.057
05:32:44	0.062	05:32:44	0.056	05:32:44	0.053
05:37:44	0.057	05:37:44	0.057	05:37:44	0.056
05:42:44	0.057	05:42:44	0.058	05:42:44	0.053
05:47:44	0.056	05:47:44	0.053	05:47:44	0.056
05:52:44	0.053	05:52:44	0.062	05:52:44	0.052
05:57:44	0.062	05:57:44	0.056	05:57:44	0.056
06:02:44	0.056	06:02:44	0.06	06:02:44	0.057
06:07:44	0.058	06:07:44	0.056	06:07:44	0.057
06:12:44	0.058	06:12:44	0.057	06:12:44	0.056
06:17:44	0.062	06:17:44	0.058	06:17:44	0.06
06:22:44	0.056	06:22:44	0.056	06:22:44	0.053
06:27:44	0.056	06:27:44	0.055	06:27:44	0.057
06:32:44	0.057	06:32:44	0.057	06:32:44	0.056
06:37:44	0.057	06:37:44	0.062	06:37:44	0.057
06:42:44	0.056	06:42:44	0.053	06:42:44	0.056
06:47:44	0.062	06:47:44	0.062	06:47:44	0.061
06:52:44	0.053	06:52:44	0.053	06:52:44	0.06
06:57:44	0.06	06:57:44	0.058	06:57:44	0.058
07:02:44	0.055	07:02:44	0.056	07:02:44	0.059
07:07:44	0.053	07:07:44	0.057	07:07:44	0.055
07:12:44	0.06	07:12:44	0.06	07:12:44	0.053
07:17:44	0.06	07:17:44	0.056	07:17:44	0.053
07:22:44	0.056	07:22:44	0.058	07:22:44	0.057
07:27:44	0.057	07:27:44	0.056	07:27:44	0.053
07:32:44	0.061	07:32:44	0.053	07:32:44	0.065
07:37:44	0.059	07:37:44	0.06	07:37:44	0.053
07:42:44	0.057	07:42:44	0.057	07:42:44	0.056
07:47:44	0.058	07:47:44	0.061	07:47:44	0.061
07:52:44	0.062	07:52:44	0.056	07:52:44	0.058
07:57:44	0.055	07:57:44	0.056	07:57:44	0.058
08:02:44	0.057	08:02:44	0.056	08:02:44	0.053

08:07:44	0.058	08:07:44	0.058	08:07:44	0.056
08:12:44	0.056	08:12:44	0.062	08:12:44	0.056
08:17:44	0.057	08:17:44	0.062	08:17:44	0.056
08:22:44	0.058	08:22:44	0.064	08:22:44	0.061
08:27:44	0.056	08:27:44	0.064	08:27:44	0.06
08:32:44	0.056	08:32:44	0.057	08:32:44	0.056
08:37:44	0.058	08:37:44	0.058	08:37:44	0.053
08:42:44	0.06	08:42:44	0.057	08:42:44	0.061
08:47:44	0.057	08:47:44	0.055	08:47:44	0.061
08:52:44	0.056	08:52:44	0.058	08:52:44	0.058
08:57:44	0.059	08:57:44	0.058	08:57:44	0.058
09:02:44	0.057	09:02:44	0.061	09:02:44	0.057
09:07:44	0.058	09:07:44	0.055	09:07:44	0.056
09:12:44	0.059	09:12:44	0.055	09:12:44	0.058
09:17:44	0.06	09:17:44	0.06	09:17:44	0.056
09:22:44	0.053	09:22:44	0.064	09:22:44	0.053
09:27:44	0.053	09:27:44	0.06	09:27:44	0.184
09:32:44	0.058	09:32:44	0.084	09:32:44	0.062
09:37:44	0.056	09:37:44	0.057	09:37:44	0.062
09:42:44	0.058	09:42:44	0.061	09:42:44	0.058
09:47:44	0.065	09:47:44	0.06	09:47:44	0.056
09:52:44	0.058	09:52:44	0.062	09:52:44	0.136
09:57:44	0.056	09:57:44	0.06	09:57:44	0.061
10:02:44	0.053	10:02:44	0.056	10:02:44	0.097
10:07:44	0.058	10:07:44	0.058	10:07:44	0.064
10:12:44	0.059	10:12:44	0.053	10:12:44	0.392
10:17:44	0.237	10:17:44	0.055	10:17:44	0.157
10:22:44	0.126	10:22:44	0.093	10:22:44	0.154
10:27:44	0.346	10:27:44	0.057	10:27:44	0.057
10:32:44	0.061	10:32:44	0.056	10:32:44	0.057
10:37:44	0.056	10:37:44	0.056	10:37:44	0.058
10:42:44	0.056	10:42:44	0.057	10:42:44	0.057
10:47:44	0.062	10:47:44	0.061	10:47:44	0.059
10:52:44	0.068	10:52:44	0.057	10:52:44	0.062
10:57:44	0.122	10:57:44	0.055	10:57:44	0.056
11:02:44	0.111	11:02:44	0.055	11:02:44	0.058
11:07:44	0.105	11:07:44	0.055	11:07:44	0.177
11:12:44	0.067	11:12:44	0.064	11:12:44	0.056
11:17:44	0.081	11:17:44	0.058	11:17:44	0.058
11:22:44	1.429	11:22:44	0.059	11:22:44	0.057
11:27:44	0.282	11:27:44	0.062	11:27:44	0.057
11:32:44	0.062	11:32:44	0.056	11:32:44	0.058
11:37:44	0.055	11:37:44	0.058	11:37:44	0.053
11:42:44	0.055	11:42:44	0.056	11:42:44	0.058
11:47:44	0.056	11:47:44	0.06	11:47:44	0.056
11:52:44	0.063	11:52:44	0.056	11:52:44	0.056
11:57:44	0.376	11:57:44	0.056	11:57:44	0.057
12:02:44	0.057	12:02:44	0.06	12:02:44	0.056
12:07:44	0.057	12:07:44	0.06	12:07:44	0.058
12:12:44	0.096	12:12:44	0.058	12:12:44	0.053

12:17:44	0.132	12:17:44	0.058	12:17:44	0.062
12:22:44	0.058	12:22:44	0.056	12:22:44	0.057
12:27:44	0.079	12:27:44	0.065	12:27:44	0.058
12:32:44	0.105	12:32:44	0.06	12:32:44	0.065
12:37:44	0.333	12:37:44	0.064	12:37:44	0.056
12:42:44	0.064	12:42:44	0.06	12:42:44	0.053
12:47:44	0.056	12:47:44	0.057	12:47:44	0.057
12:52:44	0.061	12:52:44	0.058	12:52:44	0.06
12:57:44	0.061	12:57:44	0.057	12:57:44	0.056
13:02:44	0.062	13:02:44	0.058	13:02:44	0.058
13:07:44	0.062	13:07:44	0.058	13:07:44	0.058
13:12:44	0.059	13:12:44	0.058	13:12:44	0.053
13:17:44	0.064	13:17:44	0.056	13:17:44	0.066
13:22:44	0.058	13:22:44	0.061	13:22:44	0.06
13:27:44	0.056	13:27:44	0.06	13:27:44	0.059
13:32:44	0.062	13:32:44	0.059	13:32:44	0.056
13:37:44	0.061	13:37:44	0.056	13:37:44	0.059
13:42:44	0.056	13:42:44	0.06	13:42:44	0.058
13:47:44	0.059	13:47:44	0.058	13:47:44	0.056
13:52:44	0.064	13:52:44	0.056	13:52:44	0.057
13:57:44	0.056	13:57:44	0.06	13:57:44	0.068
14:02:44	0.055	14:02:44	0.057	14:02:44	0.056
14:07:44	0.062	14:07:44	0.056	14:07:44	0.061
14:12:44	0.058	14:12:44	0.064	14:12:44	0.057
14:17:44	0.061	14:17:44	0.057	14:17:44	0.061
14:22:44	0.057	14:22:44	0.064	14:22:44	0.06
14:27:44	0.057	14:27:44	0.057	14:27:44	0.059
14:32:44	0.261	14:32:44	0.062	14:32:44	0.058
14:37:44	0.064	14:37:44	0.061	14:37:44	0.062
14:42:44	0.071	14:42:44	0.06	14:42:44	0.064
14:47:44	0.088	14:47:44	0.062	14:47:44	0.056
14:52:44	0.082	14:52:44	0.057	14:52:44	0.056
14:57:44	0.384	14:57:44	0.064	14:57:44	0.058
15:02:44	0.103	15:02:44	0.056	15:02:44	0.057
15:07:44	0.068	15:07:44	0.061	15:07:44	0.058
15:12:44	0.053	15:12:44	0.057	15:12:44	0.055
15:17:44	0.107	15:17:44	0.06	15:17:44	0.062
15:22:44	0.098	15:22:44	0.06	15:22:44	0.058
15:27:44	0.265	15:27:44	0.064	15:27:44	0.058
15:32:44	0.142	15:32:44	0.057	15:32:44	0.058
15:37:44	0.053	15:37:44	0.062	15:37:44	0.062
15:42:44	0.06	15:42:44	0.056	15:42:44	0.058
15:47:44	0.061	15:47:44	0.062	15:47:44	0.061
15:52:44	0.104	15:52:44	0.062	15:52:44	0.06
15:57:44	0.057	15:57:44	0.056	15:57:44	0.056
16:02:44	0.061	16:02:44	0.06	16:02:44	0.053
16:07:44	0.059	16:07:44	0.058	16:07:44	0.055
16:12:44	0.059	16:12:44	0.058	16:12:44	0.058
16:17:44	0.053	16:17:44	0.057	16:17:44	0.057
16:22:44	0.053	16:22:44	0.065	16:22:44	0.058

16:27:44	0.057	16:27:44	0.055	16:27:44	0.055
16:32:44	0.061	16:32:44	0.056	16:32:44	0.06
16:37:44	0.056	16:37:44	0.061	16:37:44	0.057
16:42:44	0.057	16:42:44	0.053	16:42:44	0.056
16:47:44	0.057	16:47:44	0.056	16:47:44	0.062
16:52:44	0.057	16:52:44	0.064	16:52:44	0.058
16:57:44	0.055	16:57:44	0.057	16:57:44	0.056
17:02:44	0.058	17:02:44	0.057	17:02:44	0.058
17:07:44	0.062	17:07:44	0.055	17:07:44	0.056
17:12:44	0.059	17:12:44	0.057	17:12:44	0.061
17:17:44	0.056	17:17:44	0.059	17:17:44	0.058
17:22:44	0.057	17:22:44	0.058	17:22:44	0.057
17:27:44	0.057	17:27:44	0.056	17:27:44	0.057
17:32:44	0.057	17:32:44	0.065	17:32:44	0.059
17:37:44	0.052	17:37:44	0.058	17:37:44	0.057
17:42:44	0.057	17:42:44	0.06	17:42:44	0.061
17:47:44	0.057	17:47:44	0.056	17:47:44	0.067
17:52:44	0.057	17:52:44	0.062	17:52:44	0.056
17:57:44	0.053	17:57:44	0.057	17:57:44	0.057
18:02:44	0.057	18:02:44	0.06	18:02:44	0.06
18:07:44	0.053	18:07:44	0.058	18:07:44	0.058
18:12:44	0.056	18:12:44	0.056	18:12:44	0.06
18:17:44	0.056	18:17:44	0.056	18:17:44	0.06
18:22:44	0.055	18:22:44	0.062	18:22:44	0.059
18:27:44	0.062	18:27:44	0.06	18:27:44	0.064
18:32:44	0.057	18:32:44	0.055	18:32:44	0.055
18:37:44	0.053	18:37:44	0.055	18:37:44	0.056
18:42:44	0.057	18:42:44	0.061	18:42:44	0.06
18:47:44	0.056	18:47:44	0.052	18:47:44	0.057
18:52:44	0.053	18:52:44	0.059	18:52:44	0.057
18:57:44	0.058	18:57:44	0.057	18:57:44	0.059
19:02:44	0.056	19:02:44	0.058	19:02:44	0.056
19:07:44	0.058	19:07:44	0.058	19:07:44	0.053
19:12:44	0.053	19:12:44	0.056	19:12:44	0.06
19:17:44	0.058	19:17:44	0.058	19:17:44	0.06
19:22:44	0.056	19:22:44	0.062	19:22:44	0.058
19:27:44	0.06	19:27:44	0.057	19:27:44	0.056
19:32:44	0.058	19:32:44	0.064	19:32:44	0.062
19:37:44	0.057	19:37:44	0.056	19:37:44	0.056
19:42:44	0.057	19:42:44	0.059	19:42:44	0.059
19:47:44	0.057	19:47:44	0.056	19:47:44	0.058
19:52:44	0.057	19:52:44	0.061	19:52:44	0.058
19:57:44	0.058	19:57:44	0.06	19:57:44	0.062
20:02:44	0.056	20:02:44	0.055	20:02:44	0.056
20:07:44	0.057	20:07:44	0.06	20:07:44	0.058
20:12:44	0.057	20:12:44	0.06	20:12:44	0.055
20:17:44	0.056	20:17:44	0.057	20:17:44	0.057
20:22:44	0.058	20:22:44	0.06	20:22:44	0.06
20:27:44	0.056	20:27:44	0.057	20:27:44	0.057
20:32:44	0.055	20:32:44	0.058	20:32:44	0.058

20:37:44	0.06	20:37:44	0.058	20:37:44	0.058
20:42:44	0.058	20:42:44	0.056	20:42:44	0.056
20:47:44	0.057	20:47:44	0.058	20:47:44	0.058
20:52:44	0.058	20:52:44	0.061	20:52:44	0.058
20:57:44	0.056	20:57:44	0.057	20:57:44	0.058
21:02:44	0.053	21:02:44	0.055	21:02:44	0.053
21:07:44	0.056	21:07:44	0.058	21:07:44	0.057
21:12:44	0.062	21:12:44	0.062	21:12:44	0.055
21:17:44	0.055	21:17:44	0.055	21:17:44	0.057
21:22:44	0.056	21:22:44	0.053	21:22:44	0.06
21:27:44	0.059	21:27:44	0.06	21:27:44	0.055
21:32:44	0.059	21:32:44	0.058	21:32:44	0.056
21:37:44	0.061	21:37:44	0.064	21:37:44	0.056
21:42:44	0.053	21:42:44	0.065	21:42:44	0.056
21:47:44	0.056	21:47:44	0.056	21:47:44	0.057
21:52:44	0.057	21:52:44	0.058	21:52:44	0.053
21:57:44	0.053	21:57:44	0.058	21:57:44	0.056
22:02:44	0.056	22:02:44	0.056	22:02:44	0.061
22:07:44	0.053	22:07:44	0.055	22:07:44	0.056
22:12:44	0.058	22:12:44	0.059	22:12:44	0.051
22:17:44	0.058	22:17:44	0.056	22:17:44	0.057
22:22:44	0.056	22:22:44	0.062	22:22:44	0.053
22:27:44	0.055	22:27:44	0.057	22:27:44	0.057
22:32:44	0.055	22:32:44	0.058	22:32:44	0.062
22:37:44	0.056	22:37:44	0.061	22:37:44	0.057
22:42:44	0.056	22:42:44	0.059	22:42:44	0.058
22:47:44	0.053	22:47:44	0.058	22:47:44	0.058
22:52:44	0.058	22:52:44	0.06	22:52:44	0.06
22:57:44	0.057	22:57:44	0.058	22:57:44	0.057
23:02:44	0.06	23:02:44	0.053	23:02:44	0.058
23:07:44	0.056	23:07:44	0.057	23:07:44	0.062
23:12:44	0.057	23:12:44	0.06	23:12:44	0.057
23:17:44	0.056	23:17:44	0.057	23:17:44	0.06
23:22:44	0.055	23:22:44	0.058	23:22:44	0.061
23:27:44	0.058	23:27:44	0.06	23:27:44	0.055
23:32:44	0.06	23:32:44	0.059	23:32:44	0.056
23:37:44	0.059	23:37:44	0.058	23:37:44	0.058
23:42:44	0.058	23:42:44	0.057	23:42:44	0.057
23:47:44	0.062	23:47:44	0.057	23:47:44	0.056
23:52:44	0.059	23:52:44	0.056	23:52:44	0.06
23:57:44	0.059	23:57:44	0.06	23:57:44	0.064

Appendix 3 – Noise data set

Kilwex Baseline Noise Data 20th-25th February 2023

Date	Time	LAeq	LAFmin	LAFmax	LAF5	LAF10	LAF50	LAF90
20/02/2023	15:45:00	42.8	34.4	63.6	46.7	44.7	40.3	37
20/02/2023	16:00:00	44	34.6	66.7	46.7	43.6	39.4	37
20/02/2023	16:15:00	45.9	30.2	68.5	48.3	45.2	38.4	34.7
20/02/2023	16:30:00	51.9	29.6	79.1	55.8	47.2	37.8	33.3
20/02/2023	16:45:00	43.6	28.5	64.2	48	45	38.9	35.5
20/02/2023	17:00:00	42.1	29.1	62.1	46.6	44	39.2	35.2
20/02/2023	17:15:00	39.3	29.5	60.3	42.7	41.2	36.7	33.3
20/02/2023	17:30:00	44.2	28	73.2	41.4	39	34.4	31.6
20/02/2023	17:45:00	35	27.7	52.3	38.8	37.7	33.6	30.6
20/02/2023	18:00:00	38.2	28.6	57.1	42.2	40.6	35.6	32.1
20/02/2023	18:15:00	38.7	30.5	57.1	42.2	41.1	37.7	34.7
20/02/2023	18:30:00	34.3	26.1	41.6	37.9	37.1	33.4	29.9
20/02/2023	18:45:00	32.5	26.3	41.3	35.8	34.9	31.8	29.3
20/02/2023	19:00:00	30.8	24.3	42.4	34.9	33.2	29.4	26.6
20/02/2023	19:15:00	32.8	23.9	44.6	37.3	35.9	30.8	27.5
20/02/2023	19:30:00	31.9	25.1	43	35.9	34.3	30.6	28
20/02/2023	19:45:00	34.4	25.8	45.2	39.1	37.5	32.7	28.7
20/02/2023	20:00:00	33.9	26.1	45.3	37.6	36.4	32.6	29.3
20/02/2023	20:15:00	38.4	25.2	62.6	40.1	37.5	31.3	27.9
20/02/2023	20:30:00	31.9	24.2	44	36	34.7	30.2	27
20/02/2023	20:45:00	32.7	24.8	44.5	36.6	35.5	31.5	28.4
20/02/2023	21:00:00	31.4	25.2	43.2	35.9	34	29.6	27.3
20/02/2023	21:15:00	30.4	24.4	44.2	34	32.6	29.1	27.4
20/02/2023	21:30:00	30.2	22.4	42.8	34.6	33	28.4	25.5
20/02/2023	21:45:00	29.9	22.2	46.2	34.7	33	27.3	24.7
20/02/2023	22:00:00	29.6	21.8	43	34.9	33.6	26.3	23.5
20/02/2023	22:15:00	31.1	21.2	47.2	36.7	34.8	26.3	23.7
20/02/2023	22:30:00	30.7	20.5	51.3	36.5	33.8	25.4	22.2
20/02/2023	22:45:00	29	19	51.2	34.3	32.1	23.7	20.4
20/02/2023	23:00:00	28.7	19.1	44.2	33.7	31.6	25.6	22
20/02/2023	23:15:00	26.1	18.4	46.4	30.2	28	23	20.5
20/02/2023	23:30:00	27	19.1	42.5	32.7	30.6	23.1	20.5
20/02/2023	23:45:00	23.7	18.7	37.8	28.2	26	21.6	20.1
21/02/2023	00:00:00	28.3	18.9	46.6	34.4	31.3	23.1	20.8
21/02/2023	00:15:00	21.6	17.7	40.3	23.8	22.2	20.2	18.7
21/02/2023	00:30:00	18.6	17.2	31.2	19.9	19.4	18.2	17.8
21/02/2023	00:45:00	22	17.9	40.6	25.7	22.2	19.6	18.9
21/02/2023	01:00:00	21.5	17.5	42.1	24.7	21.9	19	18.2
21/02/2023	01:15:00	21.7	17.6	40.2	25.3	22.2	19.1	18.3
21/02/2023	01:30:00	26.1	17.9	47.3	30.9	27.8	19.9	18.7
21/02/2023	01:45:00	23.7	18.1	46.6	27.5	25.4	20.4	19.1
21/02/2023	02:00:00	28.5	18.6	45.7	35	31.5	21.3	19.9
21/02/2023	02:15:00	26.8	18.6	44.7	32.7	29.7	21.4	19.8
21/02/2023	02:30:00	29.3	19.3	46.1	35.5	32.2	23.6	20.9
21/02/2023	02:45:00	29.8	19.9	47.1	36.1	32.3	23.1	21.1
21/02/2023	03:00:00	32.8	18.8	52.5	38.1	35	24.7	21.1
21/02/2023	03:15:00	26.7	18.5	43	33.1	30.4	21.3	19.9
21/02/2023	03:30:00	29.3	19.6	50.6	35.7	32.8	22.6	20.6

21/02/2023	03:45:00	28	18.1	46.4	35.9	29.4	20.6	19.2
21/02/2023	04:00:00	29.3	18.1	49.3	36.3	31.7	20.2	19
21/02/2023	04:15:00	22	17.3	36.9	26.6	24.2	19.7	18.2
21/02/2023	04:30:00	25.2	17.2	43.1	30.5	26.1	18.4	17.7
21/02/2023	04:45:00	31	17.5	51.2	38.3	32.2	19.4	18.3
21/02/2023	05:00:00	29.1	18.4	47.4	35	32.8	22.3	19.8
21/02/2023	05:15:00	30.3	19.9	51.1	36.2	33	23.4	21.2
21/02/2023	05:30:00	30.3	19.8	45.8	36.1	34.1	25.7	21.4
21/02/2023	05:45:00	31.2	19.8	47.3	37.4	35	25.7	21.4
21/02/2023	06:00:00	33	20.6	49.6	38.5	36.1	28.7	23.3
21/02/2023	06:15:00	34.1	22.8	50.7	39.3	37.4	31.3	26.2
21/02/2023	06:30:00	35.5	24.3	48.8	40.9	39.1	32.8	28.2
21/02/2023	06:45:00	49.6	24.9	72.3	54.1	43.8	36.8	30.6
21/02/2023	07:00:00	54.9	27.5	73.3	62.4	55.6	38.6	32.9
21/02/2023	07:15:00	54.7	31.3	72.4	60.9	47.5	40.7	36
21/02/2023	07:30:00	56.7	30.3	74.8	64.1	61.1	44.5	37.3
21/02/2023	07:45:00	50.8	30.3	76.3	51.5	47.8	40	34.8
21/02/2023	08:00:00	49.7	31.3	72.3	49.7	47	40.4	36
21/02/2023	08:15:00	44.9	31.5	69.5	47.1	45.7	40.8	36.9
21/02/2023	08:30:00	47.6	30.6	71.3	51	47.2	40.5	36.3
21/02/2023	08:45:00	45.4	31.5	67.9	50	46.6	40	35.8
21/02/2023	09:00:00	53	31.7	69.1	60	57.5	44.7	37.8
21/02/2023	09:15:00	49.5	30.6	65.8	57.4	53.8	40.9	35.9
21/02/2023	09:30:00	46.9	29.3	70	51.2	45.9	37.4	33.5
21/02/2023	09:45:00	45	30.5	66	49.3	46.5	39.2	34.7
21/02/2023	10:00:00	44.5	28.7	72.1	49.7	47.2	37.4	32.3
21/02/2023	10:15:00	43.5	30.4	66	47.2	44.5	37.8	33.2
21/02/2023	10:30:00	45.5	30.9	72.7	50	48.2	41.2	35.9
21/02/2023	10:45:00	52	30.8	74.3	54.5	50.7	41.8	36.6
21/02/2023	11:00:00	44.8	31.4	67.5	49.1	46.4	40	35.7
21/02/2023	11:15:00	48.5	30.1	69.6	54.5	50.9	41	34.3
21/02/2023	11:30:00	42.8	30.2	61.8	48	45.4	38.7	34.4
21/02/2023	11:45:00	41.4	30.7	61.1	46.5	44	37.9	34.2
21/02/2023	12:00:00	49.4	32.5	73.8	53.8	48.5	39.5	35.5
21/02/2023	12:15:00	51.1	36.3	70.8	57.3	53.1	42.8	38.8
21/02/2023	12:30:00	45.2	36.3	65.1	50.6	48.6	41.9	38.5
21/02/2023	12:45:00	46.3	35.7	74.3	49.5	46.5	41.1	38.2
21/02/2023	13:00:00	43.9	35	68.1	49.4	45.6	39.1	36.6
21/02/2023	13:15:00	43.3	31.1	62.2	48.5	46.3	39.9	37
21/02/2023	13:30:00	44.2	31.7	65.6	50	47.1	39.7	35.6
21/02/2023	13:45:00	43.8	30.3	66.3	48.6	45.7	38.5	34.3
21/02/2023	14:00:00	46.3	32.8	66.3	51.2	48.4	41.7	37.6
21/02/2023	14:15:00	43.9	35.5	60.8	49	46.2	40.5	37.5
21/02/2023	14:30:00	44.8	33	65.8	48.8	45.5	40.5	36.3
21/02/2023	14:45:00	45.3	33.2	68.7	48.8	45.1	39.5	35.7
21/02/2023	15:00:00	47	29.9	68.8	49.8	45.6	39.3	34.9
21/02/2023	15:15:00	42.1	27.4	69.1	45.6	43.1	36.7	31.8
21/02/2023	15:30:00	42.2	29.6	65.1	47.5	44.4	36.2	31.9
21/02/2023	15:45:00	43	30.9	61.6	48.4	46.2	39.5	34.4
21/02/2023	16:00:00	42.8	31.7	67.1	47.3	45.1	39.2	35

21/02/2023	16:15:00	42.7	31.7	66.2	47.1	45	39.2	35.3
21/02/2023	16:30:00	40.1	30.7	59.6	44.7	42.9	37.9	34.7
21/02/2023	16:45:00	42.3	31.3	60.5	47.9	44.7	38.6	34.6
21/02/2023	17:00:00	38.6	28.7	50.5	42.8	41.6	37.5	33
21/02/2023	17:15:00	39.3	30.1	52.5	43.1	41.9	38.1	34.3
21/02/2023	17:30:00	41.3	31	58.8	45.7	43.9	39.5	35.1
21/02/2023	17:45:00	42.2	28.8	71	44.3	42.6	37.6	33.6
21/02/2023	18:00:00	44	28.6	66.1	44.9	43.3	38.1	32.7
21/02/2023	18:15:00	50.8	29.3	72.5	57.3	52.6	38.7	33.2
21/02/2023	18:30:00	38.9	29.3	58.4	42.8	41.8	37.4	33.1
21/02/2023	18:45:00	46.1	32.4	64.2	51.6	48.9	42.2	37.2
21/02/2023	19:00:00	43.4	32.1	59.1	48.7	46.7	40.9	36.4
21/02/2023	19:15:00	39.1	27.9	54.3	44	42.3	36.5	31.5
21/02/2023	19:30:00	38.8	27.1	56.9	43.2	41.4	36.1	31.8
21/02/2023	19:45:00	38	27.9	56.6	42.2	40.8	36.4	31.9
21/02/2023	20:00:00	38.2	27.3	51.1	42.8	41.3	36.2	32.1
21/02/2023	20:15:00	44	29.8	59	50	45	40	35.9
21/02/2023	20:30:00	38.1	32.2	48	41.8	40.6	37.2	34.9
21/02/2023	20:45:00	39.8	30.7	50.5	43.9	43	38.5	33.2
21/02/2023	21:00:00	34.7	28	52.8	39.1	37.2	32.3	30
21/02/2023	21:15:00	32.2	26.1	46.4	36.6	34.8	30.3	28.3
21/02/2023	21:30:00	39.7	27.3	49	43.3	42.8	39.5	30
21/02/2023	21:45:00	36.7	30.2	47.6	40	38.9	35.8	33
21/02/2023	22:00:00	34.9	26.4	45.8	38.7	37.9	34.1	28.6
21/02/2023	22:15:00	33	27.3	47.5	36.7	35.1	31.2	29.1
21/02/2023	22:30:00	32.9	27.3	47.2	36.3	35.1	31.7	29.4
21/02/2023	22:45:00	37.2	28.3	50.7	41.2	40.3	36	30.7
21/02/2023	23:00:00	34.6	28.1	46.8	38.6	37.3	33.2	30.6
21/02/2023	23:15:00	46.8	34.9	59.5	52.7	50.6	43	38.7
21/02/2023	23:30:00	48.7	42.1	58.8	52	51.1	47.9	45.2
21/02/2023	23:45:00	45.8	37.5	56	49.3	48.4	45	40.7
22/02/2023	00:00:00	40.3	31.9	58.5	45	43.3	37.9	34.6
22/02/2023	00:15:00	31.6	24.4	46.9	34.7	33.9	30.4	26.8
22/02/2023	00:30:00	28.6	24.8	38.4	31.5	30.2	27.8	26.3
22/02/2023	00:45:00	29.2	24.9	38.4	32.5	31.6	28.3	26.8
22/02/2023	01:00:00	29.6	25	38.7	33	31.4	29	27
22/02/2023	01:15:00	29.8	24.8	37.6	34	33	28.5	26.4
22/02/2023	01:30:00	30.7	25	46.2	35	32.7	28.9	26.6
22/02/2023	01:45:00	36.1	25.5	50.9	43.9	38.2	30.5	27.8
22/02/2023	02:00:00	33.5	27	44.6	38.1	36.4	31.5	29
22/02/2023	02:15:00	32.8	25.6	44.6	37	35.8	31.8	27.6
22/02/2023	02:30:00	33.7	24.6	42.7	38.5	37.3	32.4	27.3
22/02/2023	02:45:00	38.7	29.4	47.6	43.1	41.8	37.2	32.6
22/02/2023	03:00:00	44.5	34.4	54.8	49.5	47.4	42.8	38.5
22/02/2023	03:15:00	46.8	35.9	57.3	51	49.7	44.9	41
22/02/2023	03:30:00	40.1	32.5	50.1	44.6	43.3	38.5	35
22/02/2023	03:45:00	39.7	33.1	45.4	43	42.4	39.1	35.5
22/02/2023	04:00:00	38.3	31.3	45.9	42.2	41.3	37.1	33.9
22/02/2023	04:15:00	39.8	28	57.1	46.1	43.7	33.9	30.6
22/02/2023	04:30:00	33.4	26.8	42	37.6	36.7	31.8	29.1

