P2288

# ENVIRONMENTAL IMPACT ASSESSMENT REPORT
# VOLUME 3: APPENDICES

## CHAPTER 9 APPENDICES

## RIVERINE COMMUNITY PARK

## LIFFORD-STRABANE

## AUGUST 2021


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## Appendix 9-1

**Flood Risk Assessment**

McCloy Consulting

# Appendix 9-1
# Flood Risk Assessment
## Riverine Community Park

M01959-02_FR01 | August 2021



WATER & ENVIRONMENTAL CONSULTANTS

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# CONTENTS


NON-TECHNICAL / EXECUTIVE SUMMARY ..... 1
1 INTRODUCTION ..... 3
1.1 Terms of Reference ..... 3
1.2 Statement of Authority ..... 3
1.3 Structure of this Report ..... 3
1.4 Approach to the Assessment ..... 4
2 SITE SETTING ..... 5
2.1 Application Site ..... 5
2.2 Existing Land Use ..... 5
*2.2.1 Lifford, Co Donegal ..... 5*
*2.2.2 Strabane, Derry and Strabane ..... 5*
2.3 Proposed Development ..... 5
2.4 Site Characteristics ..... 9
*2.4.1 Topography (Whole Site Context) ..... 9*
*2.4.2 Topography - Lifford, Co Donegal ..... 9*
*2.4.3 Topography - Strabane, Derry and Strabane ..... 10*
*2.4.4 Hydrology and Watercourses ..... 11*
3 FLOOD DATA GATHERING ..... 13
3.1 Internet / Media / Background Search ..... 13
3.2 Department for Infrastructure (DfI) – Rivers ..... 13
*3.2.1 Pre-Application Consultation ..... 13*
*3.2.2 Local Area Office / Asset Management Consultation ..... 13*
*3.2.3 Asset Information ..... 14*
*3.2.4 Flood Maps NI ..... 15*
3.3 Northern Ireland Water ..... 18
*3.3.1 PAD Consultation ..... 18*
*3.3.2 Out of Sewer Flooding ..... 18*
*3.3.3 NI Water Assets ..... 18*
3.4 Office of Public Works Data ..... 19
*3.4.1 Preliminary Flood Risk Assessment (PFRA) ..... 19*
*3.4.2 Catchment Flood Risk Assessment and Management (CFRAM) Programme ..... 20*
*3.4.3 OPW Past Flood Events ..... 21*
*3.4.4 Arterial Drainage Assets ..... 21*
*3.4.5 OPW Consultation ..... 22*
*3.4.6 Lifford Flood Relief Scheme Consultation ..... 22*
4 FLOOD RISK ASSESSMENT ..... 24
4.1 Initial Assessment ..... 24
4.2 Fluvial Flooding ..... 25
*4.2.1 Flood Model Context ..... 25*
*4.2.2 Pre-Development Flood Risk ..... 25*
*4.2.3 Post-Development Flood Risk ..... 27*
*4.2.4 Effect of the Development ..... 29*
4.3 Flood Defence Breach ..... 30
5 POLICY CONTEXT – LIFFORD, CO. DONEGAL ..... 31
5.1 Planning Guidelines ..... 31
*5.1.1 Flood Zones ..... 31*
5.2 County Donegal Development Plan 2018-2024 ..... 31
5.3 Vulnerability Classification ..... 32
5.4 Sequential Approach ..... 32
5.5 Justification Test ..... 32
5.6 Existing (Pre-Development) Fluvial Flooding ..... 32
*5.6.1 Existing Flood Risk - Present Day ..... 32*
*5.6.1 Existing Flood Risk – Flood Zones ..... 33*
5.7 Proposed (Post-Development) Fluvial Flooding ..... 33
*5.7.1 Preamble ..... 33*
*5.7.2 Principle of Development ..... 33*
*5.7.3 Risk to the Development – Present Day Hydrology ..... 33*
*5.7.4 Proposed Flood Risk – Climate Change Hydrology ..... 36*
*5.7.5 Effect of on Flood Risk Elsewhere ..... 37*
5.8 Proposed Flood Risk – Flood Defence Failure ..... 39
5.9 Effect of Works to Watercourses ..... 40