22/02/2023	04:45:00	40.5	29.7	57.7	46.2	43.7	34.4	31.6
22/02/2023	05:00:00	33.9	26.3	49.7	38.7	37.2	31.1	28.9
22/02/2023	05:15:00	36.8	28.3	48.6	40.1	39.2	35.8	32.7
22/02/2023	05:30:00	37.8	30.1	48.8	41.9	40.8	36.6	32.8
22/02/2023	05:45:00	36.9	30.2	49.5	41	39.8	35.4	32.1
22/02/2023	06:00:00	36	30.9	48.4	39.4	37.9	34.8	33.1
22/02/2023	06:15:00	42.4	31.8	61	48.3	44.4	37.8	34.2
22/02/2023	06:30:00	41.3	32.8	70.1	41.9	40.7	37.4	34.6
22/02/2023	06:45:00	44.1	33.7	67.4	49.5	47	39.1	36.3
22/02/2023	07:00:00	49.6	34.3	67.9	56.1	47.9	39.7	36.7
22/02/2023	07:15:00	49.4	34.4	71.3	56.2	51.1	41.5	37.8
22/02/2023	07:30:00	48.4	34.7	65.4	54.8	52.4	42.9	38.6
22/02/2023	07:45:00	44.5	36.1	66.2	46	44.6	41.1	38.7
22/02/2023	08:00:00	44.5	35.4	66.4	47.4	46	42.7	39.8
22/02/2023	08:15:00	46.2	37.4	75.5	47.3	46	42.7	40.3
22/02/2023	08:30:00	44.2	36.9	61.9	47.7	46.3	42.3	39.3
22/02/2023	08:45:00	45.1	36.2	63.4	49.5	47.2	42.1	39.2
22/02/2023	09:00:00	45.2	35.4	63.6	50.2	47.6	41.4	37.9
22/02/2023	09:15:00	43.3	34.1	62.8	48.6	44.9	38.3	36.3
22/02/2023	09:30:00	47.4	33.7	70.5	52.3	46.2	38.3	35.9
22/02/2023	09:45:00	48.2	33.2	71.4	51.2	48	39.3	35.6
22/02/2023	10:00:00	43.8	31	66.4	49.1	45.2	37.6	33.9
22/02/2023	10:15:00	47	35	64.2	53.2	49.7	41.7	38.2
22/02/2023	10:30:00	53.5	36.2	73.6	60.2	55.4	47.7	40.1
22/02/2023	10:45:00	54.9	34.3	74.7	61.8	56.9	43.2	39.2
22/02/2023	11:00:00	42.2	33.4	62.4	45.6	44	40.5	37.1
22/02/2023	11:15:00	44.4	34.9	63.5	48.6	46.3	41.5	38.5
22/02/2023	11:30:00	41	33.6	60.6	44.5	43	39.1	36.7
22/02/2023	11:45:00	43.9	31.3	65	49.3	45.4	38.6	34.7
22/02/2023	12:00:00	42.3	32.2	57.6	47.6	45.6	39.4	35.8
22/02/2023	12:15:00	52.2	29.5	73.8	55.8	50.6	36.9	32.5
22/02/2023	12:30:00	42.5	29.7	66.5	45.8	42.4	36.1	33.2
22/02/2023	12:45:00	43.8	27.6	69	49.4	45.4	35.9	32.2
22/02/2023	13:00:00	45.7	29.6	72.8	47	44.2	37.4	33.8
22/02/2023	13:15:00	41	29.2	67.3	40.5	39	35.4	32.4
22/02/2023	13:30:00	37.6	29.6	50.8	41.6	40.4	36.4	32.8
22/02/2023	13:45:00	38.1	26.8	56	42.5	40.8	35	30.5
22/02/2023	14:00:00	52.4	29.4	68.5	59.9	56.8	41.9	32.6
22/02/2023	14:15:00	49.2	29.9	69.5	56.2	53.1	39.6	33.4
22/02/2023	14:30:00	41.9	30.7	60.2	46.9	45.2	38.9	34.2
22/02/2023	14:45:00	45.1	31.5	61.8	51.2	49	40.7	34.5
22/02/2023	15:00:00	43.3	34.3	60	48.7	46.4	40.5	37.8
22/02/2023	15:15:00	51.2	33.8	71.1	58.5	55.2	41.1	36.8
22/02/2023	15:30:00	38.4	31	53.9	42	41	37.1	34.9
22/02/2023	15:45:00	41	31.6	66.5	45	43.2	38.5	35.7
22/02/2023	16:00:00	47	30	63.6	49.9	49.2	46.6	33.9
22/02/2023	16:15:00	56.1	45.5	76.7	63	60.5	48.6	47.7
22/02/2023	16:30:00	59.9	51.4	80	66	64.3	53.3	52.6
22/02/2023	16:45:00	55.2	32.4	74.7	61.4	53	40.4	36.7
22/02/2023	17:00:00	41.5	31.8	55.6	47.6	44.8	38	35.2

22/02/2023	17:15:00	39.8	33	54.8	42.9	41.9	39.1	36.3
22/02/2023	17:30:00	41	32	62.3	43.5	42.1	39.2	36.3
22/02/2023	17:45:00	39.3	32.8	48.1	42.5	41.6	38.7	35.7
22/02/2023	18:00:00	43.7	34.3	68.8	46.3	44.4	40.1	37.4
22/02/2023	18:15:00	40.2	35.3	61.2	42.8	41.9	39.3	37.4
22/02/2023	18:30:00	39.2	34.8	53.7	41.7	41.1	38.7	36.8
22/02/2023	18:45:00	38.5	33.9	47.8	41.1	40.3	38.1	36
22/02/2023	19:00:00	39.9	30.6	54.2	45.4	43.1	37.1	34.5
22/02/2023	19:15:00	36.1	31.1	45.5	39.5	38.3	35.2	33.1
22/02/2023	19:30:00	36.8	30.8	46.3	40.3	39.2	35.8	33.3
22/02/2023	19:45:00	36.7	31	47.8	40.8	39.4	35.4	32.8
22/02/2023	20:00:00	41	34.2	51.3	44.1	43	39.7	37.1
22/02/2023	20:15:00	36.3	29.9	49.4	39.7	38.7	35.2	32.6
22/02/2023	20:30:00	36.6	30.2	44.6	40.4	39.3	35.6	33.1
22/02/2023	20:45:00	37.1	30.8	48	41.2	40	35.6	32.9
22/02/2023	21:00:00	37.3	30.9	52.5	40.9	39.7	36.1	33.4
22/02/2023	21:15:00	38.4	32.3	52.6	41.7	40.5	37.5	34.9
22/02/2023	21:30:00	34	28.5	47.5	37.6	36.6	32.8	30.4
22/02/2023	21:45:00	39.1	29.5	55.8	45.7	41.8	34.2	31.6
22/02/2023	22:00:00	34.8	29.8	47.9	37.8	36.8	34	31.9
22/02/2023	22:15:00	37.5	31.9	48.8	41.1	39.9	36.4	34.2
22/02/2023	22:30:00	37.2	30.9	52.1	41.4	40.1	35.8	33.4
22/02/2023	22:45:00	34.4	28.3	44	37.4	36.4	33.7	31.4
22/02/2023	23:00:00	31	26	43.4	34.3	33.1	30.2	28.3
22/02/2023	23:15:00	31.8	26.1	43.8	35.2	33.9	30.9	28.5
22/02/2023	23:30:00	33.5	28.4	44.3	36.8	35.7	32.7	30.5
22/02/2023	23:45:00	33.5	27	50.1	36.7	35.4	32.1	29.4
23/02/2023	00:00:00	35.2	29.9	43.2	38.6	37.6	34.4	32
23/02/2023	00:15:00	36.8	30.3	45.9	40.9	39.3	35.6	33
23/02/2023	00:30:00	36.2	30	52.3	39.5	38.5	35.2	33
23/02/2023	00:45:00	34.1	26.6	42.7	38.1	36.9	33	29.6
23/02/2023	01:00:00	34.3	27.9	42.9	37.9	36.9	33.4	30.7
23/02/2023	01:15:00	34.2	28.3	42.8	37.4	36.4	33.4	31
23/02/2023	01:30:00	34.2	28	44.4	38.3	37	33	30.1
23/02/2023	01:45:00	34.7	27.3	44.2	38.7	37.6	33.5	30.2
23/02/2023	02:00:00	32.4	25.9	46.4	36.1	34.8	31	28.4
23/02/2023	02:15:00	30.3	23.9	43.9	34.5	33	28.7	26
23/02/2023	02:30:00	28.3	22.9	44.3	32.4	31.2	26.6	24.5
23/02/2023	02:45:00	27.7	22.9	35.9	30.9	29.9	26.9	24.8
23/02/2023	03:00:00	30.7	22.9	44	36	33.6	28	24.9
23/02/2023	03:15:00	27.3	22.4	39.1	30.8	29.6	26.4	24.4
23/02/2023	03:30:00	27.1	23.2	35	30.1	29	26.5	24.7
23/02/2023	03:45:00	27.7	22.5	39.8	31.5	29.9	26.4	24.6
23/02/2023	04:00:00	28.7	24.6	37.5	31.8	30.7	27.9	26.3
23/02/2023	04:15:00	29	24.2	37.3	31.7	30.8	28.3	26.3
23/02/2023	04:30:00	30.5	25.6	48.2	33.7	32.4	29.4	27.2
23/02/2023	04:45:00	34.5	26	52.4	39.5	37.3	31.6	28.6
23/02/2023	05:00:00	30.2	22.9	43.9	34.6	33	28.5	25
23/02/2023	05:15:00	31.6	22	48.3	38	35.6	25.6	23.6
23/02/2023	05:30:00	25.8	20.8	35.2	28.9	27.9	25.3	22.3

23/02/2023	05:45:00	28.1	21.2	42	33.1	31	25.8	22.6
23/02/2023	06:00:00	30.6	22.2	45.6	35.6	34	28.2	25
23/02/2023	06:15:00	34.5	23.2	51.2	41	37.9	29.8	25
23/02/2023	06:30:00	34.3	24.9	49.7	39.3	38.1	31.6	27.7
23/02/2023	06:45:00	40.2	28.6	61.1	44.2	42.7	38	33.6
23/02/2023	07:00:00	41.7	28.4	59.7	47.7	45.4	37.6	33.1
23/02/2023	07:15:00	45.8	29.8	68.9	50.8	47.5	39.4	33.4
23/02/2023	07:30:00	49.3	32	70.3	51.5	47.7	40.9	36.5
23/02/2023	07:45:00	41.7	33.4	56.9	46	44.2	39.9	36.8
23/02/2023	08:00:00	43.6	33.2	70.3	44.9	43.7	40.1	37.1
23/02/2023	08:15:00	47.5	32.4	73.9	50.8	49.2	41.8	37.6
23/02/2023	08:30:00	44.9	32.7	66.8	50	47.8	39.3	35.6
23/02/2023	08:45:00	42.9	32.4	63.8	49	46	37.5	35
23/02/2023	09:00:00	46.3	31.9	66.6	52.6	47.8	37.7	34.6
23/02/2023	09:15:00	48.7	31.3	66.2	56.5	50.3	39	34.6
23/02/2023	09:30:00	49.2	29.4	66	56	53.1	39.8	33.6
23/02/2023	09:45:00	41.3	30.3	66	44.8	42.4	35.9	32.8
23/02/2023	10:00:00	53.1	27.3	85.6	52.8	49.8	35.7	30.8
23/02/2023	10:15:00	53.8	28.9	68.3	61.5	58.1	41.3	32.6
23/02/2023	10:30:00	45.5	29.7	70.7	50	46.5	37.1	32.6
23/02/2023	10:45:00	52	30.8	74.6	58.5	52.2	37.5	33.3
23/02/2023	11:00:00	53.3	28.5	71.8	61.5	54.1	36.6	31.5
23/02/2023	11:15:00	52.9	29.2	74.4	59.3	58	41.6	33.7
23/02/2023	11:30:00	45.5	26.6	66.8	51.2	46.1	34.5	30
23/02/2023	11:45:00	56.3	29.1	75.5	63.9	59.7	40.3	33.7
23/02/2023	12:00:00	55.7	27.9	69	63.2	61.7	38.6	33.3
23/02/2023	12:15:00	50.8	25.3	73.2	57.2	55.2	34.2	30.4
23/02/2023	12:30:00	53.8	26.9	78.7	61.2	57.2	34.7	30.1
23/02/2023	12:45:00	53.6	25.6	72.4	61.6	55.7	34.3	29.5
23/02/2023	13:00:00	49.9	25.5	65.4	58.4	55	35	29.8
23/02/2023	13:15:00	49.3	25.6	68.9	57.5	54	33.2	29
23/02/2023	13:30:00	49	25.5	70.6	51.5	40.7	32.9	28.4
23/02/2023	13:45:00	38.6	29.5	56.3	43	41.6	36.7	33.6
23/02/2023	14:00:00	46.9	28.5	63.4	53.5	44.5	36.5	32.2
23/02/2023	14:15:00	49.1	27.9	61.2	54.9	53.8	38	32.6
23/02/2023	14:30:00	51.3	32.6	66.4	54	53.6	51.9	38
23/02/2023	14:45:00	48.3	29	66.3	53.4	51.1	37.2	33.1
23/02/2023	15:00:00	56	29	72.7	64	61.3	37.2	33.1
23/02/2023	15:15:00	52.9	31.3	76.7	60	57.5	39.6	34.9
23/02/2023	15:30:00	38.3	30.1	58.6	43.1	40.5	35.8	33.5
23/02/2023	15:45:00	41.6	29	71.3	43.3	40.6	35.6	32.4
23/02/2023	16:00:00	37.2	28.4	56.7	40.9	39.7	35.8	32.9
23/02/2023	16:15:00	36.1	29.6	49.8	39.3	38.2	35.3	32.8
23/02/2023	16:30:00	36.5	29.4	50.2	39.8	38.7	35.7	33
23/02/2023	16:45:00	37.7	31.1	54.8	41	39.8	36.5	33.8
23/02/2023	17:00:00	38.1	31	51	41.5	40.4	37.1	34.8
23/02/2023	17:15:00	41.6	32.2	61.8	45.8	43.4	37.7	35.1
23/02/2023	17:30:00	59.2	31.7	77.8	68.4	55	37.1	34.6
23/02/2023	17:45:00	37	30.4	48	41	40	35.6	32.7
23/02/2023	18:00:00	39.6	30.9	54.8	44.4	42.5	37.4	33.5

23/02/2023	18:15:00	38.5	31.3	52	42	40.9	37.5	34.9
23/02/2023	18:30:00	35.6	29.7	44.7	39	38	34.7	32.6
23/02/2023	18:45:00	36.5	30.4	48.8	40.4	39.2	35.3	32.8
23/02/2023	19:00:00	36.9	30.5	49.3	41.1	39.3	35.2	32.4
23/02/2023	19:15:00	38.9	29.1	62.7	40.2	38.5	34.5	31.7
23/02/2023	19:30:00	34.7	28.6	46.5	38.4	37.2	33.5	31.2
23/02/2023	19:45:00	36.2	29	48.9	39.8	38.6	35.3	32.2
23/02/2023	20:00:00	35.8	28.1	49.7	39.7	38.6	34.3	30.5
23/02/2023	20:15:00	34	28.9	44.9	37.7	36.5	33	30.7
23/02/2023	20:30:00	35.4	27.9	47	39.6	38.4	34.2	30.4
23/02/2023	20:45:00	34.6	28.2	46.1	38.8	37.3	33.3	30.3
23/02/2023	21:00:00	35.3	27	51	40.2	37.9	32.6	29.7
23/02/2023	21:15:00	36.5	26.3	64.8	37.3	35	30.6	27.8
23/02/2023	21:30:00	31.4	26.4	44	35.2	33.6	29.9	28
23/02/2023	21:45:00	32.1	25.9	45.3	37.3	35.7	29.4	27.5
23/02/2023	22:00:00	29.6	25.1	43.6	34	31.7	27.8	26.6
23/02/2023	22:15:00	32.1	26.4	44.7	36.1	34.7	30.5	28.2
23/02/2023	22:30:00	30.4	24.3	44.9	35.1	33.1	28.1	26.1
23/02/2023	22:45:00	30.4	24	41.1	34.6	33.3	28.8	26.1
23/02/2023	23:00:00	28.5	24.4	39.8	31.4	30.2	27.7	26.3
23/02/2023	23:15:00	27.1	23.6	39.8	29.6	28.6	26.6	25
23/02/2023	23:30:00	27.3	22.8	37.5	31.3	29.8	25.8	24.6
23/02/2023	23:45:00	27.2	22.4	40.2	30.9	28.8	26	24.2
24/02/2023	00:00:00	27.1	22.4	43.1	30.8	29	25.6	24.1
24/02/2023	00:15:00	24.1	20.8	33.9	26.6	25.8	23.6	22.4
24/02/2023	00:30:00	26.6	21.9	45	29.7	27.1	24.8	23.5
24/02/2023	00:45:00	24.2	21.4	29	25.9	25.5	23.9	22.7
24/02/2023	01:00:00	25.1	21.2	30.2	27	26.4	24.9	23.6
24/02/2023	01:15:00	26.8	20.8	48.7	31.2	28.4	24	22.9
24/02/2023	01:30:00	25.7	21	44.7	28.8	27	24.6	23.4
24/02/2023	01:45:00	30.2	21.1	47.1	36.7	33.5	25.1	23.1
24/02/2023	02:00:00	27.6	22.6	41.8	32.6	29.9	25.3	23.9
24/02/2023	02:15:00	26	20.7	41.8	30.5	27.8	23.7	22.3
24/02/2023	02:30:00	26.6	21.3	42.4	30.7	28.7	24.8	23.1
24/02/2023	02:45:00	27.8	21.5	49.2	30.3	27.1	24.4	23.1
24/02/2023	03:00:00	26.8	20.7	41.7	31.1	28.2	24.7	23.2
24/02/2023	03:15:00	25.3	21.8	33.7	27.9	27.1	24.8	23.3
24/02/2023	03:30:00	26.3	22.5	39.7	29.1	27.6	25.4	24.1
24/02/2023	03:45:00	27.9	22.9	43.9	31.5	30.1	26.1	24.3
24/02/2023	04:00:00	29	22.3	45.2	34.4	32.1	26.2	24.2
24/02/2023	04:15:00	31	24.4	44.7	36.3	33.6	28.9	26.7
24/02/2023	04:30:00	31.9	24.7	46.4	36.6	34.7	29.4	26.9
24/02/2023	04:45:00	31.4	26.5	40.3	35.5	33.8	30.2	28.3
24/02/2023	05:00:00	33.1	27.7	45.2	36.8	35.6	32	29.7
24/02/2023	05:15:00	34.5	27.6	48.2	40	37.6	31.5	29.4
24/02/2023	05:30:00	35.7	26.9	51.5	41.7	39	31.8	29.7
24/02/2023	05:45:00	32.5	27.5	44.6	35.9	34.7	31.3	29.3
24/02/2023	06:00:00	33.3	27.7	45.5	37.4	35.8	31.7	29.6
24/02/2023	06:15:00	34.5	28.2	49	39.7	37.2	32.1	30.2
24/02/2023	06:30:00	50.6	28.4	73.4	53.3	41.4	34	30.9

24/02/2023	06:45:00	39.9	30.9	53.5	45	42.7	37.6	34.1
24/02/2023	07:00:00	49.9	30.5	76.3	55.4	51.3	39.2	33.7
24/02/2023	07:15:00	49	33.1	65.5	56.2	53.6	41.2	37
24/02/2023	07:30:00	59.7	31.9	79.5	67.1	61.2	42.4	37.3
24/02/2023	07:45:00	48.6	31.8	69	54.1	49.2	40.6	36.2
24/02/2023	08:00:00	46.4	32.9	72.2	47.2	43.6	39.5	37.5
24/02/2023	08:15:00	55.9	33.9	75.3	62.3	55.2	41.4	37.8
24/02/2023	08:30:00	49	34.2	67.2	55.8	51.4	41.5	38.3
24/02/2023	08:45:00	41	33.7	54.6	44.6	42.9	39.7	37.1
24/02/2023	09:00:00	40.7	34	61.2	44	42.3	39	36.6
24/02/2023	09:15:00	46	33.2	65	51.2	48	38.4	35.7
24/02/2023	09:30:00	41.8	31.7	70.7	44.3	42	36.7	34.1
24/02/2023	09:45:00	54	32.9	73.4	62	56.6	39	35.4
24/02/2023	10:00:00	52.6	31.8	72.1	60	49.7	36.9	34.5
24/02/2023	10:15:00	40.8	31.8	57.8	45.9	42.8	38.2	35.2
24/02/2023	10:30:00	46.3	32.9	67.7	47.9	44	38.3	35.5
24/02/2023	10:45:00	42.6	32.2	60.3	46.7	44	39.7	36.5
24/02/2023	11:00:00	52.7	31.8	84.7	47.4	44.9	37.4	34.6
24/02/2023	11:15:00	46.6	31.5	70.7	51.4	48.3	38.2	34.5
24/02/2023	11:30:00	46.3	29.5	67	53.4	46.9	36.4	32.9
24/02/2023	11:45:00	41.1	30.9	64.2	45.5	42.3	37.1	33.8
24/02/2023	12:00:00	46.2	31.9	66.3	53.2	49.2	38.5	35.4
24/02/2023	12:15:00	50.8	33.4	72.2	58.1	54.4	39.6	35.7
24/02/2023	12:30:00	49.2	30.8	72.3	54.2	49.1	38	34.3
24/02/2023	12:45:00	46.7	34.7	74.7	48.3	46.3	40.8	37.9
24/02/2023	13:00:00	42.1	31	63.3	46.1	44.6	38.4	34.3
24/02/2023	13:15:00	43	32.2	67.1	47	43.8	38.9	35.6
24/02/2023	13:30:00	39.8	31.7	59.8	43.4	42	37.9	34.9
24/02/2023	13:45:00	39	31.1	59	43.4	41.3	36.3	33.6
24/02/2023	14:00:00	52.9	31.6	71	58.1	47.8	38.4	35.2
24/02/2023	14:15:00	41.1	30.4	54.5	45.9	44	38.9	34.1
24/02/2023	14:30:00	38.5	30.3	60.9	42	40	36	33.7
24/02/2023	14:45:00	50.7	31	68.3	57.8	55	40.8	34.7
24/02/2023	15:00:00	37.6	29.5	51.1	41.3	40.2	36.6	33.2
24/02/2023	15:15:00	39.2	30.2	58	43.8	41.9	37.1	33.8
24/02/2023	15:30:00	38.4	29.3	61.7	40.8	39.4	36.1	33.3
24/02/2023	15:45:00	40.1	28.3	72.3	41.1	39.9	36.1	32.2
24/02/2023	16:00:00	38.4	31.5	56.2	42	40.8	37.3	34.4
24/02/2023	16:15:00	37.7	31.5	54.1	41.6	40.3	36.2	33.9
24/02/2023	16:30:00	36.9	30.7	50.3	40.1	39.1	36.1	33.1
24/02/2023	16:45:00	40	29.9	59.5	45.2	42.2	36.7	33
24/02/2023	17:00:00	40.8	32.3	63.9	42.6	40.2	36.5	34.6
24/02/2023	17:15:00	37.9	31.7	59.8	40.4	39.3	36.2	33.8
24/02/2023	17:30:00	38.2	32.2	53.2	42.9	40.9	36	34
24/02/2023	17:45:00	40.4	31.4	66.4	40.6	39.4	36.3	33.7
24/02/2023	18:00:00	36.9	31.4	50.8	39.5	38.7	36.3	34
24/02/2023	18:15:00	45.8	31.5	73.8	42.4	40.6	36.9	34.5
24/02/2023	18:30:00	37.9	30.7	54.6	41.3	39.8	36.5	34.1
24/02/2023	18:45:00	35.8	30.8	47	39.2	38.1	34.9	32.8
24/02/2023	19:00:00	39.5	32.7	47.8	43.8	42.6	38.1	35.4

24/02/2023	19:15:00	38.5	28.4	63.8	39.1	36.8	33.5	31.4
24/02/2023	19:30:00	32.6	28	44	35.6	34.7	31.9	29.8
24/02/2023	19:45:00	32.8	28.1	42.6	36.2	35.1	31.8	30
24/02/2023	20:00:00	34.8	28.1	48.7	38.6	37.6	33.5	31.2
24/02/2023	20:15:00	34	26.3	47.4	37.9	36.1	32.7	29.5
24/02/2023	20:30:00	31.6	25.9	42.6	35.1	33.7	30.8	28.4
24/02/2023	20:45:00	38	27.7	56.8	43.8	41.3	35	31.6
24/02/2023	21:00:00	31.9	26.1	40.9	35.2	34.2	31.2	28.4
24/02/2023	21:15:00	31.1	25.3	42.8	34.7	33.6	30.2	27.3
24/02/2023	21:30:00	35.1	24.4	52.8	42.1	35.5	29	27
24/02/2023	21:45:00	28.9	23.3	39.7	31.9	30.9	28.2	25.6
24/02/2023	22:00:00	28	22.6	41	30.9	29.9	27.3	24.8
24/02/2023	22:15:00	28.5	23.2	40.2	32.4	30.9	27.2	25
24/02/2023	22:30:00	27.4	23.1	36.9	30.2	29.3	26.8	25
24/02/2023	22:45:00	25.9	21.9	37.9	29.2	27.9	24.9	23.5
24/02/2023	23:00:00	28.2	22.2	49	31.7	30	25.9	24.1
24/02/2023	23:15:00	25.2	21.4	34	27.6	26.8	24.8	23.4
24/02/2023	23:30:00	26.8	21.2	38.7	31	29.4	25.1	23.2
24/02/2023	23:45:00	26.7	21.2	41	30.9	29.3	25.2	23
25/02/2023	00:00:00	27.3	21.1	39.4	31.2	29.8	26.2	23.2
25/02/2023	00:15:00	27.5	20	36.7	31.6	30.4	26.5	22.1
25/02/2023	00:30:00	24.8	20	38	27.7	26.2	23.5	21.9
25/02/2023	00:45:00	24.5	19.8	37.5	28	26.7	23.4	21.5
25/02/2023	01:00:00	25.6	19	41.4	29.8	28.1	23.4	20.7
25/02/2023	01:15:00	23.2	18.9	32.7	26.4	25.3	22.3	20.8
25/02/2023	01:30:00	25.5	19.8	39.9	28.8	27.5	24	21.9
25/02/2023	01:45:00	24.1	18.4	38.5	28.1	26.3	22.6	19.7
25/02/2023	02:00:00	24	18.2	37.3	28.5	26.5	21.7	19.6
25/02/2023	02:15:00	20.8	18	30	23.5	22.3	20	19
25/02/2023	02:30:00	20.1	17.5	48.5	21.3	20.5	18.9	18.2
25/02/2023	02:45:00	22.7	18	47.3	25	22.9	20.4	19.1
25/02/2023	03:00:00	20.1	17.7	32.8	22.9	21.6	19.3	18.4
25/02/2023	03:15:00	22.3	17.6	39.4	25.6	24	20.5	18.8
25/02/2023	03:30:00	20.6	17.9	44.3	23.1	22	19.5	18.6
25/02/2023	03:45:00	26.4	19	40.4	34	29.5	21.9	20.3
25/02/2023	04:00:00	25.6	18.3	44.5	30.1	27.7	22.8	20.6
25/02/2023	04:15:00	23.6	18	44.3	28.5	26.2	21.1	19.1
25/02/2023	04:30:00	21.5	18.2	36.8	23.8	22.9	20.8	19.3
25/02/2023	04:45:00	24.9	17.9	51.2	26.9	25.4	21.5	19.3
25/02/2023	05:00:00	25.4	17.5	39.8	30.4	27.9	23.3	19.7
25/02/2023	05:15:00	20.5	17.8	32.5	22.2	21.7	20.1	18.7
25/02/2023	05:30:00	21.2	17.8	33.7	24.1	22.9	20.3	18.9
25/02/2023	05:45:00	19.8	17.4	35.2	21.8	20.6	19.1	18.1
25/02/2023	06:00:00	32.1	17.8	47.5	39.7	37.3	21.8	19
25/02/2023	06:15:00	23.7	17.8	38.9	27.9	25.2	20.9	19.2
25/02/2023	06:30:00	37.8	18.5	70.7	35.9	33.4	24.2	20.1
25/02/2023	06:45:00	41.3	20.6	71.2	39.8	38.2	32.2	27
25/02/2023	07:00:00	47.1	20.7	64.5	55.5	48.1	30.4	24.5
25/02/2023	07:15:00	36.2	21.5	54.2	42.6	38.1	31.2	24.7
25/02/2023	07:30:00	52.2	25.6	74.1	56.4	49.6	36.9	30.4

25/02/2023	07:45:00	40.9	24.9	58.9	47.9	44	34.6	29.3
25/02/2023	08:00:00	49.2	24.9	76.3	55	50.1	31.7	27.5
25/02/2023	08:15:00	55.3	25.4	79.2	55.6	49	32.8	28.4
25/02/2023	08:30:00	42.9	25.3	65.3	49	45.9	35.2	29.2
25/02/2023	08:45:00	48.4	26.9	80.2	46.9	43.3	33.9	30
25/02/2023	09:00:00	37.8	26.5	52.9	43.7	41.4	34	29.6
25/02/2023	09:15:00	46.9	27.6	67.9	54	50.9	36.4	30.4
25/02/2023	09:30:00	47.4	37.3	66.2	54	49.9	41.1	38.7
25/02/2023	09:45:00	56.4	37.7	67.8	58.3	58.2	57.5	39.8
25/02/2023	10:00:00	59.8	30.6	77.9	59	58.2	57.5	53
25/02/2023	10:15:00	50.8	27.7	70	56.2	50.9	37.1	31.3
25/02/2023	10:30:00	42	28.3	65.2	46.9	41.6	34	30.6
25/02/2023	10:45:00	41.9	27.1	62.7	48.5	41.8	32.8	29.6
25/02/2023	11:00:00	45.9	28.2	63.9	52.7	49.4	38	32.5
25/02/2023	11:15:00	46.1	27.6	67.6	51.8	45.7	34.5	30.8
25/02/2023	11:30:00	45.1	26.7	65.1	51.3	47	34.6	30.2
25/02/2023	11:45:00	47.8	27.2	70.3	53.9	49	36.6	31.9
25/02/2023	12:00:00	40.1	28.7	68.4	44.5	42	36	32
25/02/2023	12:15:00	37.4	26.3	58.8	42.1	39.8	34.5	30
25/02/2023	12:30:00	41	26.2	69.7	44.1	41.2	34.7	30.7
25/02/2023	12:45:00	36.2	29	58	39.8	38.2	33.7	31.3
25/02/2023	13:00:00	39.9	27.3	64.3	44	41.4	35.5	30.5
25/02/2023	13:15:00	39.8	28.8	58.2	43.9	42.2	37.2	32.8
25/02/2023	13:30:00	41.2	26	63.9	46.7	44.1	35.7	29.8
25/02/2023	13:45:00	41.5	27.8	63.8	45.8	43.7	35.8	30.7
25/02/2023	14:00:00	42	30.2	64.3	46.5	43.7	37.5	33.3
25/02/2023	14:15:00	40.2	28.5	62.5	43.7	41	36.2	31.9
25/02/2023	14:30:00	46.2	29.3	71.1	49.5	46.2	39.4	33.8
25/02/2023	14:45:00	42.7	29.2	66	47.7	44	38	33.8
25/02/2023	15:00:00	40.4	27.3	73.1	42	39	33.3	30.1
25/02/2023	15:15:00	39.7	28.5	64.2	43.6	41.4	36.4	31.9
25/02/2023	15:30:00	38.3	28.8	61.9	42.3	40.4	35.3	31.3
25/02/2023	15:45:00	39.6	28.3	64.1	44.1	42.2	35.8	30.9
25/02/2023	16:00:00	41	26.5	64.8	44	42.1	35	30
25/02/2023	16:15:00	41.3	30.2	67	44.5	40.8	35.9	32.4
25/02/2023	16:30:00	39.8	29.3	61.7	44.5	41.8	35.4	32.2
25/02/2023	16:45:00	38	26.8	66.8	38.8	36.1	31.7	29.4
25/02/2023	17:00:00	38.7	25.3	64.7	39.9	36.3	30.7	28.1
25/02/2023	17:15:00	34.8	26.2	60.9	37.5	35	30.1	28.1
25/02/2023	17:30:00	38.4	25.9	58.8	44.3	41.1	31.6	27.7
25/02/2023	17:45:00	33.2	25.9	51.8	38.1	34.9	30	28
25/02/2023	18:00:00	37.3	26.2	67.5	33.8	32.4	29.9	28.4
25/02/2023	18:15:00	49.9	26.3	77	49.6	44.6	31.2	28.3
25/02/2023	18:30:00	30.8	25	54	32.5	31.3	28.4	26.9
25/02/2023	18:45:00	27.1	23.3	38.4	29.5	28.8	26.5	24.9
25/02/2023	19:00:00	26.8	22.9	45.9	28.9	28.2	26	24.5
25/02/2023	19:15:00	26.2	21.8	38.2	28.7	27.9	25.7	24.1
25/02/2023	19:30:00	26.3	21.7	40.3	29.3	28.2	25.3	23.8
25/02/2023	19:45:00	26	21.5	45	29.3	27.6	24.7	23
25/02/2023	20:00:00	28	20.1	46.6	32.9	30	24.8	22.6

25/02/2023	20:15:00	26.5	21.3	43.3	29.5	28.4	25.6	23.7
25/02/2023	20:30:00	24.4	20.7	35.6	27.2	26.3	23.7	22.2
25/02/2023	20:45:00	25.7	20.7	38.5	29.6	27.8	24.3	22.8
25/02/2023	21:00:00	23.6	20.2	40.3	25.8	24.9	23	21.7
25/02/2023	21:15:00	23.7	20.1	46.2	25.7	24.9	22.9	21.6
25/02/2023	21:30:00	24.9	20.3	43.7	27.3	25.8	23.4	21.8
25/02/2023	21:45:00	25.5	20.7	43.7	29	26.4	23.2	22
25/02/2023	22:00:00	27	20.4	46	31.2	29.3	24.9	22.9
25/02/2023	22:15:00	24.2	19.9	36.6	27.6	26.2	23.3	21.7
25/02/2023	22:30:00	22.3	18.8	34.7	24.5	23.7	21.9	20.5
25/02/2023	22:45:00	21.7	18.3	34.7	24.6	23.3	21	19.6
25/02/2023	23:00:00	21.2	17.5	37	23.6	22.7	20.6	18.9
25/02/2023	23:15:00	27.1	17.9	47.9	33.5	26.9	20.6	19
25/02/2023	23:30:00	23.8	18.5	45.5	26.2	24.9	22.1	20
25/02/2023	23:45:00	29	21.1	47.8	32.9	30.9	27.2	23.1

Appendix 4 – Calibration Certificate

Calibration Certificate

Certificate Number 2021003965

Customer:

Environmental Measurement
Unit 12 Tallaght Business Centre
Whitestown Business Park
Dublin, 24, Ireland

Model Number LxT SE
Serial Number 0006435
Test Results **Pass**

Initial Condition As Manufactured

Description Sound Expert LxT
Class 1 Sound Level Meter
Firmware Revision: 2.404

Procedure Number D0001.8384
Technician Kyle Holm
Calibration Date 7 Apr 2021
Calibration Due

Temperature	23.9	°C	± 0.25 °C
Humidity	51.1	%RH	± 2.0 %RH
Static Pressure	86.26	kPa	± 0.13 kPa

Evaluation Method ***Tested with:*** ***Data reported in dB re 20 μPa.***

Larson Davis PRMLxT1L, S/N 070056
PCB 377B02, S/N 329147
Larson Davis CAL200, S/N 9079
Larson Davis CAL291, S/N 0108

Compliance Standards Compliant to Manufacturer Specifications and the following standards when combined with Calibration Certificate from procedure D0001.8378:

IEC 60651:2001 Type 1
IEC 60804:2000 Type 1
IEC 61252:2002
IEC 61260:2001 Class 1
IEC 61672:2013 Class 1

ANSI S1.4-2014 Class 1
ANSI S1.4 (R2006) Type 1
ANSI S1.11 (R2009) Class 1
ANSI S1.25 (R2007)
ANSI S1.43 (R2007) Type 1

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2017.
Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2015.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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Correction data from Larson Davis LxT Manual for SoundTrack LxT & SoundExpert Lxt, I770.01 Rev J Supporting Firmware Version

2.301, 2015-04-30

For 1/4" microphones, the Larson Davis ADP024 1/4" to 1/2" adaptor is used with the calibrators and the Larson Davis ADP043 1/4" to 1/2" adaptor is used with the preamplifier.

Calibration Check Frequency: 1000 Hz; Reference Sound Pressure Level: 114 dB re 20 µPa

Periodic tests were performed in accordance with precedures from IEC 61672-3:2013 / ANSI/ASA S1.4-2014/Part3.

No Pattern approval for IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1 available.

The sound level meter submitted for testing successfully completed the periodic tests of IEC 61672-3:2013 / ANSI/ASA S1.4-2014/Part 3, for the environmental conditions under which the tests were performed. However, no general statement or conclusion can be made about conformance of the sound level meter to the full specifications of IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1 because (a) evidence was not publicly available, from an independent testing organization responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the class 1 specifications in IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1 or correction data for acoustical test of frequency weighting were not provided in the Instruction Manual and (b) because the periodic tests of IEC 61672-3:2013 / ANSI/ASA S1.4-2014/Part 3 cover only a limited subset of the specifications in IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1.

Standards Used

Description	Cal Date	Cal Due	Cal Standard
Larson Davis CAL291 Residual Intensity Calibrator	2020-09-18	2021-09-18	001250
Hart Scientific 2626-S Humidity/Temperature Sensor	2020-05-12	2021-05-12	006943
Larson Davis CAL200 Acoustic Calibrator	2020-07-21	2021-07-21	007027
Larson Davis Model 831	2021-03-02	2022-03-02	007182
PCB 377A13 1/2 inch Prepolarized Pressure Microphone	2021-03-03	2022-03-03	007185
SRS DS360 Ultra Low Distortion Generator	2020-04-14	2021-04-14	007635
Larson Davis 1/2" Preamplifier for Model 831 Type 1	2020-10-06	2021-10-06	PCB0004783

Acoustic Calibration

Measured according to IEC 61672-3:2013 10 and ANSI S1.4-2014 Part 3: 10

Measurement	Test Result [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
1000 Hz	114.00	113.80	114.20	0.14	Pass

Loaded Circuit Sensitivity

Measurement	Test Result [dB re 1 V / Pa]	Lower Limit [dB re 1 V / Pa]	Upper Limit [dB re 1 V / Pa]	Expanded Uncertainty [dB]	Result
1000 Hz	-27.92	-29.61	-26.24	0.14	Pass

-- End of measurement results--

Acoustic Signal Tests, C-weighting

Measured according to IEC 61672-3:2013 12 and ANSI S1.4-2014 Part 3: 12 using a comparison coupler with Unit Under Test (UUT) and reference SLM using slow time-weighted sound level for compliance to IEC 61672-1:2013 5.5; ANSI S1.4-2014 Part 1: 5.5

Frequency [Hz]	Test Result [dB]	Expected [dB]	Lowe Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
125	-0.20	-0.20	-1.20	0.80	0.23	Pass
1000	0.13	0.00	-0.70	0.70	0.23	Pass
8000	-3.22	-3.00	-5.50	-1.50	0.32	Pass

-- End of measurement results--

Self-generated Noise

Measured according to IEC 61672-3:2013 11.1 and ANSI S1.4-2014 Part 3: 11.1

Measurement	Test Result [dB]
A-weighted	40.29

-- End of measurement results--

-- End of Report--

Signatory: Kyle Holm

Calibration Certificate

Certificate Number 2021003955

Customer:

Environmental Measurement
Unit 12 Tallaght Business Centre
Whitestown Business Park
Dublin, 24, Ireland

Model Number LxT SE

Serial Number 0006435

Test Results **Pass**

Initial Condition As Manufactured

Description Sound Expert LxT
Class 1 Sound Level Meter
Firmware Revision: 2.404

Procedure Number D0001.8378

Technician Kyle Holm

Calibration Date 7 Apr 2021

Calibration Due

Temperature 23.61 °C ± 0.25 °C

Humidity 50.9 %RH ± 2.0 %RH

Static Pressure 86.35 kPa ± 0.13 kPa

Evaluation Method Tested electrically using Larson Davis PRMLxT1L S/N 070056 and a 12.0 pF capacitor to simulate microphone capacitance. Data reported in dB re 20 µPa assuming a microphone sensitivity of 23.6 mV/Pa.

Compliance Standards Compliant to Manufacturer Specifications and the following standards when combined with Calibration Certificate from procedure D0001.8384:

IEC 60651:2001 Type 1	ANSI S1.4-2014 Class 1
IEC 60804:2000 Type 1	ANSI S1.4 (R2006) Type 1
IEC 61252:2002	ANSI S1.25 (R2007)
IEC 61672:2013 Class 1	ANSI S1.43 (R2007) Type 1
IEC 61260:2001 Class 1	ANSI S1.11 (R2009) Class 1

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2017. **Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.**

The quality system is registered to ISO 9001:2015.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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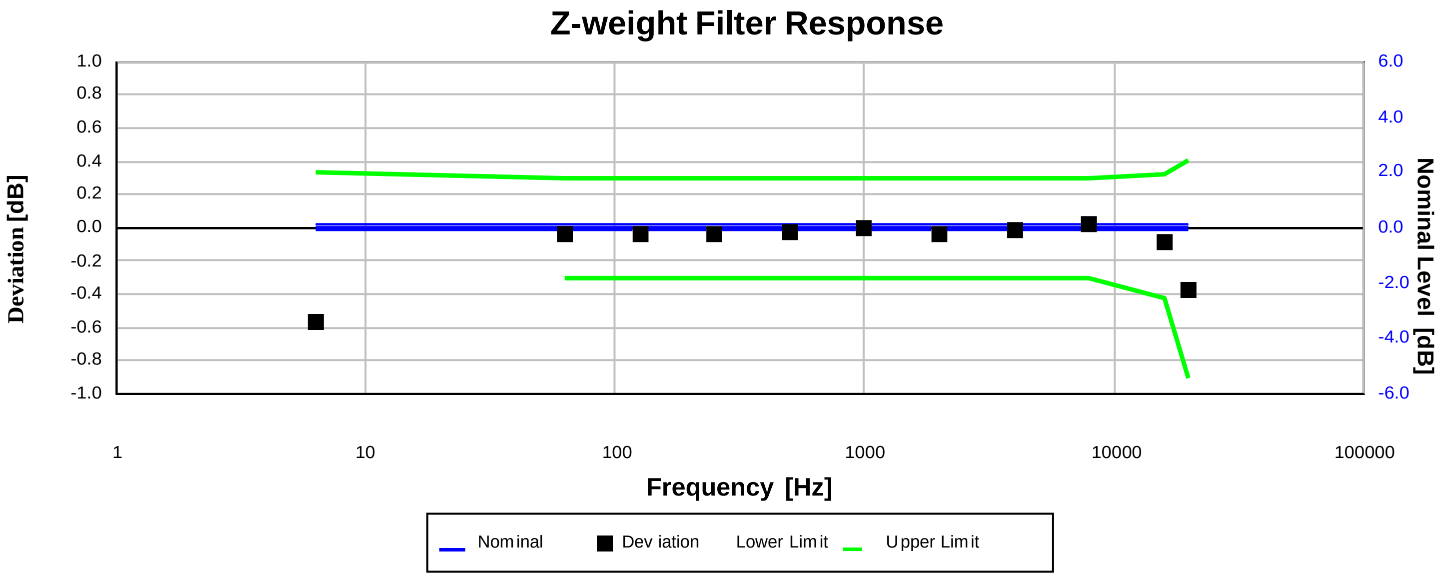
Correction data from Larson Davis LxT Manual for SoundTrack LxT & SoundExpert Lxt, I770.01 Rev O Supporting Firmware Version 4.0.5, 2019-09-10

Calibration Check Frequency: 1000 Hz; Reference Sound Pressure Level: 114 dB re 20 µPa

Standards Used

Description	Cal Date	Cal Due	Cal Standard
Hart Scientific 2626-S Humidity/Temperature Sensor	2020-05-12	2021-05-12	006943
SRS DS360 Ultra Low Distortion Generator	2020-04-14	2021-04-14	007635

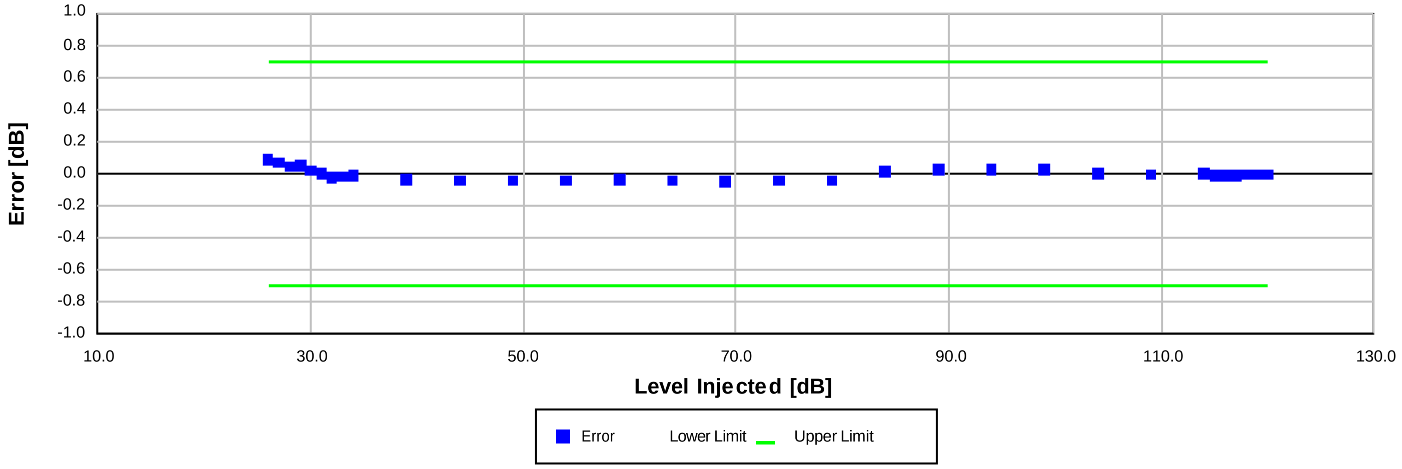


Electrical signal test of frequency weighting performed according to IEC 61672-3:2013 13 and ANSI S1.4-2014 Part 3: 13 for compliance to IEC 61672-1:2013 5.5; IEC 60651:2001 6.1 and 9.2.2; IEC 60804:2000 5; ANSI S1.4:1983 (R2006) 5.1 and 8.2.1; ANSI S1.4-2014 Part 1: 5.5

Frequency [Hz]	Test Result [dB]	Deviation [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
6.31	-0.57	-0.57	-1.11	0.33	0.15	Pass
63.10	-0.04	-0.04	-0.30	0.30	0.15	Pass
125.89	-0.04	-0.04	-0.30	0.30	0.15	Pass
251.19	-0.04	-0.04	-0.30	0.30	0.15	Pass
501.19	-0.02	-0.02	-0.30	0.30	0.15	Pass
1,000.00	0.00	0.00	-0.30	0.30	0.15	Pass
1,995.26	-0.03	-0.03	-0.30	0.30	0.15	Pass
3,981.07	-0.02	-0.02	-0.30	0.30	0.15	Pass
7,943.28	0.02	0.02	-0.30	0.30	0.15	Pass
15,848.93	-0.09	-0.09	-0.42	0.32	0.15	Pass
19,952.62	-0.37	-0.37	-0.91	0.41	0.15	Pass

-- End of measurement results--

A-weighted Broadband Log Linearity: 8,000.00 Hz



Broadband level linearity performed according to IEC 61672-3:2013 16 and ANSI S1.4-2014 Part 3: 16 for compliance to IEC 61672-1:2013 5.6, IEC 60804:2000 6.2, IEC 61252:2002 8, ANSI S1.4 (R2006) 6.9, ANSI S1.4-2014 Part 1: 5.6, ANSI S1.43 (R2007) 6.2

Level [dB]	Error [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
26.00	0.09	-0.70	0.70	0.16	Pass
27.00	0.07	-0.70	0.70	0.16	Pass
28.00	0.04	-0.70	0.70	0.17	Pass
29.00	0.05	-0.70	0.70	0.16	Pass
30.00	0.02	-0.70	0.70	0.35	Pass
31.00	0.00	-0.70	0.70	0.16	Pass
32.00	-0.02	-0.70	0.70	0.16	Pass
33.00	-0.02	-0.70	0.70	0.16	Pass
34.00	-0.02	-0.70	0.70	0.16	Pass
39.00	-0.04	-0.70	0.70	0.16	Pass
44.00	-0.04	-0.70	0.70	0.16	Pass
49.00	-0.04	-0.70	0.70	0.16	Pass
54.00	-0.04	-0.70	0.70	0.16	Pass
59.00	-0.04	-0.70	0.70	0.16	Pass
64.00	-0.05	-0.70	0.70	0.16	Pass
69.00	-0.05	-0.70	0.70	0.16	Pass
74.00	-0.04	-0.70	0.70	0.16	Pass
79.00	-0.04	-0.70	0.70	0.16	Pass
84.00	0.01	-0.70	0.70	0.16	Pass
89.00	0.02	-0.70	0.70	0.16	Pass
94.00	0.03	-0.70	0.70	0.16	Pass
99.00	0.02	-0.70	0.70	0.16	Pass
104.00	0.00	-0.70	0.70	0.15	Pass
109.00	-0.01	-0.70	0.70	0.15	Pass
114.00	0.00	-0.70	0.70	0.15	Pass
115.00	-0.02	-0.70	0.70	0.15	Pass
116.00	-0.01	-0.70	0.70	0.15	Pass
117.00	-0.01	-0.70	0.70	0.15	Pass
118.00	-0.01	-0.70	0.70	0.15	Pass
119.00	-0.01	-0.70	0.70	0.15	Pass
120.00	-0.01	-0.70	0.70	0.15	Pass

-- End of measurement results--

Peak Rise Time

Peak rise time performed according to IEC 60651:2001 9.4.4 and ANSI S1.4:1983 (R2006) 8.4.4

Amplitude [dB]	Duration [µs]		Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
116.15	40	Negative Pulse	117.54	116.10	118.10	0.15	Pass
		Positive Pulse	117.45	116.01	118.01	0.15	Pass
	30	Negative Pulse	116.57	116.10	118.10	0.15	Pass
		Positive Pulse	116.48	116.01	118.01	0.15	Pass

-- End of measurement results--

Positive Pulse Crest Factor

200 µs pulse tests at 2.0, 12.0, 22.0, 32.0 dB below Overload Limit

Crest Factor measured according to IEC 60651:2001 9.4.2 and ANSI S1.4:1983 (R2006) 8.4.2

Amplitude [dB]	Crest Factor	Test Result [dB]	Limits [dB]	Expanded Uncertainty [dB]	Result
114.15	3	OVLD	± 0.50	0.15 ‡	Pass
	5	OVLD	± 1.00	0.15 ‡	Pass
	10	OVLD	± 1.50	0.15 ‡	Pass
104.15	3	-0.14	± 0.50	0.15 ‡	Pass
	5	-0.18	± 1.00	0.16 ‡	Pass
	10	OVLD	± 1.50	0.15 ‡	Pass
94.15	3	-0.12	± 0.50	0.15 ‡	Pass
	5	-0.14	± 1.00	0.15 ‡	Pass
	10	-0.17	± 1.50	0.15 ‡	Pass
84.15	3	-0.13	± 0.50	0.15 ‡	Pass
	5	-0.13	± 1.00	0.15 ‡	Pass
	10	-0.26	± 1.50	0.15 ‡	Pass

-- End of measurement results--

Negative Pulse Crest Factor

200 µs pulse tests at 2.0, 12.0, 22.0, 32.0 dB below Overload Limit

Crest Factor measured according to IEC 60651:2001 9.4.2 and ANSI S1.4:1983 (R2006) 8.4.2

Amplitude [dB]	Crest Factor	Test Result [dB]	Limits [dB]	Expanded Uncertainty [dB]	Result
114.15	3	OVLD	± 0.50	0.15 ‡	Pass
	5	OVLD	± 1.00	0.15 ‡	Pass
	10	OVLD	± 1.50	0.15 ‡	Pass
104.15	3	-0.09	± 0.50	0.15 ‡	Pass
	5	-0.06	± 1.00	0.15 ‡	Pass
	10	OVLD	± 1.50	0.15 ‡	Pass
94.15	3	-0.09	± 0.50	0.15 ‡	Pass
	5	-0.09	± 1.00	0.15 ‡	Pass
	10	-0.03	± 1.50	0.15 ‡	Pass
84.15	3	-0.10	± 0.50	0.15 ‡	Pass
	5	-0.11	± 1.00	0.15 ‡	Pass
	10	-0.23	± 1.50	0.15 ‡	Pass

-- End of measurement results--

Gain

Gain measured according to IEC 61672-3:2013 17.3 and 17.4 and ANSI S1.4-2014 Part 3: 17.3 and 17.4

Measurement	Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
0 dB Gain	84.01	83.89	84.09	0.15	Pass
0 dB Gain, Linearity	21.15	20.29	21.69	0.16	Pass
OBA Low Range	83.99	83.89	84.09	0.15	Pass
OBA Normal Range	83.99	83.20	84.80	0.15	Pass

-- End of measurement results--

Broadband Noise Floor

Self-generated noise measured according to IEC 61672-3:2013 11.2 and ANSI S1.4-2014 Part 3: 11.2

Measurement	Test Result [dB]	Upper limit [dB]	Result
A-weight Noise Floor	7.21	16.00	Pass
C-weight Noise Floor	11.80	18.00	Pass
Z-weight Noise Floor	20.19	25.00	Pass

-- End of measurement results--

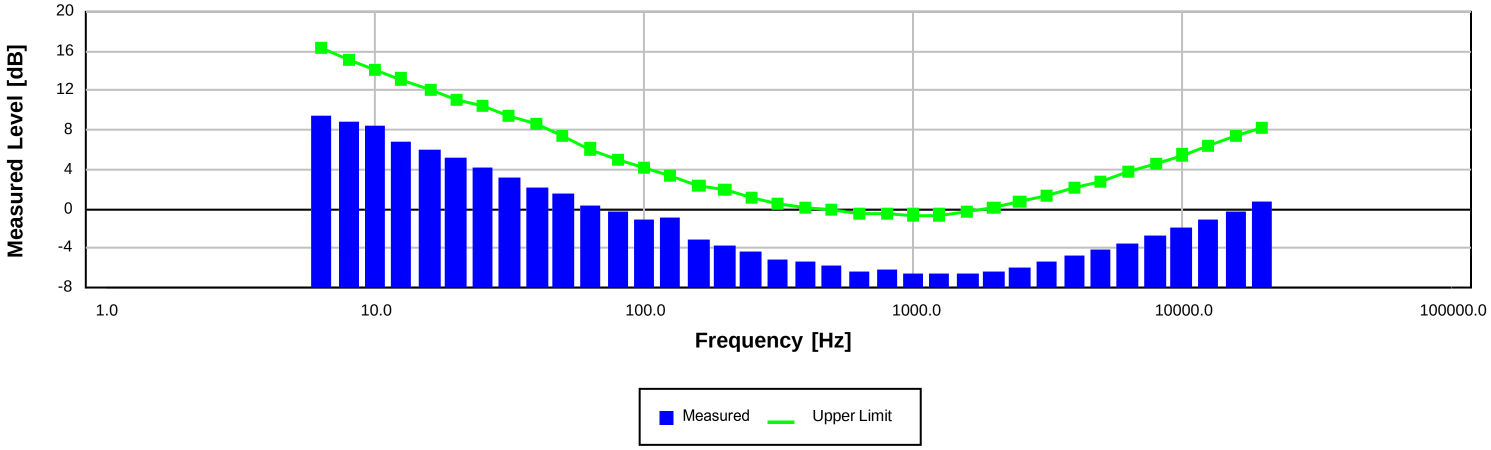
Total Harmonic Distortion

Measured using 1/3-Octave filters

Measurement	Test Result [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
10 Hz Signal	113.43	112.35	113.95	0.15	Pass
THD	-55.56		-50.00	0.00 ‡	Pass
THD+N	-54.15		-50.00	0.00 ‡	Pass

-- End of measurement results--

1/3-Octave Self-Generated Noise



The SLM is set to low range.