5.10 Proposed Foyle Bridge ..... 41
5.11 Surface Water Flooding ..... 41
*5.11.1 Pluvial Runoff onto Site ..... 41*
*5.11.2 Pluvial Runoff from Site ..... 42*
**6 POLICY CONTEXT – STRABANE, DERRY AND STRABANE ..... 43**
6.1 Requirements of Revised PPS15 – Planning and Flood Risk ..... 43
6.2 FLD 1 - Development in Fluvial & Coastal Flood Plains ..... 43
*6.2.1 Principle of Development ..... 43*
*6.2.2 Risk to the Development ..... 43*
*6.2.3 Effect of on Flood Risk Elsewhere ..... 45*
6.3 FLD 2 - Protection of Flood Defence & Drainage Infrastructure ..... 45
*6.3.1 Protection of Flood Defences ..... 45*
*6.3.2 Works to Watercourses ..... 46*
*6.3.3 Watercourse Maintenance ..... 46*
6.4 FLD 4 – Artificial Modification of Watercourses ..... 46
**7 SUMMARY & SCHEDULE OF MITIGATION ..... 47**
7.1 Summary of Findings ..... 47
7.2 Summary of Design & Mitigation Measures ..... 47

## LIST OF TABLES

Table 1-1: Report Structure & Relevance ..... 3
Table 4.1: Potential Flooding Mechanisms ..... 24
Table 5.1: Vulnerability Classification ..... 32
Table 5.2: Flood Levels & Depths at Receptors – Proposed Scenario / Present Day ..... 34
Table 5.3: Flood Levels & Depths at Receptors – Proposed Scenario / Climate Change ..... 36
Table 6-1 Policy Screening ..... 43
Table 6.2: Flood Levels & Depths at Receptors – Proposed Scenario / Climate Change ..... 44
Table 7.1: Summary of Risks and Mitigation ..... 48

## LIST OF FIGURES

Figure 2-1 -Proposed Development – Site-Wide (Context) ..... 6
Figure 2-2 -Proposed Development – Lifford ..... 7
Figure 2-3 -Proposed Development – Strabane ..... 8
Figure 2-4 -Topography – Whole Site & Environs ..... 9
Figure 2-5 -Topography – Lifford ..... 10
Figure 2-6 -Topography – Strabane ..... 11
Figure 2-7 Watercourses ..... 12
Figure 3-1: Designated Watercourses ..... 14
Figure 3-2: DfI Rivers Flood Defence Assets ..... 15
Figure 3-3: Extract from Flood Maps (NI) – Detailed 1% AEP Fluvial Flood Extents ..... 16
Figure 3-4: Extract from Flood Maps (NI) – Indicative 0.5% AEP Surface Water Flood Extents ..... 17
Figure 3-5: Extract from Flood Maps (NI) – Historical Flood Extent ..... 18
Figure 3-6: Northern Ireland Water Sewer Asset Information ..... 19
Figure 3.7: Site vs OPW Preliminary FRA Mapping ..... 20
Figure 3-8: OPW CFRAM Flood Outlines ..... 21
Figure 3-9: OPW Arterial Drainage Assets ..... 22
Figure 4-1: Existing 1% AEP PD Flood Extent by Depth ..... 26
Figure 4-2: Existing 0.1% AEP PD Flood Extent by Depth ..... 27
Figure 4-3: Proposed 1% AEP PD Flood Extent by Depth ..... 28
Figure 4-4: Proposed 0.1% AEP PD Flood Extent by Depth ..... 29
Figure 4-5: Effect of Development (Extent / Water Elevation) – 1% AEP PD ..... 30
Figure 5-1: Proposed 10% AEP PD Flood Extent by Depth - Lifford ..... 35
Figure 5-2: Effect of Development (Extent / Water Elevation) – 0.1% AEP PD, Lifford ..... 38
Figure 5-3: Existing Scenario 0.1% AEP PD – Flood Extents / Flood Routing, Foyle View ..... 39
Figure 5.4: Accommodation Works – Proposed Replacement Ditch ..... 41

## APPENDICES

Appendix A Survey and Key Proposal Drawings
Appendix B Stakeholder Correspondence / Data
Appendix C Hydraulic Modelling Method Statement
Appendix D Flood Mapping
Appendix E Preliminary Flood Evacuation & Management Plan (Lifford)
Appendix F Preliminary Flood Evacuation & Management Plan (Strabane)

## NON-TECHNICAL / EXECUTIVE SUMMARY

This Flood Risk Assessment (FRA) was commissioned by Donegal County Council & Derry & Strabane District Council to support a planning application for Riverine Community Park. The FRA forms part of a wider environmental assessment of the water environment.