Frequency [Hz]	Test Result [dB]	Upper limit [dB]	Result
6.30	9.45	16.30	Pass
8.00	8.88	15.20	Pass
10.00	8.49	14.20	Pass
12.50	6.91	13.20	Pass
16.00	5.98	12.10	Pass
20.00	5.16	11.10	Pass
25.00	4.23	10.40	Pass
31.50	3.24	9.40	Pass
40.00	2.24	8.60	Pass
50.00	1.58	7.40	Pass
63.00	0.34	6.10	Pass
80.00	-0.28	5.00	Pass
100.00	-1.11	4.20	Pass
125.00	-0.97	3.30	Pass
160.00	-3.04	2.40	Pass
200.00	-3.72	1.90	Pass
250.00	-4.27	1.20	Pass
315.00	-5.06	0.60	Pass
400.00	-5.34	0.20	Pass
500.00	-5.84	-0.10	Pass
630.00	-6.29	-0.50	Pass
800.00	-6.18	-0.50	Pass
1,000.00	-6.56	-0.60	Pass
1,250.00	-6.59	-0.60	Pass
1,600.00	-6.53	-0.20	Pass
2,000.00	-6.28	0.20	Pass
2,500.00	-5.88	0.70	Pass
3,150.00	-5.41	1.40	Pass
4,000.00	-4.83	2.10	Pass
5,000.00	-4.18	2.80	Pass
6,300.00	-3.53	3.70	Pass
8,000.00	-2.71	4.60	Pass
10,000.00	-1.89	5.50	Pass
12,500.00	-1.08	6.40	Pass
16,000.00	-0.19	7.40	Pass
20,000.00	0.70	8.30	Pass

-- End of measurement results--

-- End of Report--

Signatory: Kyle Holm

Calibration Certificate

Certificate Number 2021003853

Customer:

Environmental Measurement
Unit 12 Tallaght Business Centre
Whitestown Business Park
Dublin, 24, Ireland

Model Number PRMLxT1L
Serial Number 070056
Test Results **Pass**
Initial Condition As Manufactured

Description Larson Davis 1/2" Preamplifier for LxT Class 1 -1 dB

Procedure Number D0001.8383
Technician Ashley Anderson
Calibration Date 6 Apr 2021
Calibration Due

Temperature	23.48	°C	± 0.01 °C
Humidity	52.4	%RH	± 0.5 %RH
Static Pressure	85.86	kPa	± 0.03 kPa

Evaluation Method Tested electrically using a 12.0 pF capacitor to simulate microphone capacitance.
Data reported in dB re 20 µPa assuming a microphone sensitivity of 50.0 mV/Pa.

Compliance Standards Compliant to Manufacturer Specifications

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the SI through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2017. **Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.**

The quality system is registered to ISO 9001:2015.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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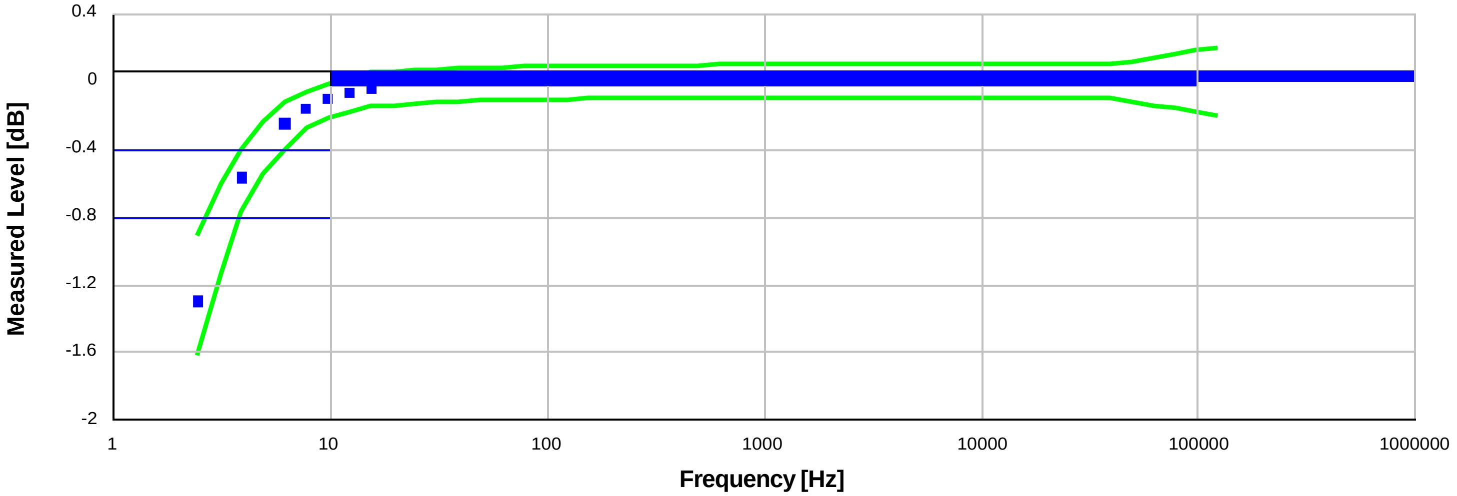
Standards Used

Description	**Cal Date**	**Cal Due**	**Cal Standard**
Larson Davis Model 2900 Real Time Analyzer	03/05/2021	03/05/2022	003003
Hart Scientific 2626-S Humidity/Temperature Sensor	05/12/2020	05/12/2021	006943
Agilent 34401A DMM	07/07/2020	07/07/2021	007165
SRS DS360 Ultra Low Distortion Generator	08/19/2020	08/19/2021	007167

ACCREDITED
Cert. #3622.01

Frequency Response



Frequency response electrically tested at 120.0 dB re 1 µV

Frequency [Hz]	Test Result [dB re 1 kHz]	Lower limit [dB]	Upp r limit [dB]	Expanded Uncertainty [dB]	Result
2.50	-1.30	-1.62	-0.91	0.12	Pass
3.20	-0.85	-1.14	-0.60	0.12	Pass
4.00	-0.57	-0.77	-0.40	0.12	Pass
5.00	-0.38	-0.54	-0.24	0.12	Pass
6.30	-0.25	-0.40	-0.12	0.12	Pass
7.90	-0.16	-0.28	-0.06	0.12	Pass
10.00	-0.10	-0.22	-0.01	0.12	Pass
12.60	-0.07	-0.18	0.02	0.12	Pass
15.80	-0.04	-0.15	0.05	0.12	Pass
20.00	-0.02	-0.14	0.06	0.12	Pass
25.10	-0.01	-0.13	0.07	0.12	Pass
31.60	-0.01	-0.12	0.07	0.12	Pass
39.80	0.00	-0.12	0.08	0.12	Pass
50.10	0.00	-0.11	0.08	0.12	Pass
63.10	0.00	-0.11	0.08	0.12	Pass
79.40	0.00	-0.11	0.09	0.12	Pass
100.00	0.00	-0.11	0.09	0.12	Pass
125.90	0.01	-0.11	0.09	0.12	Pass
158.50	0.02	-0.10	0.09	0.12	Pass
199.50	0.01	-0.10	0.09	0.12	Pass
251.20	0.01	-0.10	0.09	0.12	Pass
316.20	0.01	-0.10	0.09	0.12	Pass
398.10	0.02	-0.10	0.09	0.12	Pass
501.20	0.02	-0.10	0.09	0.12	Pass
631.00	0.02	-0.10	0.10	0.12	Pass
794.30	0.02	-0.10	0.10	0.12	Pass
1,000.00	0.02	-0.10	0.10	0.12	Pass
1,258.90	0.01	-0.10	0.10	0.12	Pass
1,584.90	0.01	-0.10	0.10	0.12	Pass
1,995.30	0.01	-0.10	0.10	0.12	Pass
2,511.90	0.01	-0.10	0.10	0.12	Pass
3,162.30	0.01	-0.10	0.10	0.12	Pass

Frequency [Hz]	Test Result [dB re 1 kHz]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
3,981.10	0.01	-0.10	0.10	0.12	Pass
5,011.90	0.02	-0.10	0.10	0.12	Pass
6,309.60	0.02	-0.10	0.10	0.12	Pass
7,943.30	0.01	-0.10	0.10	0.12	Pass
10,000.00	0.01	-0.10	0.10	0.12	Pass
12,589.30	0.01	-0.10	0.10	0.12	Pass
15,848.90	0.01	-0.10	0.10	0.12	Pass
19,952.60	0.01	-0.10	0.10	0.12	Pass
25,118.90	0.01	-0.10	0.10	0.12	Pass
31,622.80	0.01	-0.10	0.10	0.12	Pass
39,810.70	0.02	-0.10	0.10	0.12	Pass
50,118.70	0.01	-0.12	0.12	0.12	Pass
63,095.70	0.01	-0.14	0.14	0.12	Pass
79,432.80	0.02	-0.16	0.16	0.12	Pass
100,000.00	0.02	-0.18	0.18	0.12	Pass
125,892.50	0.04	-0.20	0.20	0.24	Pass

Gain Measurement

Measurement	Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
Output Gain @ 1 kHz	-1.52	-2.60	-1.00	0.12	Pass

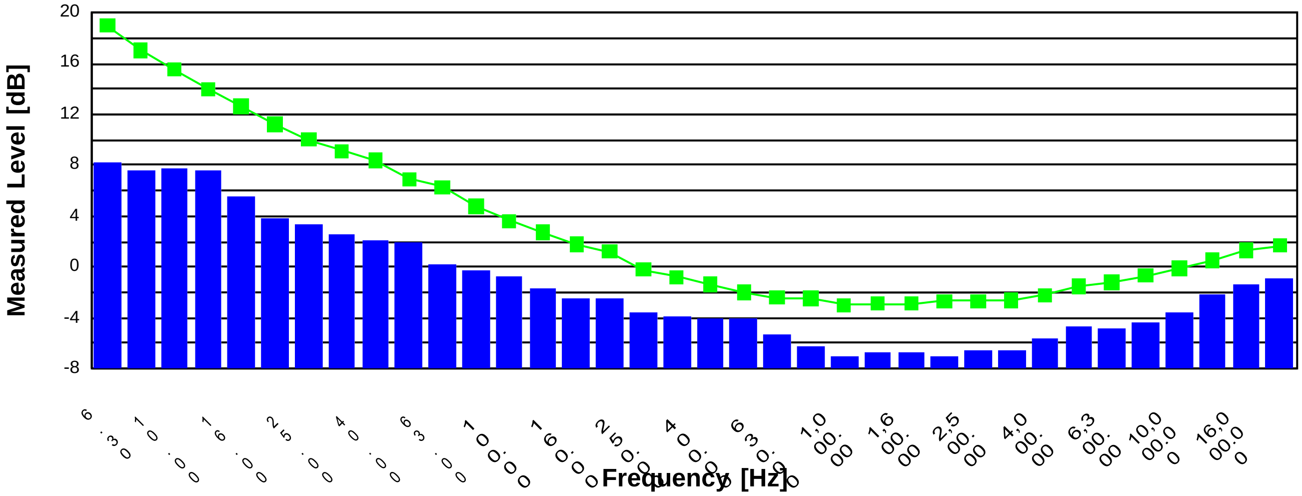
-- End of measurement results--

DC Bias Measurement

Measurement	Test Result [V]	Lower limit [V]	Upper limit [V]	Expanded Uncertainty [V]	Result
DC Voltage	3.78	2.90	3.80	0.01	Pass

-- End of measurement results--

1/3-Octave Self-Generated Noise



	Test Result [dB re 1 µV]	Upper limit [dB re 1 µV]	Result
6.30	8.20	19.00	Pass
8.00	7.60	17.00	Pass
10.00	7.70	15.50	Pass
12.50	7.60	14.00	Pass
16.00	5.60	12.60	Pass
20.00	3.90	11.20	Pass
25.00	3.30	10.00	Pass
31.50	2.50	9.10	Pass
40.00	2.10	8.40	Pass
50.00	1.90	6.90	Pass
63.00	0.20	6.30	Pass
80.00	-0.20	4.80	Pass
100.00	-0.70	3.60	Pass
125.00	-1.70	2.70	Pass
160.00	-2.40	1.80	Pass
200.00	-2.50	1.20	Pass
250.00	-3.50	-0.20	Pass
315.00	-3.90	-0.80	Pass
400.00	-4.10	-1.40	Pass
500.00	-4.00	-2.00	Pass
630.00	-5.30	-2.40	Pass
800.00	-6.30	-2.50	Pass
1,000.00	-7.10	-3.00	Pass
1,250.00	-6.70	-2.90	Pass
1,600.00	-6.70	-2.90	Pass
2,000.00	-7.00	-2.70	Pass
2,500.00	-6.60	-2.70	Pass
3,150.00	-6.60	-2.60	Pass
4,000.00	-5.60	-2.20	Pass
5,000.00	-4.60	-1.50	Pass
6,300.00	-4.90	-1.20	Pass
8,000.00	-4.40	-0.70	Pass
10,000.00	-3.60	-0.10	Pass
12,500.00	-2.20	0.50	Pass
16,000.00	-1.30	1.30	Pass
20,000.00	-0.90	1.70	Pass

-- End of measurement results--

Self-generated Noise

Bandwidth	Test Result [µV]	Test Result [dB re 1 µV]	Upper limit [dB re 1 µV]	Result
A-weighted (1 Hz - 20 kHz)	2.14	6.60	8.00	Pass
Broadband (1 Hz - 20 kHz)	4.37	12.80	14.00	Pass

-- End of measurement results--

Signatory: Ashley Anderson

~ *Certificate of Calibration and Compliance* ~

Microphone Model: 377B02 Serial Number: 329147 Manufacturer: PCB

Calibration Environmental Conditions

Environmental test conditions as printed on microphone calibration chart.

Reference Equipment

Manufacturer	Model #	Serial #	PCB Control #	Cal Date	Due Date
National Instruments	PCIe-6351	1896F08	CA1918	10/19/20	10/19/21
Larson Davis	PRM915	146	CA2115	4/1/20	4/1/21
Larson Davis	PRM902	4394	CA1244	6/30/20	6/30/21
Larson Davis	PRM916	128	CA1553	10/14/20	10/14/21
Larson Davis	CAL250	5026	CA1278	1/26/21	1/26/22
Larson Davis	2201	151	CA2073	11/24/20	11/24/21
Bruel & Kjaer	4192	3259547	CA3214	1/21/21	1/21/22
Larson Davis	GPRM902	5283	CA2152	3/31/20	3/31/21
Newport	iTHX-SD/N	1080002	CA1511	2/4/21	2/4/22
Larson Davis	PRA951-4	234	CA1154	11/11/20	11/11/21
Larson Davis	PRM915	136	CA1434	10/14/20	10/14/21
0	0	0	0	not required	not required
0	0	0	0	not required	not required
0	0	0	0	not required	not required
0	0	0	0	not required	not required

Frequency sweep performed with B&K UA0033 electrostatic actuator.

Condition of Unit

As Found: n/a

As Left: New Unit, In Tolerance

Notes

1. Calibration of reference equipment is traceable to one or more of the following National Labs; NIST, PTB or DFM.
2. This certificate shall not be reproduced, except in full, without written approval from PCB Piezotronics, Inc.
3. Calibration is performed in compliance with ISO 10012-1, ANSI/NCSL Z540.3 and ISO 17025.
4. See Manufacturer's Specification Sheet for a detailed listing of performance specifications.
5. Open Circuit Sensitivity is measured using the insertion voltage method following procedure AT603-5.
6. Measurement uncertainty (95% confidence level with coverage factor of 2) for sensitivity is +/-0.20 dB.
7. Unit calibrated per ACS-20.

Technician: Leonard Lukasik

Date: March 6, 2021

ilac-MRA A2LA ACCREDITED

CALIBRATION CERT #1862.01

PCB PIEZOTRONICS
VIBRATION DIVISION

3425 Walden Avenue, Depew, New York, 14043

TEL: 888-684-0013 FAX: 716-685-3886 www.pcb.com

ID:CAL112-3697872355.079+0

~ Calibration Report ~

Microphone Model: 377B02 Serial Number: 329147 Description: 1/2" Free-Field Microphone

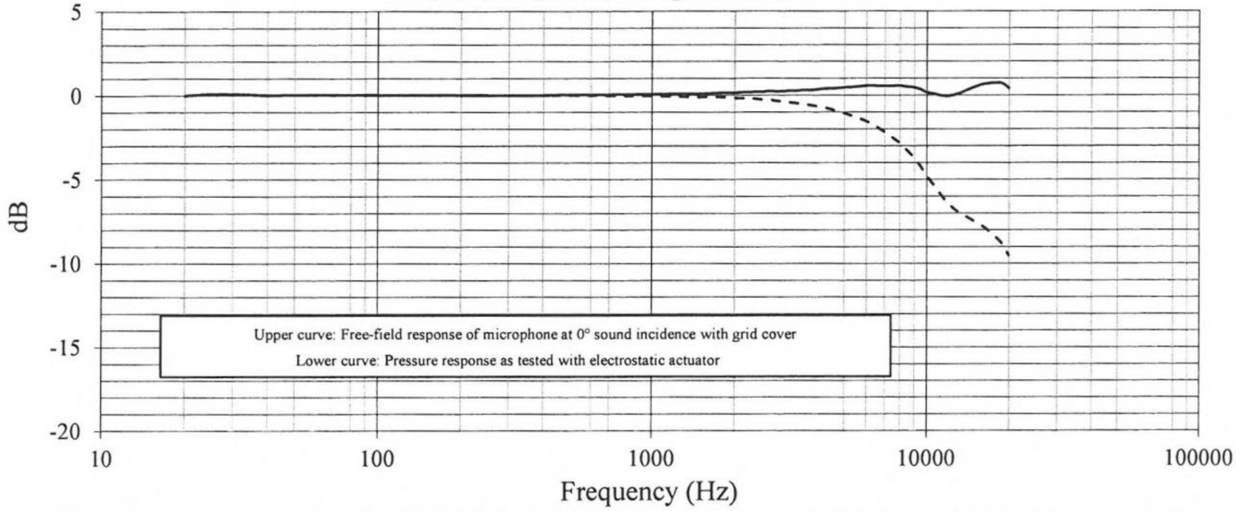
Calibration Data

Open Circuit Sensitivity @ 251.2 Hz: 47.37 mV/Pa
-26.49 dB re 1V/Pa

Polarization Voltage, External: 0 V
Capacitance: 12.4 pF

Temperature: 67 °F (20°C) Ambient Pressure: 993 mbar Relative Humidity: 23 %

Frequency Response (0 dB @ 251.2 Hz)



Freq (Hz)	Lower (dB)	Upper (dB)	Freq (Hz)	Lower (dB)	Upper (dB)	Freq (Hz)	Lower (dB)	Upper (dB)	Freq (Hz)	Lower (dB)	Upper (dB)
20.0	-0.01	-0.01	1679	-0.11	0.13	7499	-2.53	0.54	-	-	-
25.1	0.09	0.09	1778	-0.11	0.14	7943	-2.82	0.57	-	-	-
31.6	0.07	0.07	1884	-0.13	0.15	8414	-3.23	0.50	-	-	-
39.8	0.01	0.01	1995	-0.17	0.14	8913	-3.65	0.46	-	-	-
50.1	0.04	0.04	2114	-0.17	0.17	9441	-4.17	0.35	-	-	-
63.1	0.04	0.04	2239	-0.19	0.18	10000	-4.80	0.16	-	-	-
79.4	0.03	0.03	2371	-0.21	0.20	10593	-5.32	0.08	-	-	-
100.0	0.02	0.02	2512	-0.26	0.20	11220	-5.88	-0.02	-	-	-
125.9	0.02	0.02	2661	-0.27	0.25	11885	-6.37	-0.05	-	-	-
158.5	0.01	0.01	2818	-0.34	0.22	12589	-6.75	0.02	-	-	-
199.5	0.00	0.00	2985	-0.38	0.24	13335	-7.04	0.15	-	-	-
251.2	0.00	0.00	3162	-0.43	0.25	14125	-7.26	0.33	-	-	-
316.2	-0.01	0.00	3350	-0.47	0.27	14962	-7.49	0.48	-	-	-
398.1	0.00	0.00	3548	-0.52	0.31	15849	-7.73	0.62	-	-	-
501.2	-0.01	0.04	3758	-0.60	0.30	16788	-8.03	0.69	-	-	-
631.0	-0.02	0.03	3981	-0.66	0.34	17783	-8.39	0.72	-	-	-
794.3	-0.04	0.05	4217	-0.73	0.38	18837	-8.82	0.70	-	-	-
1000.0	-0.05	0.07	4467	-0.84	0.39	19953	-9.52	0.41	-	-	-
1059.3	-0.06	0.08	4732	-0.95	0.42	-	-	-	-	-	-
1122.0	-0.07	0.07	5012	-1.08	0.45	-	-	-	-	-	-
1188.5	-0.06	0.09	5309	-1.22	0.48	-	-	-	-	-	-
1258.9	-0.08	0.08	5623	-1.37	0.51	-	-	-	-	-	-
1333.5	-0.09	0.09	5957	-1.52	0.55	-	-	-	-	-	-
1412.5	-0.11	0.08	6310	-1.73	0.56	-	-	-	-	-	-
1496.2	-0.11	0.09	6683	-1.98	0.54	-	-	-	-	-	-
1584.9	-0.11	0.10	7080	-2.24	0.54	-	-	-	-	-	-

Technician: Leonard Lukasik Date: March 6, 2021

CALIBRATION CERT #1862.01

PCB PIEZOTRONICS
VIBRATION DIVISION

Calibration Certificate

Certificate Number 2021003950

Customer:

Environmental Measurement
Unit 12 Tallaght Business Centre
Whitestown Business Park
Dublin, 24, Ireland

Model Number LxT SE
Serial Number 0006433
Test Results **Pass**

Initial Condition As Manufactured

Description Sound Expert LxT
Class 1 Sound Level Meter
Firmware Revision: 2.404

Procedure Number D0001.8384
Technician Kyle Holm
Calibration Date 7 Apr 2021

Calibration Due
Temperature 23.5 °C ± 0.25 °C

Humidity 51.8 %RH ± 2.0 %RH
Static Pressure 86.39 kPa ± 0.13 kPa

Evaluation Method

Tested with:
Larson Davis PRMLxT1L, S/N 070022
PCB 377B02, S/N 328839
Larson Davis CAL200, S/N 9079
Larson Davis CAL291, S/N 0108

Data reported in dB re 20 µPa.

Compliance Standards

Compliant to Manufacturer Specifications and the following standards when combined with Calibration Certificate from procedure D0001.8378:

IEC 60651:2001 Type 1
IEC 60804:2000 Type 1
IEC 61252:2002
IEC 61260:2001 Class 1
IEC 61672:2013 Class 1

ANSI S1.4-2014 Class 1
ANSI S1.4 (R2006) Type 1
ANSI S1.11 (R2009) Class 1
ANSI S1.25 (R2007)
ANSI S1.43 (R2007) Type 1

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2017.

Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2015.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

This report may not be reproduced, except in full, unless permission for the publication of an approved abstract is obtained in writing from the organization issuing this report.

Correction data from Larson Davis LxT Manual for SoundTrack LxT & SoundExpert Lxt, I770.01 Rev J Supporting Firmware Version

2.301, 2015-04-30

For 1/4" microphones, the Larson Davis ADP024 1/4" to 1/2" adaptor is used with the calibrators and the Larson Davis ADP043 1/4" to 1/2" adaptor is used with the preamplifier.

Calibration Check Frequency: 1000 Hz; Reference Sound Pressure Level: 114 dB re 20 µPa

Periodic tests were performed in accordance with precedures from IEC 61672-3:2013 / ANSI/ASA S1.4-2014/Part3.

No Pattern approval for IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1 available.

The sound level meter submitted for testing successfully completed the periodic tests of IEC 61672-3:2013 / ANSI/ASA S1.4-2014/Part 3, for the environmental conditions under which the tests were performed. However, no general statement or conclusion can be made about conformance of the sound level meter to the full specifications of IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1 because (a) evidence was not publicly available, from an independent testing organization responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the class 1 specifications in IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1 or correction data for acoustical test of frequency weighting were not provided in the Instruction Manual and (b) because the periodic tests of IEC 61672-3:2013 / ANSI/ASA S1.4-2014/Part 3 cover only a limited subset of the specifications in IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1.

Standards Used

Description	**Cal Date**	**Cal Due**	**Cal Standard**
Larson Davis CAL291 Residual Intensity Calibrator	2020-09-18	2021-09-18	001250
Hart Scientific 2626-S Humidity/Temperature Sensor	2020-05-12	2021-05-12	006943
Larson Davis CAL200 Acoustic Calibrator	2020-07-21	2021-07-21	007027
Larson Davis Model 831	2021-03-02	2022-03-02	007182
PCB 377A13 1/2 inch Prepolarized Pressure Microphone	2021-03-03	2022-03-03	007185
SRS DS360 Ultra Low Distortion Generator	2020-04-14	2021-04-14	007635
Larson Davis 1/2" Preamplifier for Model 831 Type 1	2020-10-06	2021-10-06	PCB0004783

Acoustic Calibration

Measured according to IEC 61672-3:2013 10 and ANSI S1.4-2014 Part 3: 10

Measurement	**Test Result [dB]**	**Lower Limit [dB]**	**Upper Limit [dB]**	**Expanded Uncertainty [dB]**	**Result**
1000 Hz	114.00	113.80	114.20	0.14	Pass

Loaded Circuit Sensitivity

Measurement	**Test Result [dB re 1 V / Pa]**	**Lower Limit [dB re 1 V / Pa]**	**Upper Limit [dB re 1 V / Pa]**	**Expanded Uncertainty [dB]**	**Result**
1000 Hz	-28.26	-29.61	-26.24	0.14	Pass

-- End of measurement results--

Acoustic Signal Tests, C-weighting

Measured according to IEC 61672-3:2013 12 and ANSI S1.4-2014 Part 3: 12 using a comparison coupler with Unit Under Test (UUT) and reference SLM using slow time-weighted sound level for compliance to IEC 61672-1:2013 5.5; ANSI S1.4-2014 Part 1: 5.5

Frequency [Hz]	Test Result [dB]	Expected [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
125	-0.20	-0.20	-1.20	0.80	0.23	Pass
1000	0.12	0.00	-0.70	0.70	0.23	Pass
8000	-2.56	-3.00	-5.50	-1.50	0.32	Pass

-- End of measurement results--

Self-generated Noise

Measured according to IEC 61672-3:2013 11.1 and ANSI S1.4-2014 Part 3: 11.1

Measurement	Test Result [dB]
A-weighted	40.43

-- End of measurement results--

-- End of Report--

Signatory: Kyle Holm

Calibration Certificate

Certificate Number 2021003944

Customer:

Environmental Measurement
Unit 12 Tallaght Business Centre
Whitestown Business Park
Dublin, 24, Ireland

Model Number	LxT SE	***Procedure Number***	D0001.8378		
Serial Number	0006433	***Technician***	Kyle Holm		
Test Results	**Pass**	***Calibration Date***	7 Apr 2021		
		Calibration Due			
Initial Condition	As Manufactured	***Temperature***	23.41	°C	± 0.25 °C
Description	Sound Expert LxT Class 1 Sound Level Meter Firmware Revision: 2.404	***Humidity***	50.8	%RH	± 2.0 %RH
		Static Pressure	86.45	kPa	± 0.13 kPa

Evaluation Method Tested electrically using Larson Davis PRMLxT1L S/N 070022 and a 12.0 pF capacitor to simulate microphone capacitance. Data reported in dB re 20 µPa assuming a microphone sensitivity of 23.6 mV/Pa.

Compliance Standards Compliant to Manufacturer Specifications and the following standards when combined with Calibration Certificate from procedure D0001.8384:

IEC 60651:2001 Type 1	ANSI S1.4-2014 Class 1
IEC 60804:2000 Type 1	ANSI S1.4 (R2006) Type 1
IEC 61252:2002	ANSI S1.25 (R2007)
IEC 61672:2013 Class 1	ANSI S1.43 (R2007) Type 1
IEC 61260:2001 Class 1	ANSI S1.11 (R2009) Class 1

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2017. **Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.**

The quality system is registered to ISO 9001:2015.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

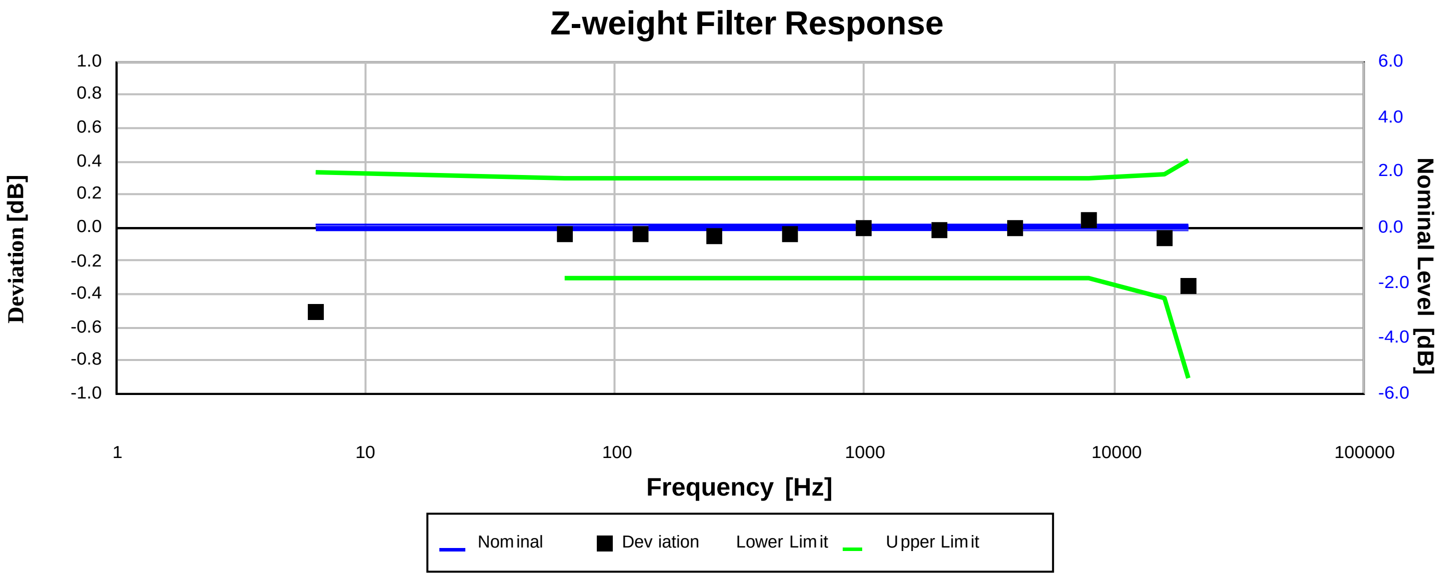
This report may not be reproduced, except in full, unless permission for the publication of an approved abstract is obtained in writing from the organization issuing this report.

Correction data from Larson Davis LxT Manual for SoundTrack LxT & SoundExpert Lxt, I770.01 Rev O Supporting Firmware Version 4.0.5, 2019-09-10

Calibration Check Frequency: 1000 Hz; Reference Sound Pressure Level: 114 dB re 20 µPa

Standards Used

Description	Cal Date	Cal Due	Cal Standard
SRS DS360 Ultra Low Distortion Generator	2021-03-09	2022-03-09	006311
Hart Scientific 2626-S Humidity/Temperature Sensor	2020-05-12	2021-05-12	006943

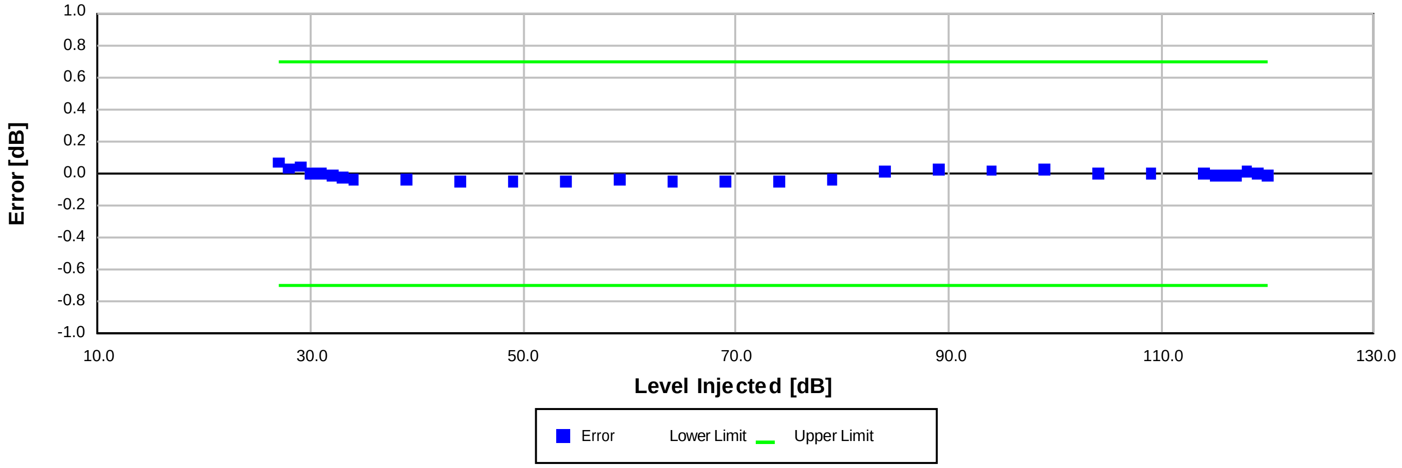


Electrical signal test of frequency weighting performed according to IEC 61672-3:2013 13 and ANSI S1.4-2014 Part 3: 13 for compliance to IEC 61672-1:2013 5.5; IEC 60651:2001 6.1 and 9.2.2; IEC 60804:2000 5; ANSI S1.4:1983 (R2006) 5.1 and 8.2.1; ANSI S1.4-2014 Part 1: 5.5

Frequency [Hz]	Test Result [dB]	Deviation [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
6.31	-0.51	-0.51	-1.11	0.33	0.15	Pass
63.10	-0.04	-0.04	-0.30	0.30	0.15	Pass
125.89	-0.04	-0.04	-0.30	0.30	0.15	Pass
251.19	-0.05	-0.05	-0.30	0.30	0.15	Pass
501.19	-0.03	-0.03	-0.30	0.30	0.15	Pass
1,000.00	0.00	0.00	-0.30	0.30	0.15	Pass
1,995.26	-0.01	-0.01	-0.30	0.30	0.15	Pass
3,981.07	0.00	0.00	-0.30	0.30	0.15	Pass
7,943.28	0.04	0.04	-0.30	0.30	0.15	Pass
15,848.93	-0.07	-0.07	-0.42	0.32	0.15	Pass
19,952.62	-0.35	-0.35	-0.91	0.41	0.15	Pass

-- End of measurement results--

A-weighted Broadband Log Linearity: 8,000.00 Hz



Broadband level linearity performed according to IEC 61672-3:2013 16 and ANSI S1.4-2014 Part 3: 16 for compliance to IEC 61672-1:2013 5.6, IEC 60804:2000 6.2, IEC 61252:2002 8, ANSI S1.4 (R2006) 6.9, ANSI S1.4-2014 Part 1: 5.6, ANSI S1.43 (R2007) 6.2

Level [dB]	Error [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
27.00	0.07	-0.70	0.70	0.16	Pass
28.00	0.03	-0.70	0.70	0.17	Pass
29.00	0.04	-0.70	0.70	0.16	Pass
30.00	0.00	-0.70	0.70	0.35	Pass
31.00	-0.01	-0.70	0.70	0.16	Pass
32.00	-0.02	-0.70	0.70	0.16	Pass
33.00	-0.03	-0.70	0.70	0.16	Pass
34.00	-0.04	-0.70	0.70	0.16	Pass
39.00	-0.04	-0.70	0.70	0.16	Pass
44.00	-0.05	-0.70	0.70	0.16	Pass
49.00	-0.05	-0.70	0.70	0.16	Pass
54.00	-0.05	-0.70	0.70	0.16	Pass
59.00	-0.04	-0.70	0.70	0.16	Pass
64.00	-0.05	-0.70	0.70	0.16	Pass
69.00	-0.05	-0.70	0.70	0.16	Pass
74.00	-0.05	-0.70	0.70	0.16	Pass
79.00	-0.04	-0.70	0.70	0.16	Pass
84.00	0.01	-0.70	0.70	0.16	Pass
89.00	0.02	-0.70	0.70	0.16	Pass
94.00	0.02	-0.70	0.70	0.16	Pass
99.00	0.02	-0.70	0.70	0.16	Pass
104.00	-0.01	-0.70	0.70	0.15	Pass
109.00	0.00	-0.70	0.70	0.15	Pass
114.00	-0.01	-0.70	0.70	0.15	Pass
115.00	-0.01	-0.70	0.70	0.15	Pass
116.00	-0.01	-0.70	0.70	0.15	Pass
117.00	-0.02	-0.70	0.70	0.15	Pass
118.00	0.01	-0.70	0.70	0.15	Pass
119.00	0.00	-0.70	0.70	0.15	Pass
120.00	-0.01	-0.70	0.70	0.15	Pass

-- End of measurement results--

Peak Rise Time

Peak rise time performed according to IEC 60651:2001 9.4.4 and ANSI S1.4:1983 (R2006) 8.4.4

Amplitude [dB]	Duration [μs]		Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
116.15	40	Negative Pulse	117.53	116.06	118.06	0.15	Pass
		Positive Pulse	117.47	116.01	118.01	0.15	Pass
	30	Negative Pulse	116.59	116.06	118.06	0.15	Pass
		Positive Pulse	116.52	116.01	118.01	0.15	Pass

-- End of measurement results--

Positive Pulse Crest Factor

200 μs pulse tests at 2.0, 12.0, 22.0, 32.0 dB below Overload Limit

Crest Factor measured according to IEC 60651:2001 9.4.2 and ANSI S1.4:1983 (R2006) 8.4.2

Amplitude [dB]	Crest Factor	Test Result [dB]	Limits [dB]	Expanded Uncertainty [dB]	Result
114.15	3	OVLD	± 0.50	0.15 ‡	Pass
	5	OVLD	± 1.00	0.15 ‡	Pass
	10	OVLD	± 1.50	0.15 ‡	Pass
104.15	3	-0.15	± 0.50	0.15 ‡	Pass
	5	-0.13	± 1.00	0.16 ‡	Pass
	10	OVLD	± 1.50	0.15 ‡	Pass
94.15	3	-0.13	± 0.50	0.15 ‡	Pass
	5	-0.13	± 1.00	0.15 ‡	Pass
	10	-0.18	± 1.50	0.15 ‡	Pass
84.15	3	-0.13	± 0.50	0.15 ‡	Pass
	5	-0.12	± 1.00	0.15 ‡	Pass
	10	-0.08	± 1.50	0.15 ‡	Pass

-- End of measurement results--

Negative Pulse Crest Factor

200 μs pulse tests at 2.0, 12.0, 22.0, 32.0 dB below Overload Limit

Crest Factor measured according to IEC 60651:2001 9.4.2 and ANSI S1.4:1983 (R2006) 8.4.2

Amplitude [dB]	Crest Factor	Test Result [dB]	Limits [dB]	Expanded Uncertainty [dB]	Result
114.15	3	OVLD	± 0.50	0.15 ‡	Pass
	5	OVLD	± 1.00	0.15 ‡	Pass
	10	OVLD	± 1.50	0.15 ‡	Pass
104.15	3	-0.11	± 0.50	0.15 ‡	Pass
	5	-0.09	± 1.00	0.15 ‡	Pass
	10	OVLD	± 1.50	0.15 ‡	Pass
94.15	3	-0.12	± 0.50	0.15 ‡	Pass
	5	-0.10	± 1.00	0.15 ‡	Pass
	10	-0.15	± 1.50	0.15 ‡	Pass
84.15	3	-0.09	± 0.50	0.15 ‡	Pass
	5	-0.12	± 1.00	0.15 ‡	Pass
	10	-0.06	± 1.50	0.15 ‡	Pass

-- End of measurement results--

Gain

Gain measured according to IEC 61672-3:2013 17.3 and 17.4 and ANSI S1.4-2014 Part 3: 17.3 and 17.4

Measurement	Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
0 dB Gain	84.02	83.90	84.10	0.15	Pass
0 dB Gain, Linearity	21.20	20.30	21.70	0.16	Pass
OBA Low Range	84.00	83.90	84.10	0.15	Pass
OBA Normal Range	84.00	83.20	84.80	0.15	Pass

-- End of measurement results--

Broadband Noise Floor

Self-generated noise measured according to IEC 61672-3:2013 11.2 and ANSI S1.4-2014 Part 3: 11.2

Measurement	Test Result [dB]	Upper limit [dB]	Result
A-weight Noise Floor	7.47	16.00	Pass
C-weight Noise Floor	12.16	18.00	Pass
Z-weight Noise Floor	20.00	25.00	Pass

-- End of measurement results--

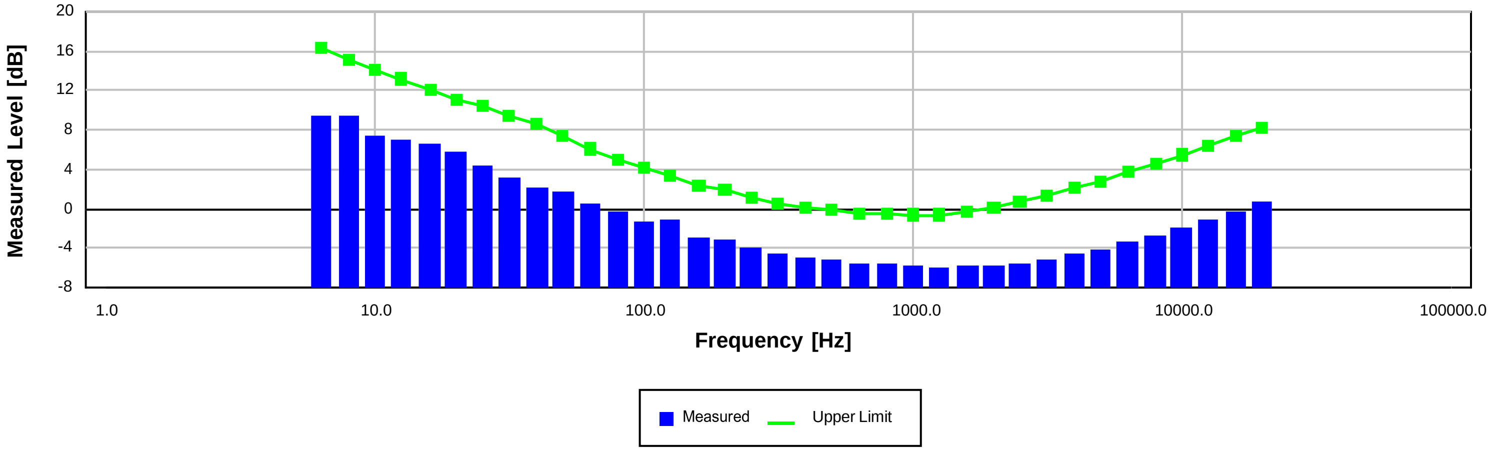
Total Harmonic Distortion

Measured using 1/3-Octave filters

Measurement	Test Result [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
10 Hz Signal	113.43	112.35	113.95	0.15	Pass
THD	-55.87		-50.00	0.01 ‡	Pass
THD+N	-54.47		-50.00	0.01 ‡	Pass

-- End of measurement results--

1/3-Octave Self-Generated Noise



The SLM is set to low range.

Frequency [Hz]	Test Result [dB]	Upper limit [dB]	Result
6.30	9.51	16.30	Pass
8.00	9.46	15.20	Pass
10.00	7.48	14.20	Pass
12.50	7.08	13.20	Pass
16.00	6.59	12.10	Pass
20.00	5.77	11.10	Pass
25.00	4.40	10.40	Pass
31.50	3.15	9.40	Pass
40.00	2.23	8.60	Pass
50.00	1.68	7.40	Pass
63.00	0.60	6.10	Pass
80.00	-0.22	5.00	Pass
100.00	-1.20	4.20	Pass
125.00	-1.01	3.30	Pass
160.00	-2.82	2.40	Pass
200.00	-3.07	1.90	Pass
250.00	-3.99	1.20	Pass
315.00	-4.56	0.60	Pass
400.00	-4.86	0.20	Pass
500.00	-5.21	-0.10	Pass
630.00	-5.51	-0.50	Pass
800.00	-5.65	-0.50	Pass
1,000.00	-5.84	-0.60	Pass
1,250.00	-5.88	-0.60	Pass
1,600.00	-5.84	-0.20	Pass
2,000.00	-5.76	0.20	Pass
2,500.00	-5.49	0.70	Pass
3,150.00	-5.09	1.40	Pass
4,000.00	-4.62	2.10	Pass
5,000.00	-4.08	2.80	Pass
6,300.00	-3.37	3.70	Pass
8,000.00	-2.68	4.60	Pass
10,000.00	-1.86	5.50	Pass
12,500.00	-1.04	6.40	Pass
16,000.00	-0.18	7.40	Pass
20,000.00	0.71	8.30	Pass

-- End of measurement results--

-- End of Report--

Signatory: Kyle Holm

Calibration Certificate

Certificate Number 2021003846

Customer:

Environmental Measurement
Unit 12 Tallaght Business Centre
Whitestown Business Park
Dublin, 24, Ireland

Model Number	PRMLxT1L	***Procedure Number***	D0001.8383
Serial Number	070022	***Technician***	Ashley Anderson
Test Results	**Pass**	***Calibration Date***	6 Apr 2021
Initial Condition	As Manufactured	***Calibration Due***	

Description	Larson Davis 1/2" Preamplifier for LxT Class 1 -1 dB	***Temperature***	23.4	°C	± 0.01 °C
		Humidity	51.1	%RH	± 0.5 %RH
		Static Pressure	85.75	kPa	± 0.03 kPa

Evaluation Method Tested electrically using a 12.0 pF capacitor to simulate microphone capacitance. Data reported in dB re 20 µPa assuming a microphone sensitivity of 50.0 mV/Pa.

Compliance Standards Compliant to Manufacturer Specifications

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the SI through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2017. **Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.**

The quality system is registered to ISO 9001:2015.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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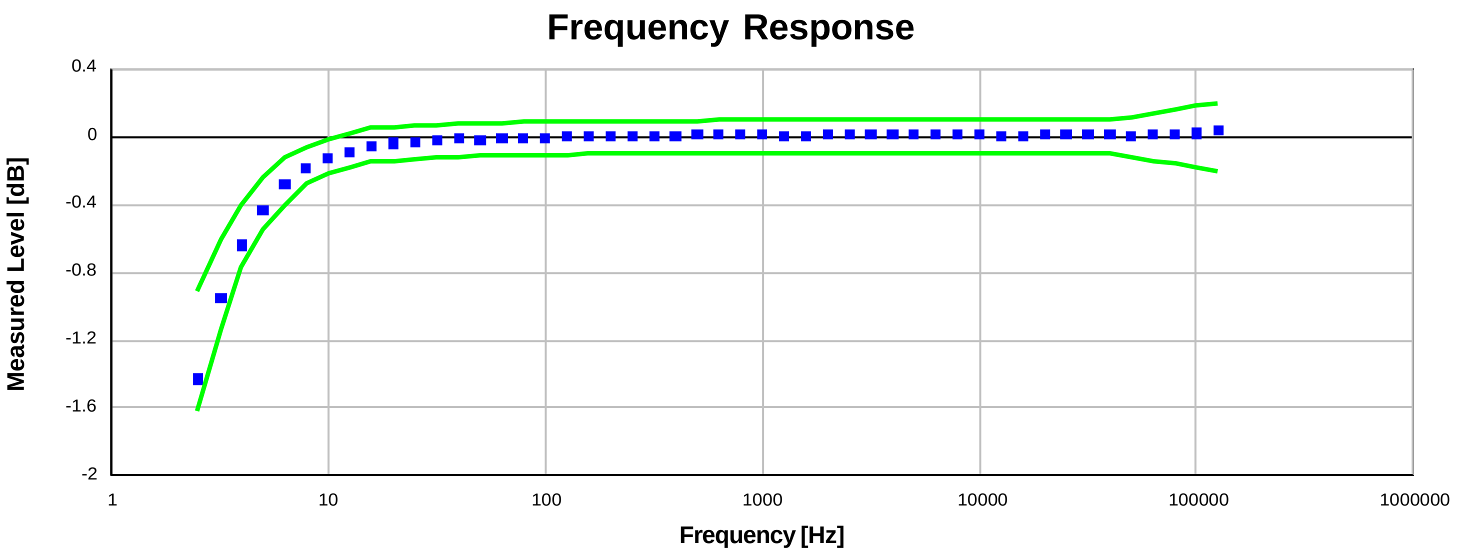
Standards Used

Description	**Cal Date**	**Cal Due**	**Cal Standard**
Larson Davis Model 2900 Real Time Analyzer	03/05/2021	03/05/2022	003003
Hart Scientific 2626-S Humidity/Temperature Sensor	05/12/2020	05/12/2021	006943
Agilent 34401A DMM	07/07/2020	07/07/2021	007165
SRS DS360 Ultra Low Distortion Generator	08/19/2020	08/19/2021	007167



Frequency response electrically tested at 120.0 dB re 1 µV

Frequency [Hz]	**Test Result [dB re 1 kHz]**	**Lower limit [dB]**	**Upper limit [dB]**	**Expanded Uncertainty [dB]**	**Result**
2.50	-1.43	-1.62	-0.91	0.12	Pass
3.20	-0.95	-1.14	-0.60	0.12	Pass
4.00	-0.64	-0.77	-0.40	0.12	Pass
5.00	-0.43	-0.54	-0.24	0.12	Pass
6.30	-0.28	-0.40	-0.12	0.12	Pass
7.90	-0.19	-0.28	-0.06	0.12	Pass
10.00	-0.13	-0.22	-0.01	0.12	Pass
12.60	-0.09	-0.18	0.02	0.12	Pass
15.80	-0.06	-0.15	0.05	0.12	Pass
20.00	-0.04	-0.14	0.06	0.12	Pass
25.10	-0.03	-0.13	0.07	0.12	Pass
31.60	-0.02	-0.12	0.07	0.12	Pass
39.80	-0.01	-0.12	0.08	0.12	Pass
50.10	-0.02	-0.11	0.08	0.12	Pass
63.10	-0.01	-0.11	0.08	0.12	Pass
79.40	-0.01	-0.11	0.09	0.12	Pass
100.00	-0.01	-0.11	0.09	0.12	Pass
125.90	0.00	-0.11	0.09	0.12	Pass
158.50	0.00	-0.10	0.09	0.12	Pass
199.50	0.00	-0.10	0.09	0.12	Pass
251.20	0.00	-0.10	0.09	0.12	Pass
316.20	0.00	-0.10	0.09	0.12	Pass
398.10	0.00	-0.10	0.09	0.12	Pass
501.20	0.01	-0.10	0.09	0.12	Pass
631.00	0.01	-0.10	0.10	0.12	Pass
794.30	0.01	-0.10	0.10	0.12	Pass
1,000.00	0.01	-0.10	0.10	0.12	Pass
1,258.90	0.00	-0.10	0.10	0.12	Pass
1,584.90	0.00	-0.10	0.10	0.12	Pass
1,995.30	0.01	-0.10	0.10	0.12	Pass
2,511.90	0.01	-0.10	0.10	0.12	Pass
3,162.30	0.01	-0.10	0.10	0.12	Pass

Frequency [Hz]	Test Result [dB re 1 kHz]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
3,981.10	0.01	-0.10	0.10	0.12	Pass
5,011.90	0.01	-0.10	0.10	0.12	Pass
6,309.60	0.01	-0.10	0.10	0.12	Pass
7,943.30	0.01	-0.10	0.10	0.12	Pass
10,000.00	0.01	-0.10	0.10	0.12	Pass
12,589.30	0.00	-0.10	0.10	0.12	Pass
15,848.90	0.00	-0.10	0.10	0.12	Pass
19,952.60	0.01	-0.10	0.10	0.12	Pass
25,118.90	0.01	-0.10	0.10	0.12	Pass
31,622.80	0.01	-0.10	0.10	0.12	Pass
39,810.70	0.01	-0.10	0.10	0.12	Pass
50,118.70	0.00	-0.12	0.12	0.12	Pass
63,095.70	0.01	-0.14	0.14	0.12	Pass
79,432.80	0.01	-0.16	0.16	0.12	Pass
100,000.00	0.02	-0.18	0.18	0.12	Pass
125,892.50	0.04	-0.20	0.20	0.24	Pass

Gain Measurement

Measurement	Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
Output Gain @ 1 kHz	-1.48	-2.60	-1.00	0.12	Pass

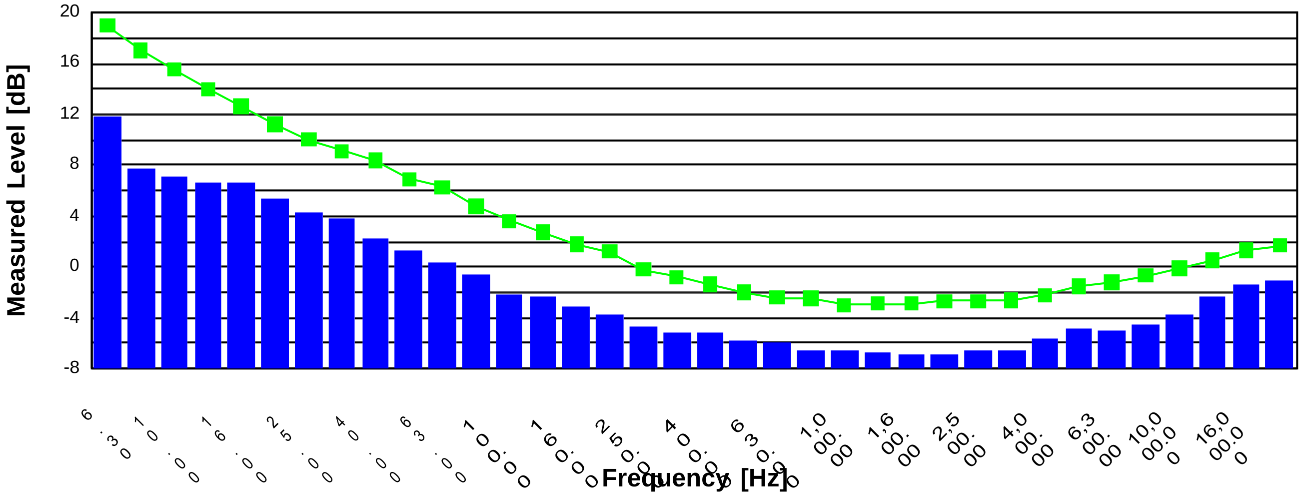
-- End of measurement results--

DC Bias Measurement

Measurement	Test Result [V]	Lower limit [V]	Upper limit [V]	Expanded Uncertainty [V]	Result
DC Voltage	3.70	2.90	3.80	0.01	Pass

-- End of measurement results--

1/3-Octave Self-Generated Noise



	Test Result [dB re 1 µV]	Upper limit [dB re 1 µV]	Result
6.30	11.80	19.00	Pass
8.00	7.80	17.00	Pass
10.00	7.20	15.50	Pass
12.50	6.60	14.00	Pass
16.00	6.70	12.60	Pass
20.00	5.40	11.20	Pass
25.00	4.30	10.00	Pass
31.50	3.90	9.10	Pass
40.00	2.20	8.40	Pass
50.00	1.30	6.90	Pass
63.00	0.40	6.30	Pass
80.00	-0.60	4.80	Pass
100.00	-2.10	3.60	Pass
125.00	-2.30	2.70	Pass
160.00	-3.10	1.80	Pass
200.00	-3.70	1.20	Pass
250.00	-4.60	-0.20	Pass
315.00	-5.20	-0.80	Pass
400.00	-5.20	-1.40	Pass
500.00	-5.80	-2.00	Pass
630.00	-6.00	-2.40	Pass
800.00	-6.60	-2.50	Pass
1,000.00	-6.60	-3.00	Pass
1,250.00	-6.70	-2.90	Pass
1,600.00	-6.90	-2.90	Pass
2,000.00	-6.80	-2.70	Pass
2,500.00	-6.50	-2.70	Pass
3,150.00	-6.50	-2.60	Pass
4,000.00	-5.60	-2.20	Pass
5,000.00	-4.90	-1.50	Pass
6,300.00	-5.00	-1.20	Pass
8,000.00	-4.50	-0.70	Pass
10,000.00	-3.70	-0.10	Pass
12,500.00	-2.30	0.50	Pass
16,000.00	-1.40	1.30	Pass
20,000.00	-1.10	1.70	Pass

-- End of measurement results--

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Self-generated Noise

Bandwidth	Test Result [μV]	Test Result [dB re 1 μV]	Upper limit [dB re 1 μV]	Result
A-weighted (1 Hz - 20 kHz)	2.09	6.40	8.00	Pass
Broadband (1 Hz - 20 kHz)	4.37	12.80	14.00	Pass

-- End of measurement results--

Signatory: Ashley Anderson

~ *Certificate of Calibration and Compliance* ~

Microphone Model: 377B02　Serial Number: 328839　Manufacturer: PCB

Calibration Environmental Conditions

Environmental test conditions as printed on microphone calibration chart.