The Riverine Park site includes land in Lifford and Strabane, and a new pedestrian and cycling bridge crossing the River Foyle. The sites lie on relatively low-lying lands that are behind earth flood embankments. The embankments have crest heights higher than predicted water levels in the River Foyle; however, the sites flood due to floodwater elsewhere bypassing the embankments. The embankment in Lifford is an OPW maintained flood defence asset, while the embankment in Strabane is a DfI Rivers maintained flood defence asset.

Information has been gathered from a number of datasets and stakeholders including DfI Rivers and the OPW. Fluvial (river) flooding from the River Foyle system is the main flood risk to the site.

Detailed flood models used to predict floodwater levels have previously been developed by DfI Rivers and the OPW to inform their flood management plans and planning guidance. Those models have been reviewed and a new iteration has been developed that includes the best information available from the two base models and includes improved definition around topography within the site. The new model has been used to predict water levels at the site for extreme flooding that are required to be assessed by planning guidelines and policies in Ireland and Northern Ireland.

Extreme floods are expressed in terms of their probability. The Annual Exceedance Probability is the likelihood (in percentage terms) that a flood of that size or greater will happen in any given year. The smaller the AEP, the less likely the flood is to occur, and the larger the flood magnitude.

The Lifford site is predicted to have a probability of flooding with a 10% Annual Equivalent Probability which assessed as high probability flooding. The majority of the site would be affected by 1% AEP and 0.1% AEP floods (also known as 100 year and 1000-year floods). The majority of the site lies in Flood Zone A.

The Strabane site is predicted to have a probability of flooding on land where development is proposed with a 1% AEP, which is assessed as moderate probability flooding. The majority of the site would be affected in this event. The site is also substantially affected by 0.1% AEP (low probability) flooding; however Northern Ireland planning policy does not require assessment of that flood probability.

While the majority of the development is sited at existing ground level and will be allowed to flood, the proposed development includes work that could displace floodwater and affect flooding elsewhere, including land raising, work to flood embankments, a new bridge over the River Foyle, and new buildings on the Lifford side. Proposed ground levels and obstructions have been developed into a detailed ground model and tested in an iteration of the detailed river flood model. Comparing existing scenario and proposed scenario flood data confirms that the development will cause no effect to existing flood levels or floodplains outside the site for the 1% AEP flood.

Predicted flood levels post development within and outside the site are stated in the main body of this report. The effect of climate change has been assessed by including increased factors of safety on flood flows within the hydraulic model. Predicted climate change flood levels have been used to inform the design of flood resilience to the proposed development.

The proposed development includes measures to:

- Ensure that the proposed development is resilient to flooding, to reduce the consequences of flooding when it occurs, through careful selection of materials and finishes.
- Ensure that the proposed Community Hub building in Lifford will not flood, including for low probability flooding (0.1% AEP) including climate change.
- Ensure that the proposed Foyle bridge has a deck level that has freeboard to flood levels and complies with or exceeds OPW and DfI Rivers standards.
- Manage flood risk to users through Flood Evacuation and Management Plans (FEMP), which will seek to evacuate and limit access to the site when flooding is likely to occur. The FEMP will also target the removal of contaminants (fertilisers, chemicals etc associated with the maintenance of

the park) from the site in advance of flooding to reduce the likelihood of spills to watercourses during a flood.

- Ensure that existing OPW and DfI Rivers flood defence embankments are preserved and improved so that paths can safely be constructed on their crests. Measures will be put in place to ensure that the embankments and other drainage assets can be safely maintained.
- Ensure that surface water runoff from new impermeable development on the sites is managed so that new discharges to watercourses cause no increased flood risk downstream.

# 1 INTRODUCTION

## 1.1 Terms of Reference

This Flood Risk Assessment was commissioned by Donegal County Council & Derry & Strabane District Council to support a planning application for Riverine Community Park.