Reference Equipment

Manufacturer	Model #	Serial #	PCB Control #	Cal Date	Due Date
National Instruments	PCIe-6351	1896F08	CA1918	10/19/20	10/19/21
Larson Davis	PRM915	146	CA2115	4/1/20	4/1/21
Larson Davis	PRM902	4394	CA1244	6/30/20	6/30/21
Larson Davis	PRM916	128	CA1553	10/14/20	10/14/21
Larson Davis	CAL250	5026	CA1278	1/26/21	1/26/22
Larson Davis	2201	151	CA2073	11/24/20	11/24/21
Bruel & Kjaer	4192	3259547	CA3214	1/21/21	1/21/22
Larson Davis	GPRM902	5283	CA2152	3/31/20	3/31/21
Newport	iTHX-SD/N	1080002	CA1511	2/4/21	2/4/22
Larson Davis	PRA951-4	234	CA1154	11/11/20	11/11/21
Larson Davis	PRM915	136	CA1434	10/14/20	10/14/21
0	0	0	0	not required	not required
0	0	0	0	not required	not required
0	0	0	0	not required	not required
0	0	0	0	not required	not required

Frequency sweep performed with B&K UA0033 electrostatic actuator.

Condition of Unit

As Found: n/a

As Left: New Unit, In Tolerance

Notes

1. Calibration of reference equipment is traceable to one or more of the following National Labs; NIST, PTB or DFM.
2. This certificate shall not be reproduced, except in full, without written approval from PCB Piezotronics, Inc.
3. Calibration is performed in compliance with ISO 10012-1, ANSI/NCSL Z540.3 and ISO 17025.
4. See Manufacturer's Specification Sheet for a detailed listing of performance specifications.
5. Open Circuit Sensitivity is measured using the insertion voltage method following procedure AT603-5.
6. Measurement uncertainty (95% confidence level with coverage factor of 2) for sensitivity is +/-0.20 dB.
7. Unit calibrated per ACS-20.

Technician: Leonard Lukasik　Date: March 6, 2021

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CALIBRATION CERT #1862.01

PCB PIEZOTRONICS
VIBRATION DIVISION

3425 Walden Avenue, Depew, New York, 14043

TEL: 888-684-0013　FAX: 716-685-3886　www.pcb.com

ID:CAL112-3697871235.285+0

~ *Calibration Report* ~

Microphone Model: 377B02   Serial Number: 328839   Description: 1/2" Free-Field Microphone

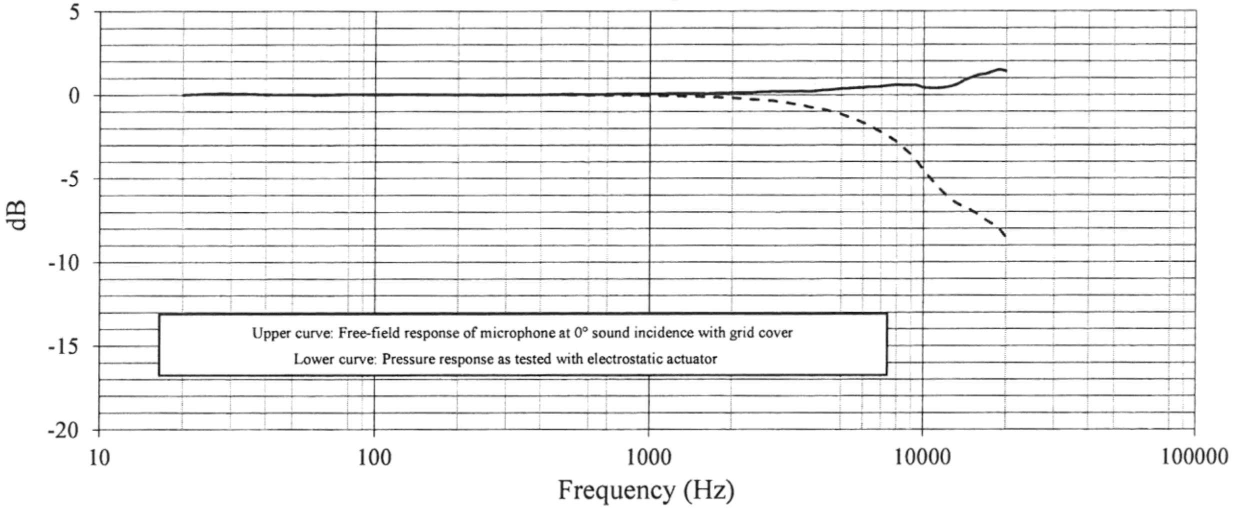
Calibration Data

Open Circuit Sensitivity @ 251.2 Hz: 45.69 mV/Pa
-26.8 dB re 1V/Pa

Polarization Voltage, External: 0 V
Capacitance: 13.1 pF

Temperature: 69 °F (20°C)   Ambient Pressure: 993 mbar   Relative Humidity: 23 %

Frequency Response (0 dB @ 251.2 Hz)



Freq (Hz)	Lower (dB)	Upper (dB)	Freq (Hz)	Lower (dB)	Upper (dB)	Freq (Hz)	Lower (dB)	Upper (dB)	Freq (Hz)	Lower (dB)	Upper (dB)
20.0	0.00	0.00	1679	-0.15	0.08	7499	-2.51	0.56	-	-	-
25.1	0.07	0.07	1778	-0.15	0.10	7943	-2.79	0.60	-	-	-
31.6	0.07	0.07	1884	-0.18	0.10	8414	-3.16	0.58	-	-	-
39.8	0.02	0.02	1995	-0.19	0.13	8913	-3.53	0.58	-	-	-
50.1	0.02	0.02	2114	-0.22	0.12	9441	-3.96	0.56	-	-	-
63.1	0.00	0.00	2239	-0.25	0.12	10000	-4.51	0.44	-	-	-
79.4	0.03	0.03	2371	-0.28	0.13	10593	-5.00	0.40	-	-	-
100.0	0.02	0.02	2512	-0.29	0.17	11220	-5.47	0.39	-	-	-
125.9	0.03	0.03	2661	-0.33	0.18	11885	-5.89	0.43	-	-	-
158.5	0.02	0.02	2818	-0.36	0.20	12589	-6.25	0.52	-	-	-
199.5	0.01	0.01	2985	-0.42	0.20	13335	-6.53	0.66	-	-	-
251.2	0.00	0.00	3162	-0.48	0.20	14125	-6.71	0.88	-	-	-
316.2	0.01	0.02	3350	-0.54	0.20	14962	-6.93	1.04	-	-	-
398.1	0.01	0.01	3548	-0.60	0.22	15849	-7.16	1.19	-	-	-
501.2	0.00	0.04	3758	-0.70	0.21	16788	-7.47	1.25	-	-	-
631.0	-0.02	0.02	3981	-0.78	0.22	17783	-7.73	1.39	-	-	-
794.3	-0.02	0.07	4217	-0.85	0.27	18837	-8.02	1.49	-	-	-
1000.0	-0.06	0.07	4467	-0.94	0.29	19953	-8.52	1.41	-	-	-
1059.3	-0.07	0.06	4732	-1.05	0.33	-	-	-	-	-	-
1122.0	-0.07	0.07	5012	-1.17	0.36	-	-	-	-	-	-
1188.5	-0.06	0.09	5309	-1.33	0.38	-	-	-	-	-	-
1258.9	-0.08	0.08	5623	-1.47	0.41	-	-	-	-	-	-
1333.5	-0.09	0.09	5957	-1.64	0.43	-	-	-	-	-	-
1412.5	-0.11	0.08	6310	-1.82	0.47	-	-	-	-	-	-
1496.2	-0.10	0.10	6683	-2.05	0.47	-	-	-	-	-	-
1584.9	-0.13	0.08	7080	-2.27	0.51	-	-	-	-	-	-

Technician: Leonard Lukasik   Date: March 6, 2021

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ID:CAL112-3697871235.285+0

Baseline Dust Monitoring Report
for
KILWEX LTD.
at
Coolnabacky, Timahoe, Co. Laois

Prepared By:

Coyle ENVIRONMENTAL

1st & 2nd Floor Kilmurry House
Main Street,
Castlerea,
Co. Roscommon,
F45 DK58
Telephone – 094 96 212 58
Visit us at www.coyleenv.ie

Document Control

Project Title: Dust Monitoring Report

Project Reference No: 22-224

Project Description: Baseline Dust Sampling for the Coolnabacky Project

Status: FINAL

Client Details: Kilwex Ltd.

Issued By: Coyle Environmental Ltd., 1st & 2nd Floor Kilmurry House,
Castlerea, Co. Roscommon

Document Production and Approval			
	Name	**Date**	**Position**
Prepared by	Clodagh Kissane	05/05/2023	Environmental Technician
Approved by	Daniella O'Neill	05/05/2023	Environmental Consultant

Revision History		
Rev	**Status**	**Date**
0	Final	05/05/2023
1		

TABLE OF CONTENTS

1 INTRODUCTION

Coyle Environmental Ltd were commissioned by Kilwex to undertake baseline dust monitoring at the nearest sensitive receptors The following report outlines the methodologies, results, and interpretation of one dust monitoring locations (Figure 1) carried out from the 2nd of March to 3rd April 2023.

1.1 Sources of dust deposition

Within the site and due to the ground conditions and exposed surfaces, dust can result from sources such as vehicle movements and wind-blown dust from both outside and within.

2 METEOROLOGICAL CONDITIONS

Meteorological conditions significantly affect the level of dust emissions and the deposition downwind of the source. The most significant meteorological elements affecting dust deposition are rainfall and wind-speed. Rain helps suppress the generation of dust due to the cohesive nature of water betweendust particles. Wind lifts up particles into the air and transports them downwind. The worst-case dustdeposition conditions typically occur during dry conditions with strong winds.

3 SITE LOCATION AND SAMPLING POINTS

The Kilwex site is located in a rural area within the townland of Timahoe. Access to the site is just off the primary road, R426. It is approximately 2.5 km north of the village of Timahoe. A map of the sampling point is presented in Figure 1. The dust gauge was set up at the location selected at positions D01 (52.979443; -7.208092).

Figure 1 Sample Location Points

4 METHODOLOGY

Total dust deposition was measured at the site using the Bergerhoff gauges specified in the German Engineering Institute VDI2119 document entitled "Measurement of Dustfall using the Bergerhoff Instrument (Standard Method)". The containers were analysed by IAS Laboratories Muine Bheag, Co. Carlow, for total dust. The liquid was evaporated in a drying chamber and the dust fall residue weighed using a calibrated balance. The daily dust deposition rate was then calculated using information on the dust fall mass, the sampling period, and the area of the collecting surface.

5 RESULTS

Table 1 Dust results for D01 March to April 2023

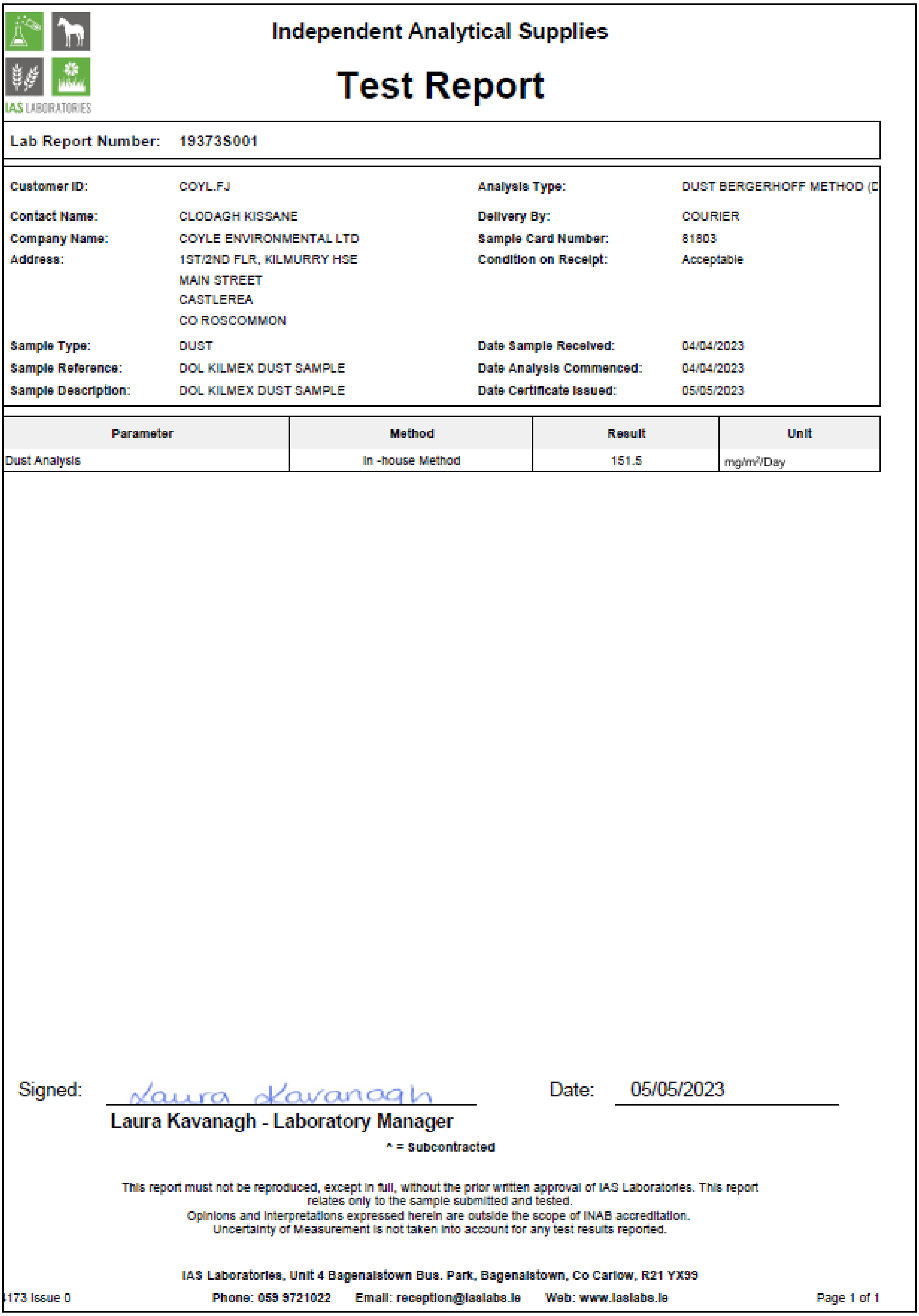
Location	Dust Level mg/m²/day	Emission Limit Value mg/m²/day
D01 (52.979443 -7.208092	151.5	350

6 INTERPRETATION OF RESULTS & RECOMMENDATIONS

This report presents the results for dust monitoring for Kilwex Ltd. At Coolnabacky Ltd, carried out for the period 2nd March to 3rd April 2023. The values presented in Table 1 show that total depositional dust levels measured at D01 monitoring location was not in exceedance of the 350 mg/m²/day limit value. This indicates that nuisance levels of dust did not occur during that period.

Appendix I

IAS Lab results



Independent Analytical Supplies

Test Report

Lab Report Number: 19373S001

Customer ID:	COYL.FJ	**Analysis Type:**	DUST BERGERHOFF METHOD (D
Contact Name:	CLODAGH KISSANE	**Delivery By:**	COURIER
Company Name:	COYLE ENVIRONMENTAL LTD	**Sample Card Number:**	81803
Address:	1ST/2ND FLR, KILMURRY HSE MAIN STREET CASTLEREA CO ROSCOMMON	**Condition on Receipt:**	Acceptable
Sample Type:	DUST	**Date Sample Received:**	04/04/2023
Sample Reference:	DOL KILMEX DUST SAMPLE	**Date Analysis Commenced:**	04/04/2023
Sample Description:	DOL KILMEX DUST SAMPLE	**Date Certificate Issued:**	05/05/2023

Parameter	Method	Result	Unit
Dust Analysis	In -house Method	151.5	mg/m^2/Day

Signed: Laura Kavanagh Date: 05/05/2023

Laura Kavanagh - Laboratory Manager

^ = Subcontracted

IAS Laboratories, Unit 4 Bagenalstown Bus. Park, Bagenalstown, Co Carlow, R21 YX99

173 Issue 0 **Phone: 059 9721022 Email: reception@iaslabs.ie Web: www.iaslabs.ie** Page 1 of 1

Baseline Groundwater and Surface water Report

for

Kilwex Ltd

at

Coolnabacky Timahoe, Co. Laois

Prepared By:

1st & 2nd Floor Kilmurry House

Main Street, Castlerea,

Co. Roscommon,

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www.coyleenv.ie

Project Title:	Baseline Groundwater and surface water report
Project Reference No.:	22-224
Project Description:	Baseline Groundwater and surface water compliance report
Status:	Final
Client Details:	Kilwex Ltd, ESB reinforcement project Coolnabacky , Co. Laois.
Issued By:	Coyle Environmental Ltd. 1st & 2nd Floor Kilmurry House, Main Street, Castlerea, Co. Roscommon

Document Production Approval			
	Name	Date	Position
Prepared by	Clodagh Kissane	20/04/23	Environmental Technician
Approved by	Daniella O' Neil	20/04/23	Environmental Consultant
Revision no		Status and date	

Contents

1.0 INTRODUCTION

Coyle Environmental Ltd were commissioned by Kilwex Ltd to undertake Baseline compliance monitoring according to the conditions stated in Planning Permission reference VA0015. The following report presents the results from a groundwater and surface water monitoring event consisting of four groundwater samples and three surface water samples taken at the Kilwex Coolnabacky, Co. Laois site.

Monitoring was undertaken on the 20th February 2023 and Laboratory analysis of the samples was undertaken on the 21st of February 2023.

2.0 SITE LOCATION AND SAMPLING POINTS

The Kilwex site is located in a rural area within the townland of Timahoe. Access to the site is just off the primary road, R426. It is approximately 2.5 km north of the village of Timahoe. A map of the sampling points is presented in Figure 1.

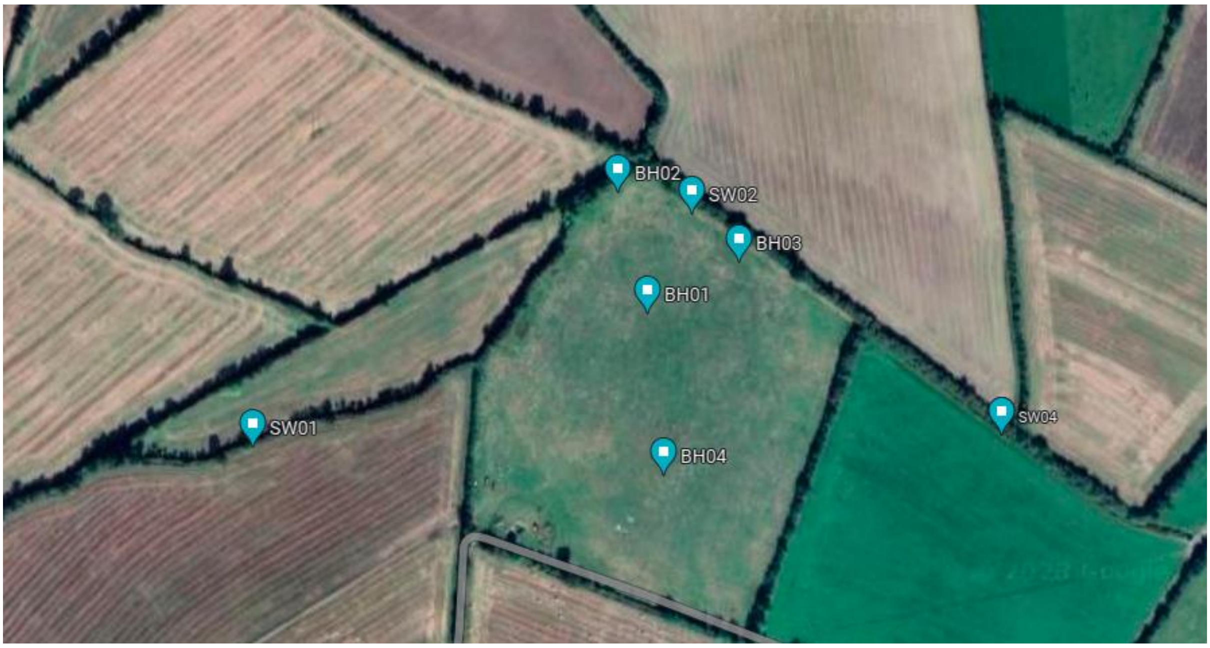


Figure 1: Sample Location Points

3.0 METHODOLOGY

The monitoring involved taking four groundwater samples and three surface water samples as shown in Figure 1, Sampling location points. Samples were stored in polyethylene and glass storage containers and preserved at below 6°C for laboratory analysis. Laboratory analysis of the samples was carried out by IAS INDEPENDENT ANALYTICAL SUPPLIES Ltd. Unit 4, Bagenalstown, Co. Carlow.

Groundwater was purged at each borehole using a WASP submersible pump. A representative groundwater sample by the well screen is then recovered, bottled, and taken for analysis.

Surface water samples were obtained by lifting a sample mid-flow using a grab sampler instrument. Samples were bottled and taken for analysis.

The following supplementary readings were recorded in the field at each sample site for groundwater and surface water using a calibrated HANNA HI98196 Multiparameter probe and a Turbimeter plus:

- pH
- Temperature (°C)
- Conductivity (µs/cm)
- DO (ppm)
- Turbidity

4.0 RESULTS

4.1 Groundwater

Table 1: Groundwater results for BH01 BH02, BH03 & BH04 20th February 2023

	BH01	BH02	BH03	BH04	Unit
pH	7.2	7.3	7.1	7.2	pH units
Conductivity	501	468	580	494	µs/cm 20 °C
Temperature	8.34	8.22	9.05	9.38	°C
Turbidity	2.84	33.3	18.7	225	NTU
DO	0.007	0.07	0.07	0.08	ppm
Nitrate	<0.03	<2.2	<2.2	<2.2	mg/l NO_3
Chloride	9.32	6.40	8.74	9.41	mg/l
Sodium	6.4	4.7	4.4	5.0	mg/l
Sulphate	11.89	2.96	6.75	10.97	mg/l
Calcium	120	120	130	120	mg/l
Magnesium	5.9	3.8	11	8.9	mg/l
Potassium	0.49	1.3	0.60	1.1	mg/l
Ammoniacal N	0.04	0.08	0.06	0.01	mg/l NH_4
Alkalinity	293.58	298.27	364.35	296.03	mg/l $CaCO_3$
Phosphorus	<0.013	0.016	<0.013	0.044	mg/l P
Total TPH	<10	<10	<10	<10	ug/l

4.2 Surface water

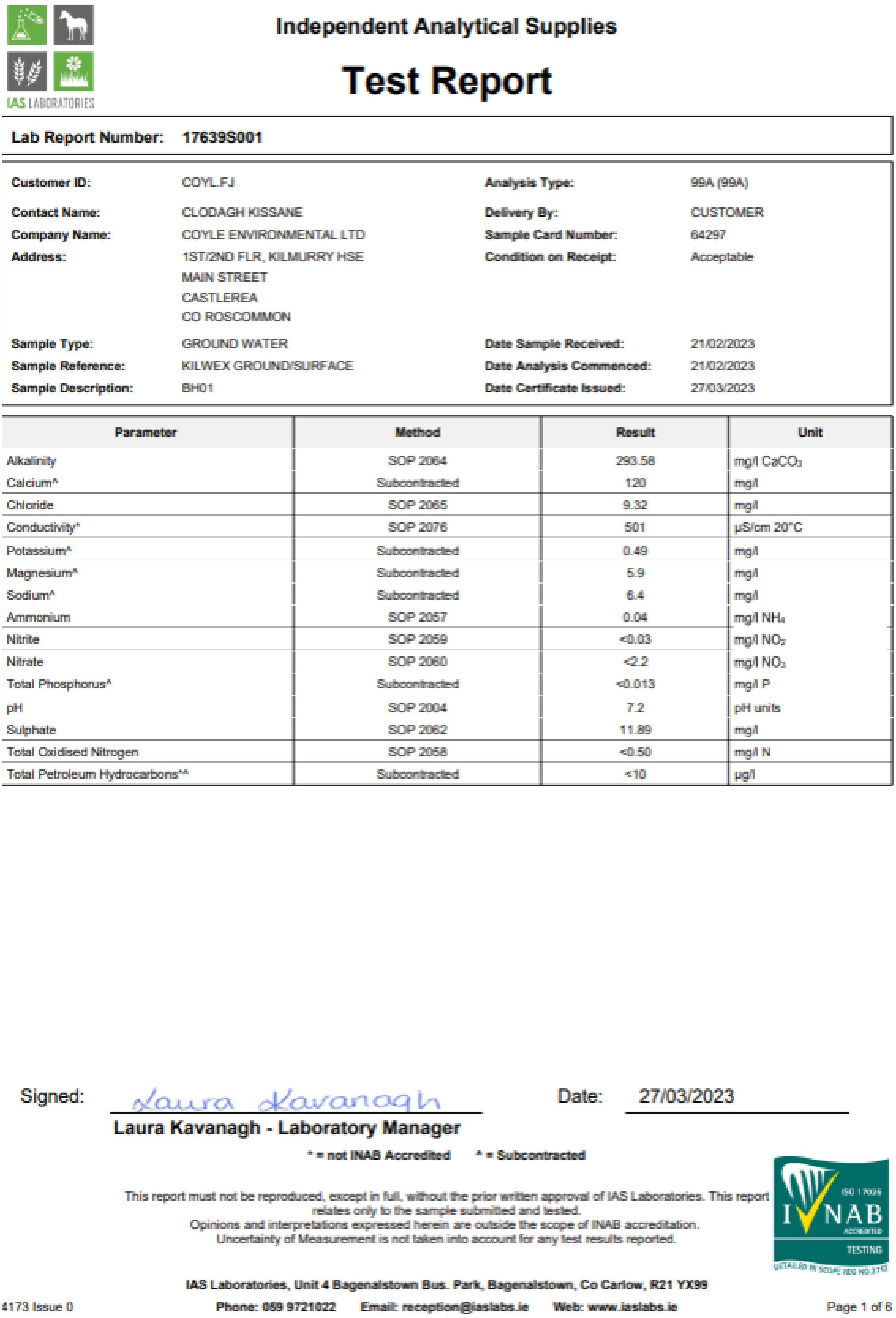
Table 2 Surface water results for SW01, SW02 & SW04 20th February 2023

	SW01	SW02	SW04	Unit
pH	8.2	8.1	8.3	pH units
Conductivity	573	579	586	µs/cm 20 °C
Temperature	12.66	9.89	10.79	°C
Turbidity	6.99	8.30	1.97	NTU
DO	0.08	0.09	0.08	ppm
Nitrate	33.26	40.26	35.16	mg/l NO_3
Chloride	19.55	18.15	25.17	mg/l
Sodium	7.8	7.5	11	mg/l
Sulphate	25.69	21.86	18.05	mg/l
Calcium	120	130	130	mg/l
Magnesium	6.1	5.7	7.4	mg/l
Potassium	3.8	3.9	3.2	mg/l
Ammoniacal N	0.06	0.04	0.06	mg/l NH_4
Alkalinity	276.89	280.14	276.77	mg/l $CaCO_3$
Phosphorus	0.031	0.021	0.029	mg/l P
Total TPH	<10	22	<10	ug/l

This report presents the results for groundwater and surface water monitoring at Kilwex Ltd, carried out on the 20th February 2023. See appendix I for IAS Laboratories certificates of analysis.

Appendix I

IAS Certificates of Analysis



IAS LABORATORIES

Independent Analytical Supplies

Test Report

Lab Report Number: **17639S001**

Customer ID:	COYL.FJ	**Analysis Type:**	99A (99A)
Contact Name:	CLODAGH KISSANE	**Delivery By:**	CUSTOMER
Company Name:	COYLE ENVIRONMENTAL LTD	**Sample Card Number:**	64297
Address:	1ST/2ND FLR, KILMURRY HSE MAIN STREET CASTLEREA CO ROSCOMMON	**Condition on Receipt:**	Acceptable
Sample Type:	GROUND WATER	**Date Sample Received:**	21/02/2023
Sample Reference:	KILWEX GROUND/SURFACE	**Date Analysis Commenced:**	21/02/2023
Sample Description:	BH01	**Date Certificate Issued:**	27/03/2023

Parameter	Method	Result	Unit
Alkalinity	SOP 2064	293.58	mg/l $CaCO_3$
Calcium^	Subcontracted	120	mg/l
Chloride	SOP 2065	9.32	mg/l
Conductivity*	SOP 2076	501	µS/cm 20°C
Potassium^	Subcontracted	0.49	mg/l
Magnesium^	Subcontracted	5.9	mg/l
Sodium^	Subcontracted	6.4	mg/l
Ammonium	SOP 2057	0.04	mg/l NH_4
Nitrite	SOP 2059	<0.03	mg/l NO_2
Nitrate	SOP 2060	<2.2	mg/l NO_3
Total Phosphorus^	Subcontracted	<0.013	mg/l P
pH	SOP 2004	7.2	pH units
Sulphate	SOP 2062	11.89	mg/l
Total Oxidised Nitrogen	SOP 2058	<0.50	mg/l N
Total Petroleum Hydrocarbons*^	Subcontracted	<10	µg/l

Signed: Laura Kavanagh Date: 27/03/2023

Laura Kavanagh - Laboratory Manager

*** = not INAB Accredited ^ = Subcontracted**

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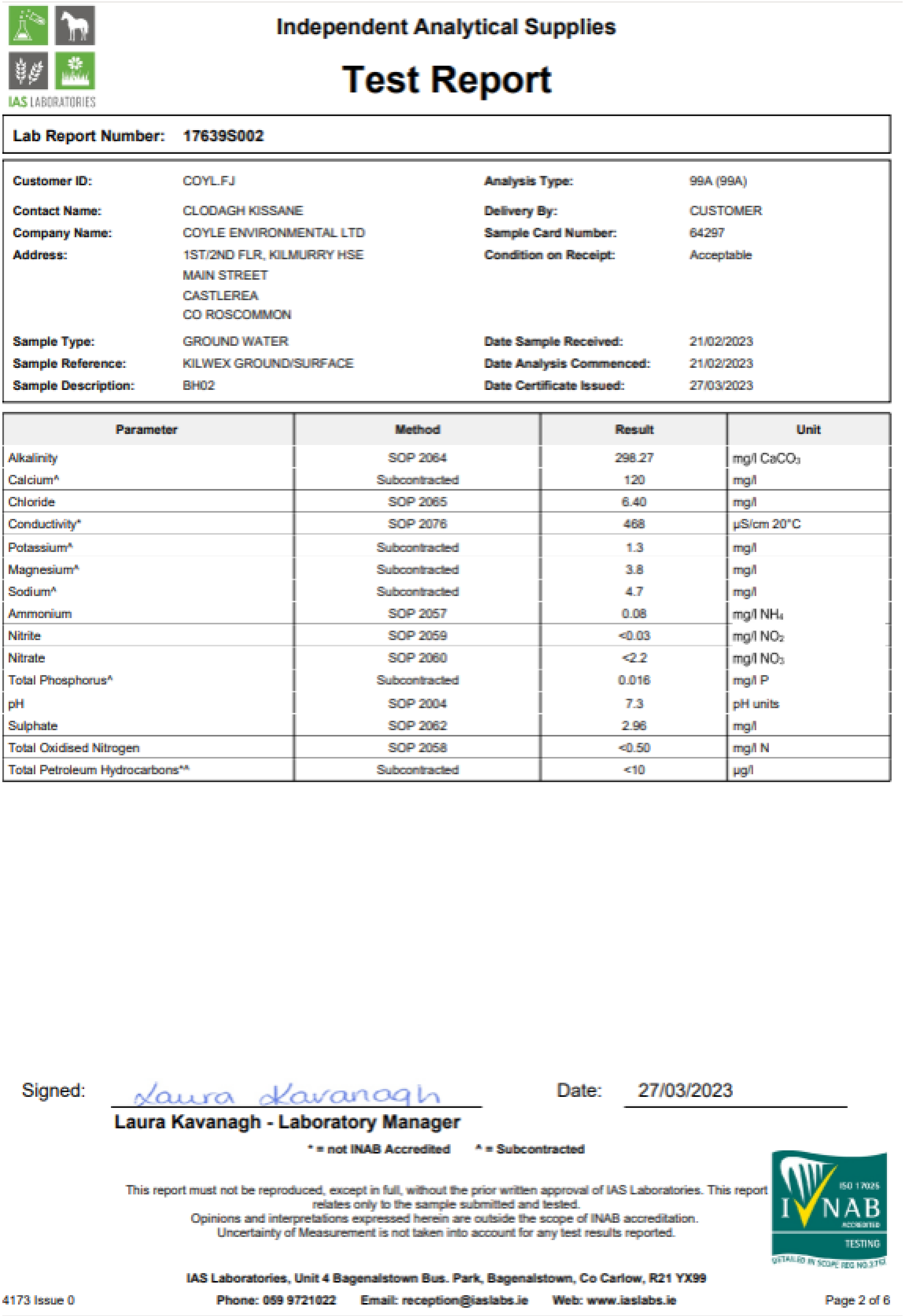

IAS LABORATORIES

Independent Analytical Supplies

Test Report

Lab Report Number: 17639S002

Customer ID: COYLFJ
Contact Name: CLODAGH KISSANE
Company Name: COYLE ENVIRONMENTAL LTD
Address: 1ST/2ND FLR, KILMURRY HSE
MAIN STREET
CASTLEREA
CO ROSCOMMON

Analysis Type: 99A (99A)
Delivery By: CUSTOMER
Sample Card Number: 64297
Condition on Receipt: Acceptable

Sample Type: GROUND WATER
Sample Reference: KILWEX GROUND/SURFACE
Sample Description: BH02

Date Sample Received: 21/02/2023
Date Analysis Commenced: 21/02/2023
Date Certificate Issued: 27/03/2023

Parameter	Method	Result	Unit
Alkalinity	SOP 2064	298.27	mg/l $CaCO_3$
Calcium^	Subcontracted	120	mg/l
Chloride	SOP 2065	6.40	mg/l
Conductivity*	SOP 2076	468	µS/cm 20°C
Potassium^	Subcontracted	1.3	mg/l
Magnesium^	Subcontracted	3.8	mg/l
Sodium^	Subcontracted	4.7	mg/l
Ammonium	SOP 2057	0.08	mg/l NH_4
Nitrite	SOP 2059	<0.03	mg/l NO_2
Nitrate	SOP 2060	<2.2	mg/l NO_3
Total Phosphorus^	Subcontracted	0.016	mg/l P
pH	SOP 2004	7.3	pH units
Sulphate	SOP 2062	2.96	mg/l
Total Oxidised Nitrogen	SOP 2058	<0.50	mg/l N
Total Petroleum Hydrocarbons*^	Subcontracted	<10	µg/l

Signed: Laura Kavanagh Date: 27/03/2023

Laura Kavanagh - Laboratory Manager

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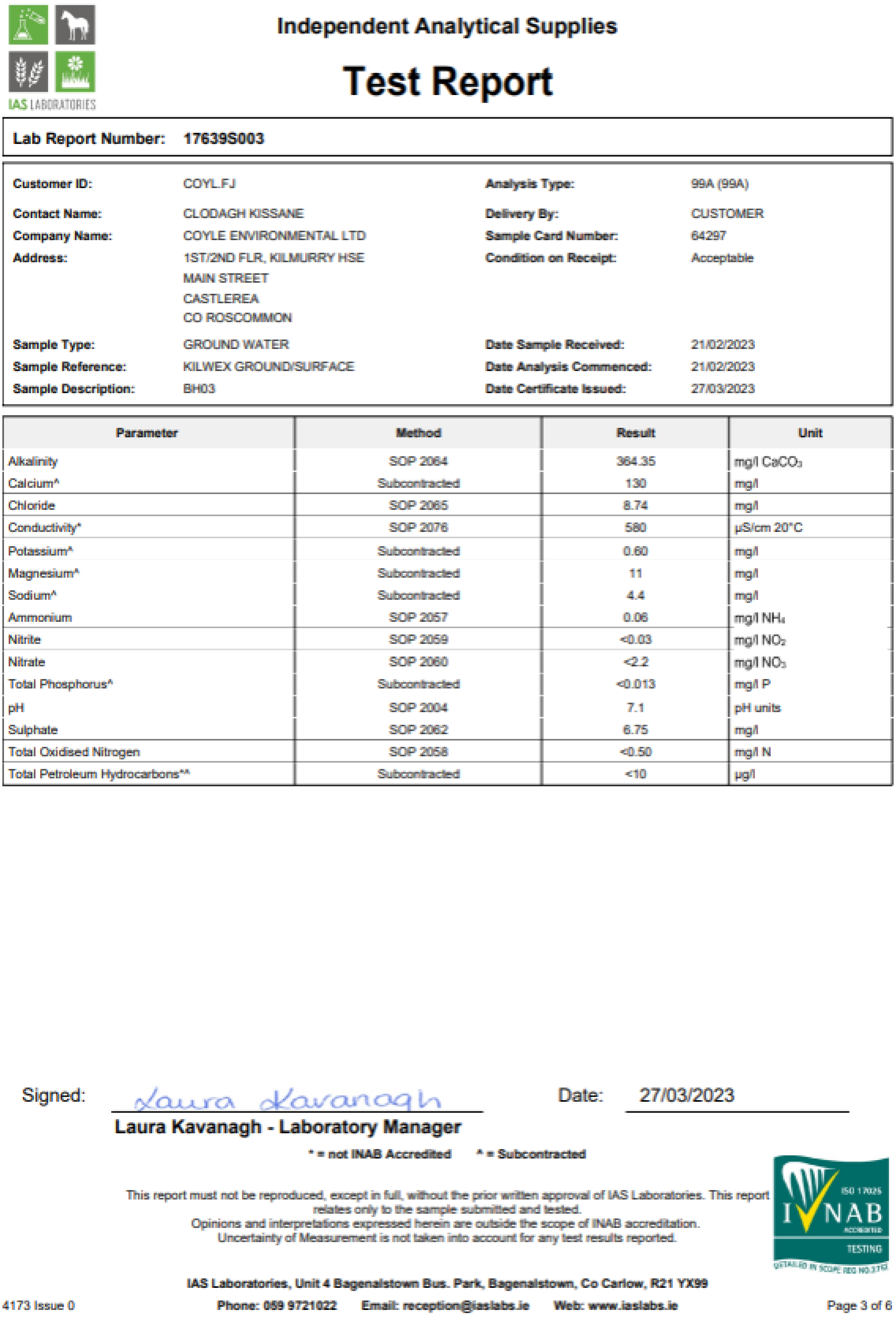

IAS LABORATORIES

Independent Analytical Supplies

Test Report

Lab Report Number: **17639S003**

Customer ID:	COYLFJ	**Analysis Type:**	99A (99A)
Contact Name:	CLODAGH KISSANE	**Delivery By:**	CUSTOMER
Company Name:	COYLE ENVIRONMENTAL LTD	**Sample Card Number:**	64297
Address:	1ST/2ND FLR, KILMURRY HSE MAIN STREET CASTLEREA CO ROSCOMMON	**Condition on Receipt:**	Acceptable
Sample Type:	GROUND WATER	**Date Sample Received:**	21/02/2023
Sample Reference:	KILWEX GROUND/SURFACE	**Date Analysis Commenced:**	21/02/2023
Sample Description:	BH03	**Date Certificate Issued:**	27/03/2023

Parameter	Method	Result	Unit
Alkalinity	SOP 2064	364.35	mg/l $CaCO_3$
Calcium^	Subcontracted	130	mg/l
Chloride	SOP 2065	8.74	mg/l
Conductivity*	SOP 2076	580	µS/cm 20°C
Potassium^	Subcontracted	0.60	mg/l
Magnesium^	Subcontracted	11	mg/l
Sodium^	Subcontracted	4.4	mg/l
Ammonium	SOP 2057	0.06	mg/l NH_4
Nitrite	SOP 2059	<0.03	mg/l NO_2
Nitrate	SOP 2060	<2.2	mg/l NO_3
Total Phosphorus^	Subcontracted	<0.013	mg/l P
pH	SOP 2004	7.1	pH units
Sulphate	SOP 2062	6.75	mg/l
Total Oxidised Nitrogen	SOP 2058	<0.50	mg/l N
Total Petroleum Hydrocarbons*^	Subcontracted	<10	µg/l

Signed: Laura Kavanagh Date: 27/03/2023

Laura Kavanagh - Laboratory Manager

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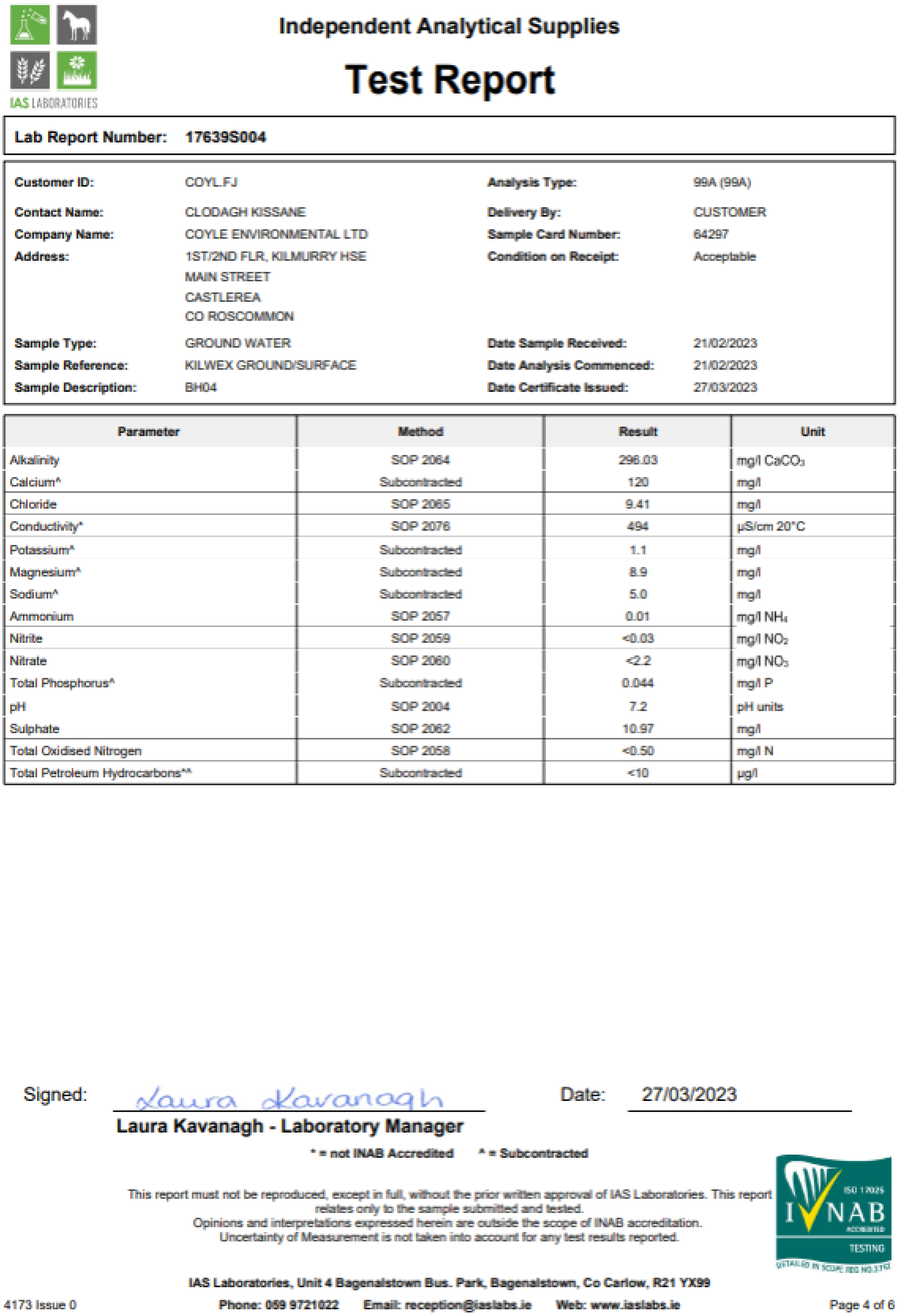

IAS LABORATORIES

Independent Analytical Supplies

Test Report

Lab Report Number: **17639S004**

Customer ID:	COYL.FJ	**Analysis Type:**	99A (99A)
Contact Name:	CLODAGH KISSANE	**Delivery By:**	CUSTOMER
Company Name:	COYLE ENVIRONMENTAL LTD	**Sample Card Number:**	64297
Address:	1ST/2ND FLR, KILMURRY HSE MAIN STREET CASTLEREA CO ROSCOMMON	**Condition on Receipt:**	Acceptable
Sample Type:	GROUND WATER	**Date Sample Received:**	21/02/2023
Sample Reference:	KILWEX GROUND/SURFACE	**Date Analysis Commenced:**	21/02/2023
Sample Description:	BH04	**Date Certificate Issued:**	27/03/2023

Parameter	Method	Result	Unit
Alkalinity	SOP 2064	296.03	mg/l CaCO$_3$
Calcium^	Subcontracted	120	mg/l
Chloride	SOP 2065	9.41	mg/l
Conductivity*	SOP 2076	494	µS/cm 20°C
Potassium^	Subcontracted	1.1	mg/l
Magnesium^	Subcontracted	8.9	mg/l
Sodium^	Subcontracted	5.0	mg/l
Ammonium	SOP 2057	0.01	mg/l NH$_4$
Nitrite	SOP 2059	<0.03	mg/l NO$_2$
Nitrate	SOP 2060	<2.2	mg/l NO$_3$
Total Phosphorus^	Subcontracted	0.044	mg/l P
pH	SOP 2004	7.2	pH units
Sulphate	SOP 2062	10.97	mg/l
Total Oxidised Nitrogen	SOP 2058	<0.50	mg/l N
Total Petroleum Hydrocarbons*^	Subcontracted	<10	µg/l

Signed: Laura Kavanagh Date: 27/03/2023

Laura Kavanagh - Laboratory Manager

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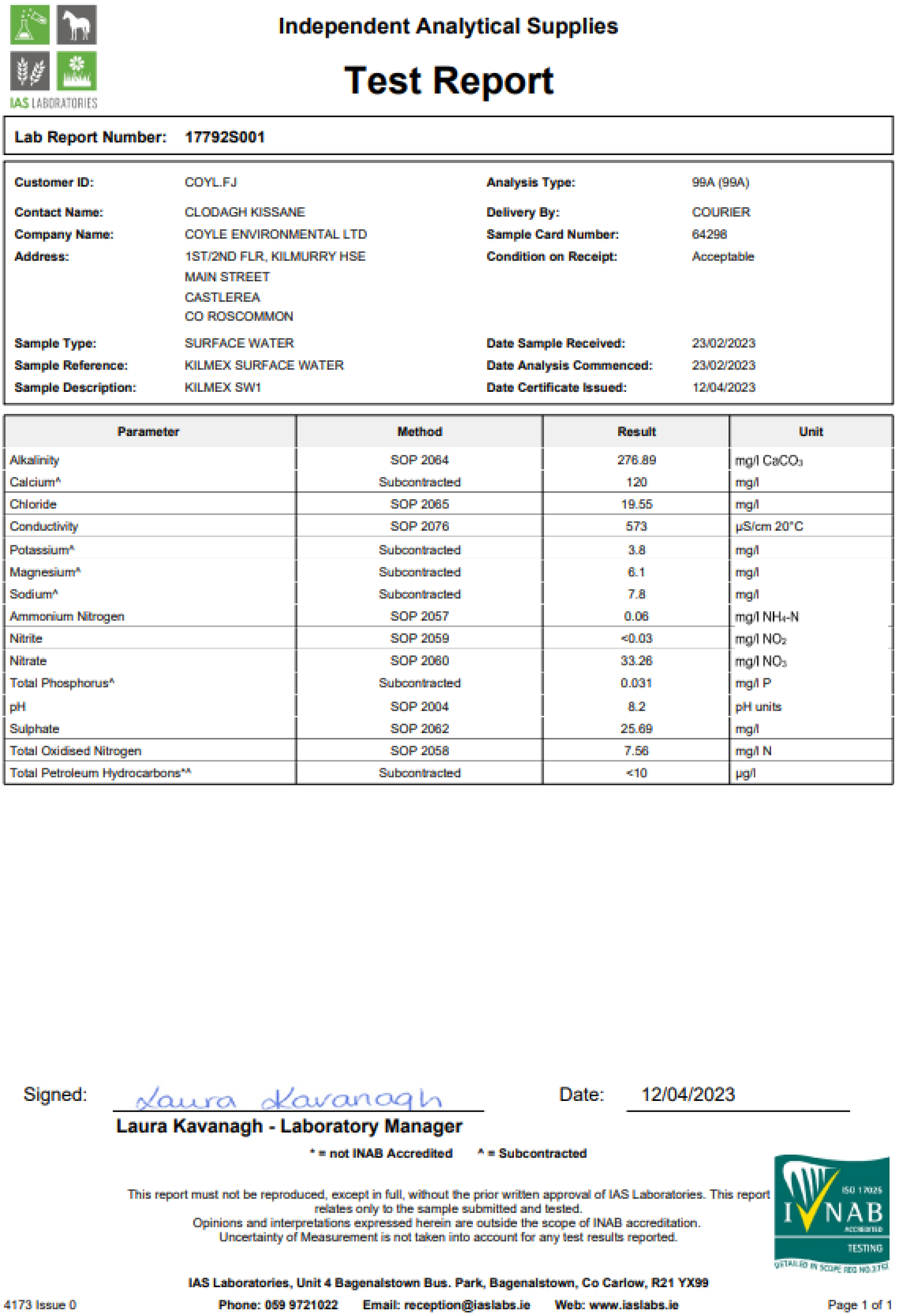

Independent Analytical Supplies

Test Report

Lab Report Number: 17792S001

Customer ID:	COYL.FJ	**Analysis Type:**	99A (99A)
Contact Name:	CLODAGH KISSANE	**Delivery By:**	COURIER
Company Name:	COYLE ENVIRONMENTAL LTD	**Sample Card Number:**	64298
Address:	1ST/2ND FLR, KILMURRY HSE MAIN STREET CASTLEREA CO ROSCOMMON	**Condition on Receipt:**	Acceptable
Sample Type:	SURFACE WATER	**Date Sample Received:**	23/02/2023
Sample Reference:	KILMEX SURFACE WATER	**Date Analysis Commenced:**	23/02/2023
Sample Description:	KILMEX SW1	**Date Certificate Issued:**	12/04/2023

Parameter	Method	Result	Unit
Alkalinity	SOP 2064	276.89	mg/l $CaCO_3$
Calcium^	Subcontracted	120	mg/l
Chloride	SOP 2065	19.55	mg/l
Conductivity	SOP 2076	573	µS/cm 20°C
Potassium^	Subcontracted	3.8	mg/l
Magnesium^	Subcontracted	6.1	mg/l
Sodium^	Subcontracted	7.8	mg/l
Ammonium Nitrogen	SOP 2057	0.06	mg/l NH_4-N
Nitrite	SOP 2059	<0.03	mg/l NO_2
Nitrate	SOP 2060	33.26	mg/l NO_3
Total Phosphorus^	Subcontracted	0.031	mg/l P
pH	SOP 2004	8.2	pH units
Sulphate	SOP 2062	25.69	mg/l
Total Oxidised Nitrogen	SOP 2058	7.56	mg/l N
Total Petroleum Hydrocarbons*^	Subcontracted	<10	µg/l