The assessment will determine potential sources of flooding at the site and their associated risk to life and property. The assessment will determine the suitability of the site for development in relation to flood risk from various sources and propose appropriate design and mitigation measures where appropriate.

## 1.2 Statement of Authority

This report and assessment have been prepared and reviewed by qualified professional civil engineers specialising in the fields of hydrology, drainage and flood risk as required by DfI Rivers. The key staff members involved in this project are as follows:

- Anna Phoenix *BEng (Hons), PhD, MIEI* – Project Engineer with specialism in the fields of hydraulic modelling and flood hydrology. Responsible for flood modelling informing this assessment.
- Paul Singleton *BEng (Hons) MSc CEng MIEI* – Chartered Civil / Environmental Engineer specialising in drainage, SuDS, and flood risk assessment, and a recognised industry professional having given industry training in these fields in both Ireland and the UK.
- Kyle Somerville *BEng (Hons) CEng MIEI* – Associate specialising in the fields of flood risk assessment, flood modelling, drainage and surface water management design.

## 1.3 Structure of this Report

The proposed development is transboundary and includes land in the Republic of Ireland (RoI) (Co. Donegal) and Northern Ireland (NI) (Derry and Strabane). The dominant hydrological feature and source of flooding is the River Foyle which forms the jurisdiction boundary.

Given that the effect of development would be transboundary, this assessment determines flood risk to the site, and as a result of the development, as a whole. The assessment subsequently explores the policy context in relation to flood risk and development management policy in each jurisdiction separately. The following table highlights whether a report section is relevant to RoI, NI, or Common to Both.

**Table 1-1: Report Structure & Relevance**

| Section | Title | Relevance |
|---|---|---|
| 1 | Introduction | Both Jurisdictions |
| 2 | Site Setting | Both Jurisdictions |
| 3 | Flood Data Gathering | Both Jurisdictions |
| 4 | Flood Risk Assessment | Both Jurisdictions |
| 5 | Policy Context – Lifford, Co. Donegal | Lifford Site |
| 6 | Policy Context – Strabane, Derry and Strabane | Strabane Site |
| 7 | Summary and Schedule of Mitigation | Both Jurisdictions |

## 1.4 Approach to the Assessment

Consideration has been given to the sources and extent of fluvial flooding at the site.

For the purposes of this study, the following have been considered:

- Available information on historical flooding in the area.
- Site level information based on a detailed site topographic survey and LiDAR derived ground models
- Site observations based on inspection undertaken in May 2021.
- Detailed assessment (by flood modelling) of potential flooding from rivers.
- Assessment of potential flooding to the site from overland sources.
- Assessment of potential flood risk to adjacent lands caused by development at the site; and,

The method of assessment complies with the Source-Pathway-Receptor model, allowing for a spatial assessment of flood risk to people, property, and the environment at the site.

# 2 SITE SETTING

The following section establishes the site setting relevant to the assessment of flood risk.

## 2.1 Application Site

The site is located on lands in Lifford and Strabane and include a span over the River Foyle. Context and location are shown on drawing plans submitted in support of the application (key drawings are included Appendix A for ease of reference). The combined application site has an area within its boundary of 22.6 Ha.

## 2.2 Existing Land Use

A land survey drawing is included at Appendix A. A summary of existing land use is as follows.

### 2.2.1 Lifford, Co Donegal

The Lifford site comprises undeveloped agricultural land with main access via Foyle View and the existing Three Rivers complex.

### 2.2.2 Strabane, Derry and Strabane

The Strabane site comprises undeveloped land (agricultural land, woods and wetlands) with the exception of a Traveller halting site at Greenbrae Park.

## 2.3 Proposed Development

The development will comprise the creation of a new community park infrastructure with multi-purpose community facilities and amenities. Aspects of the development relevant to the assessment of flood risk will include:

- Construction of a pedestrian and cycle bridge between Lifford and Strabane.
- Construction of a single storey community resource building for use as community space including office and café use.
- Provision of a multi-functional outdoor space and external stage area.
- Creation of play areas, a river walk and river access.
- Construction of an access road, car parking, walkways and cycleways.
- Associated landscaping and ancillary development, accommodation works and site services

Simplified schematic figures showing the proposed development and those aspects pertinent to the flood risk assessment are included in the following Figure 2-1 to Figure 2-3.