Signed: Laura Kavanagh Date: 12/04/2023

Laura Kavanagh - Laboratory Manager

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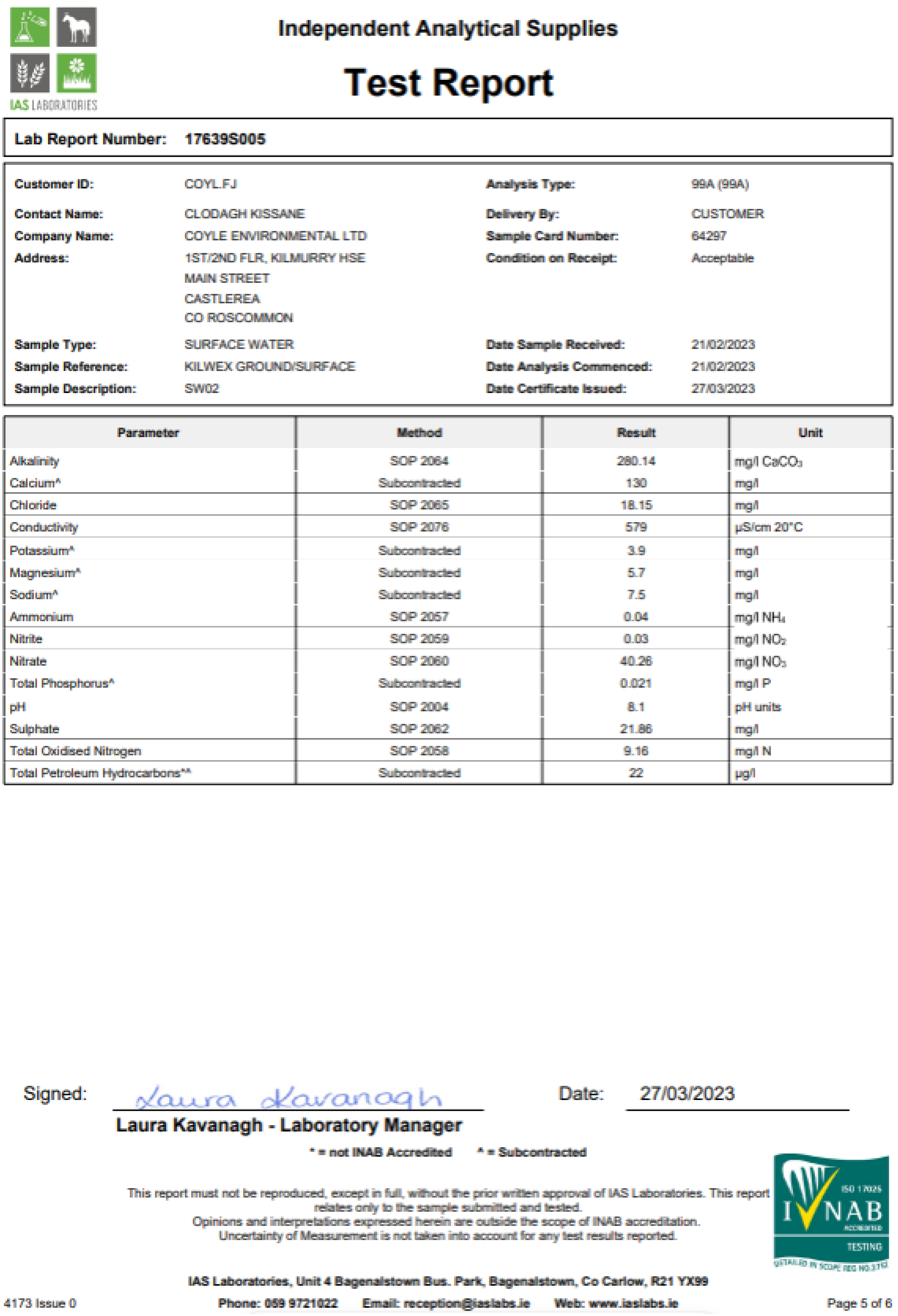

Independent Analytical Supplies

Test Report

Lab Report Number: **17639S005**

Customer ID:	COYL.FJ	**Analysis Type:**	99A (99A)
Contact Name:	CLODAGH KISSANE	**Delivery By:**	CUSTOMER
Company Name:	COYLE ENVIRONMENTAL LTD	**Sample Card Number:**	64297
Address:	1ST/2ND FLR, KILMURRY HSE MAIN STREET CASTLEREA CO ROSCOMMON	**Condition on Receipt:**	Acceptable
Sample Type:	SURFACE WATER	**Date Sample Received:**	21/02/2023
Sample Reference:	KILWEX GROUND/SURFACE	**Date Analysis Commenced:**	21/02/2023
Sample Description:	SW02	**Date Certificate Issued:**	27/03/2023

Parameter	Method	Result	Unit
Alkalinity	SOP 2064	280.14	mg/l $CaCO_3$
Calcium^	Subcontracted	130	mg/l
Chloride	SOP 2065	18.15	mg/l
Conductivity	SOP 2076	579	µS/cm 20°C
Potassium^	Subcontracted	3.9	mg/l
Magnesium^	Subcontracted	5.7	mg/l
Sodium^	Subcontracted	7.5	mg/l
Ammonium	SOP 2057	0.04	mg/l NH_4
Nitrite	SOP 2059	0.03	mg/l NO_2
Nitrate	SOP 2060	40.26	mg/l NO_3
Total Phosphorus^	Subcontracted	0.021	mg/l P
pH	SOP 2004	8.1	pH units
Sulphate	SOP 2062	21.86	mg/l
Total Oxidised Nitrogen	SOP 2058	9.16	mg/l N
Total Petroleum Hydrocarbons*^	Subcontracted	22	µg/l

Signed: Laura Kavanagh Date: 27/03/2023

Laura Kavanagh - Laboratory Manager

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ESB Networks Substation Projects
Bund Test Report

Energy for generations

Bund Test

1. Fill the bund slowly with water to within 100mm of the top of the bund walls.
2. Leave the water for a period of 24 hours to allow the concrete to be completely saturated.
3. Top up water, if required, to within 100mm of top of wall. Mark the level of the water on the bund wall at the sump and at least one other location on the other side of the bund wall.
4. Fill an open vessel (e.g. bucket) with water to $\frac{3}{4}$ of its depth and mark the water level. Place the vessel adjacent to the sump to measure evaporation/rainfall during the test period.
5. After another 48 hours, check and record the level of the water at the same locations.
6. A drop of greater than 5mm in the water level, adjusted for evaporation/rainfall is deemed to be a bund failure.
7. The checks are to be witnessed by the ESBI site inspector/site engineer.

Record of Bund Test

Project:

……………………………………………………………………………………

Bund Ref. Number:

……………………………………………………………………………………

Date and Time Water Level Marked:

……………………………………………………………………………………

Date and Time Water Level Checked:

……………………………………………………………………………………

Evaporation (-mm), Rainfall (+mm):

……………………………………………………………………………………

Change in level (mm):

……………………………………………………………………………………

Change in Level Adjusted for Evaporation/Rainfall (mm):

……………………………………………………………………………………

Signed for Contractor: ____________________ *signature* ____________ *date*

Name of Contractor: ____________________

Signed as witnessed by ESBI Site Inspector/Site Engineer: ____________________ *signature* ____________ *date*

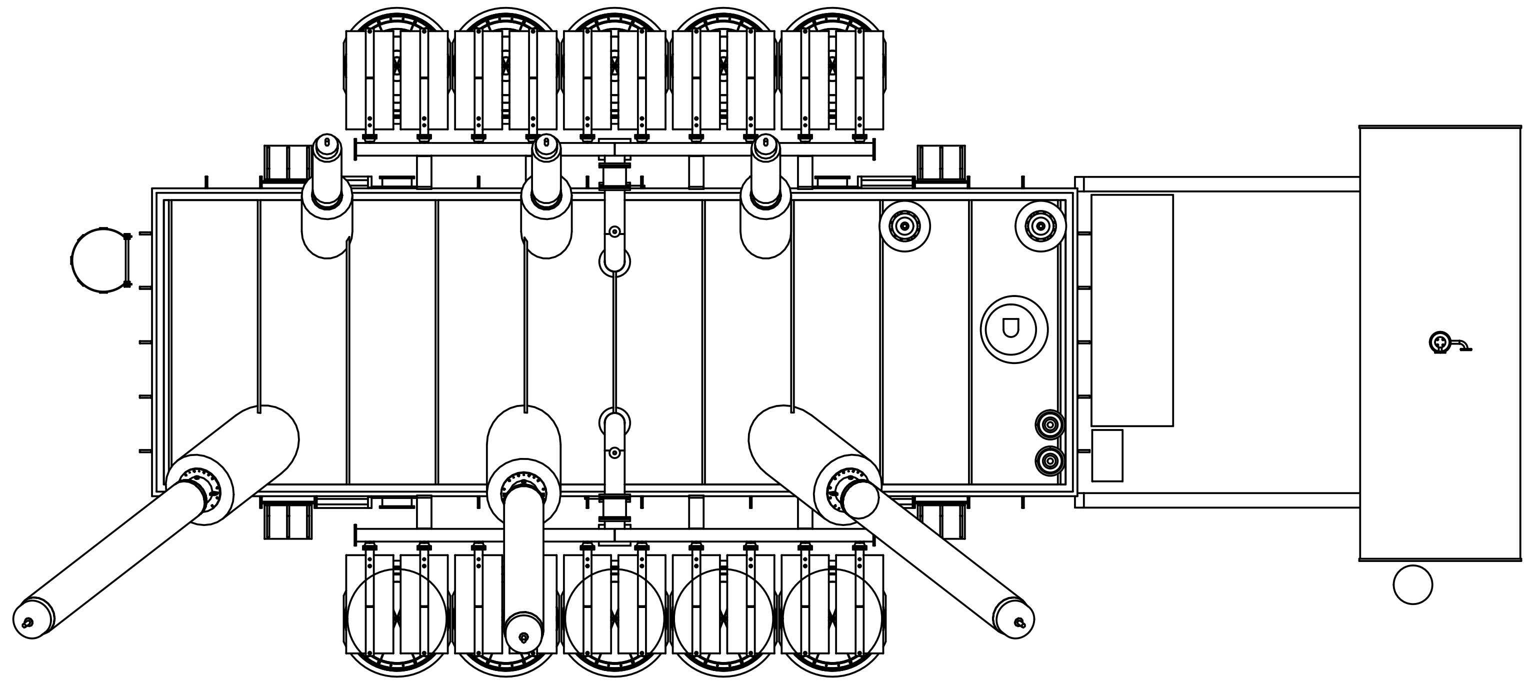
Original to: Project/Site QA File

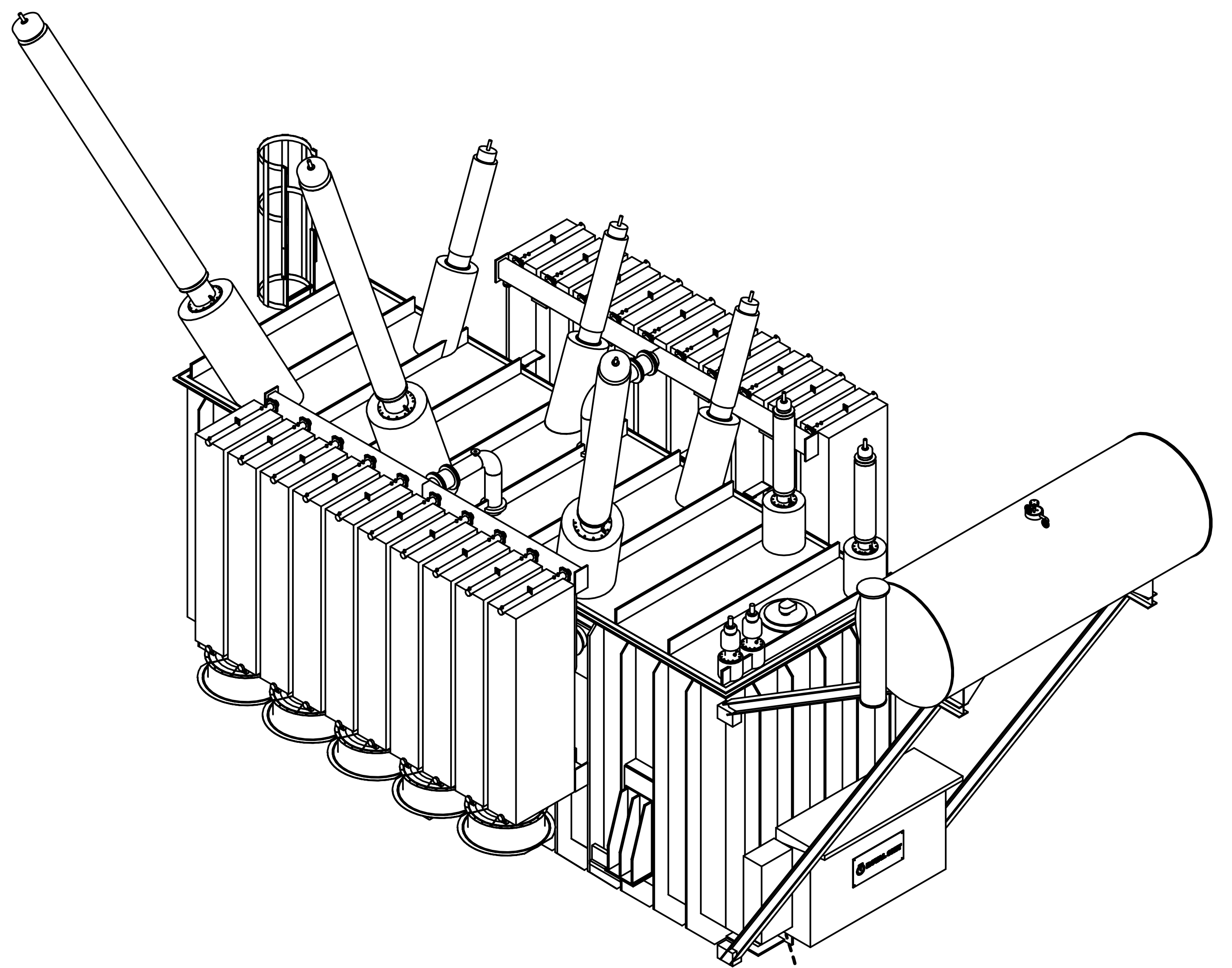
Copy to: ESBI Project Engineer

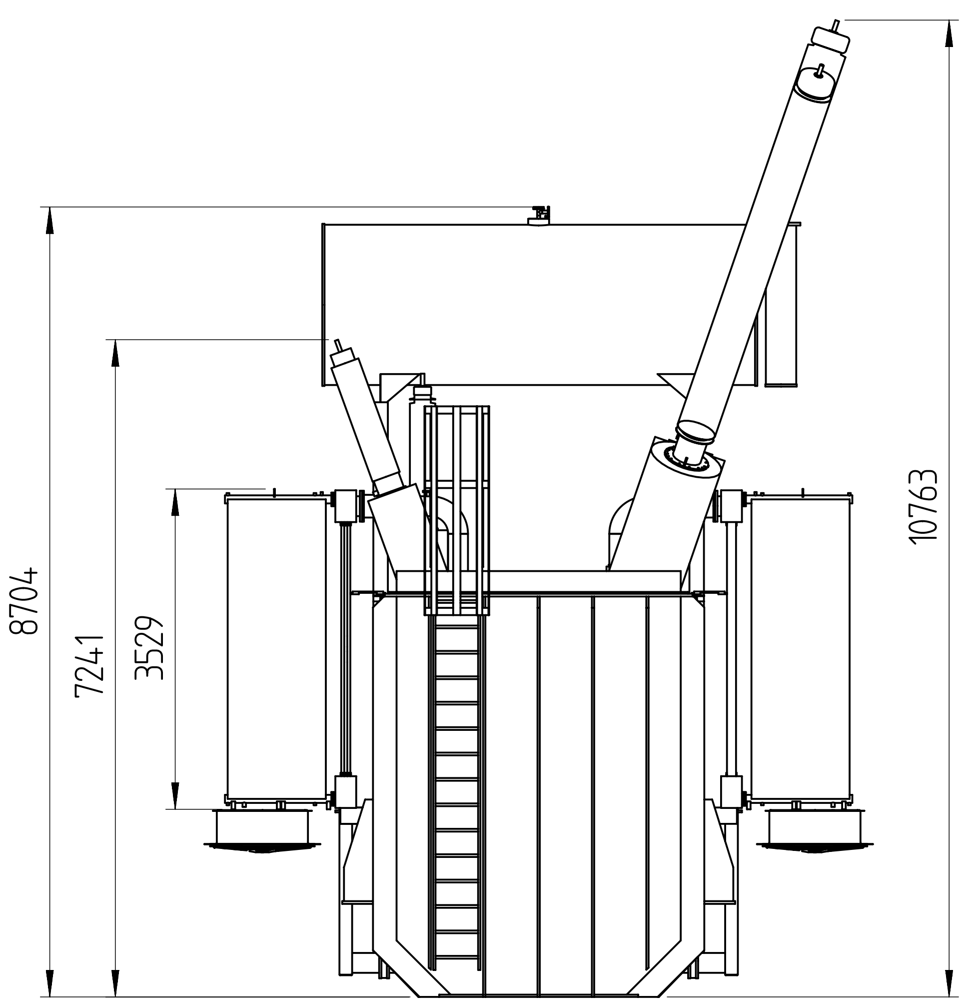
Transformer Complete

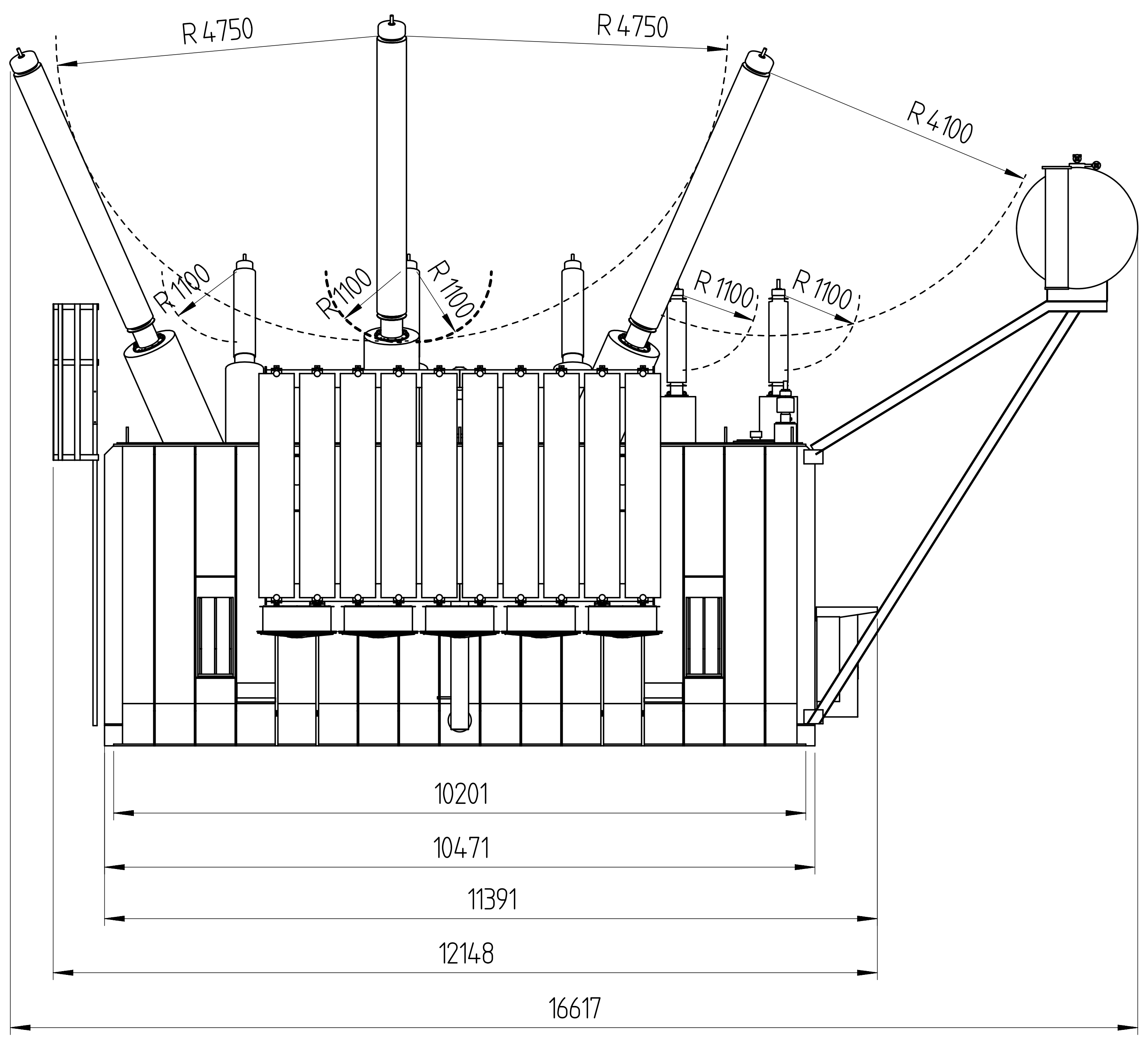
Weight incl. Oil	: 429.500 kg
Weight of Oil	: 91.000 kg
Transport Weight excl. oil	: 308.000 kg

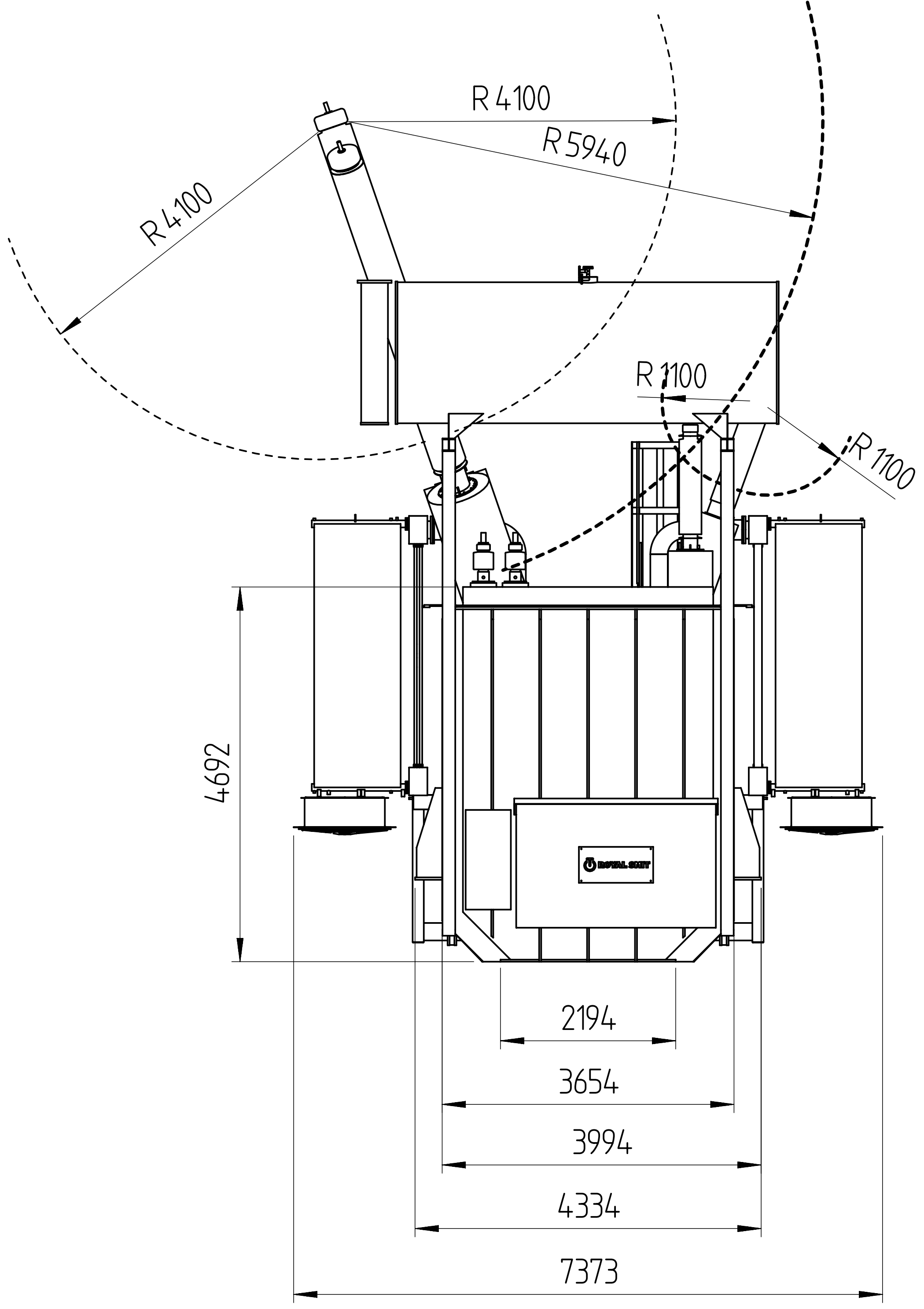
310003286-p30











Proposal drawing / Subject to changes

Projection	Description of modification				Modified by	Date
	-				-	-
	Material: n.a.	Project number	Article number	Drawn	M.Brethouwer	21-Oct-2022
				Checked	M.Brethouwer	21-Oct-2022

Smit 29.40.01-09.006e

DO NOT MEASURE FROM DRAWING

Name

Transformer

500 MVA - 371.9/110/10.5 kV

ROYAL SMIT

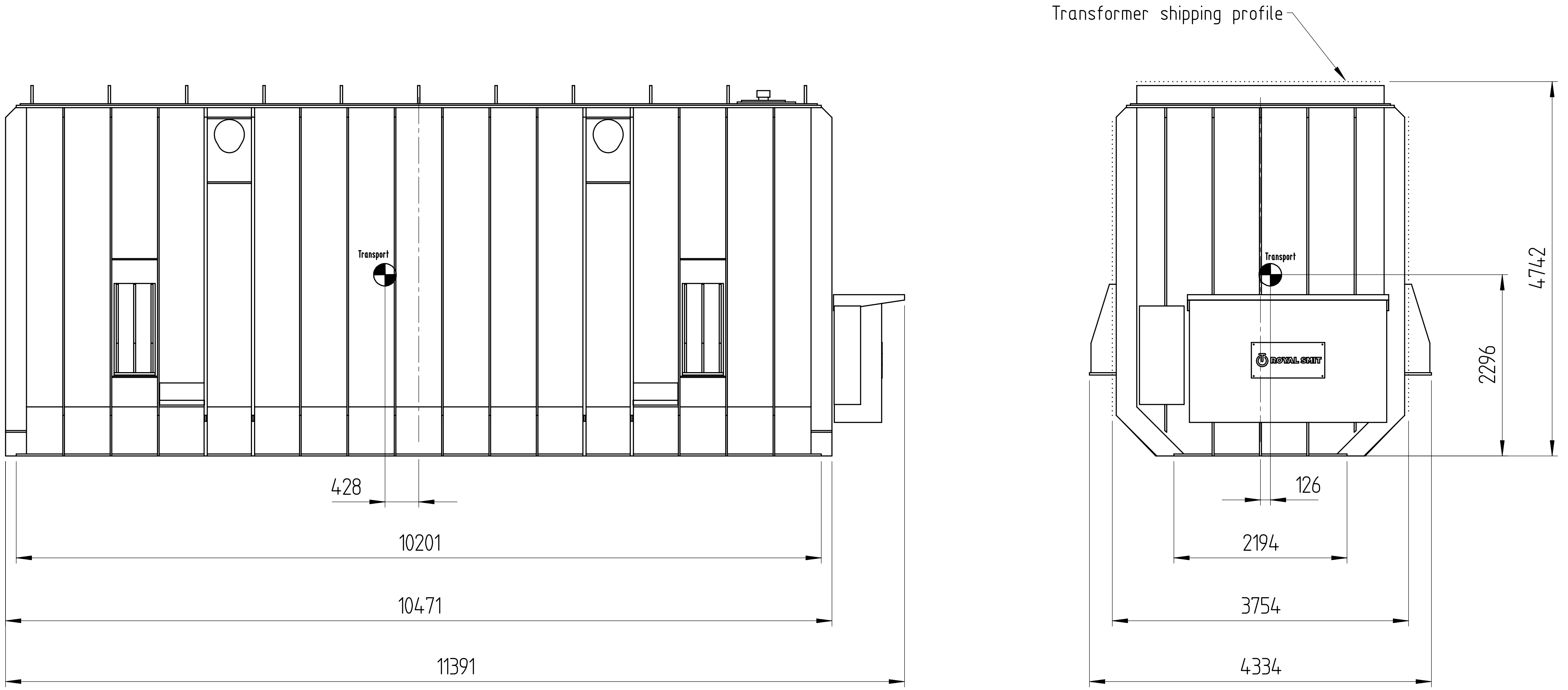
Form A2

Drawing number 2164998-101

Rev B

Transport Weight: 308.000 kg

310003286-p30



Proposal drawing / Subject to changes

Projection	Description of modification -				Modified by -	Date -
	Material: n.a.	Project number	Article number	Drawn	M.Brethouwer	21-Oct-2022
				Checked	M.Brethouwer	21-Oct-2022
Smit 29.40.01-09.006e DO NOT MEASURE FROM DRAWING	Name Transformer 500 MVA - 371.9/110/10.5 kV				ROYAL SMIT	Form A3
					Drawing number 2164998-104	Rev B