Key proposal drawings on which this assessment is based are included in Appendix A.

**Figure 2-1 -Proposed Development – Site-Wide (Context)**

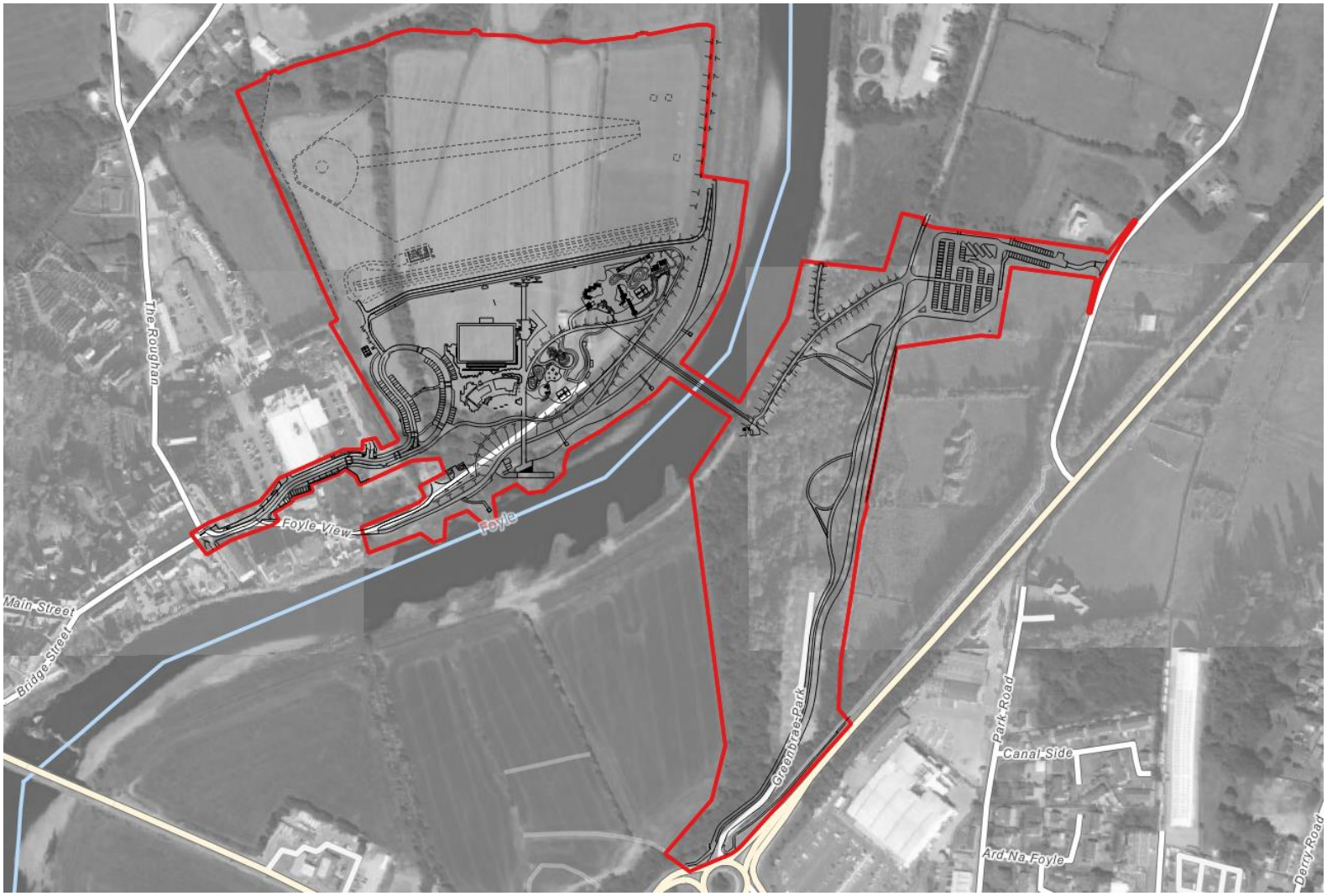


**Figure 2-2 -Proposed Development – Lifford**

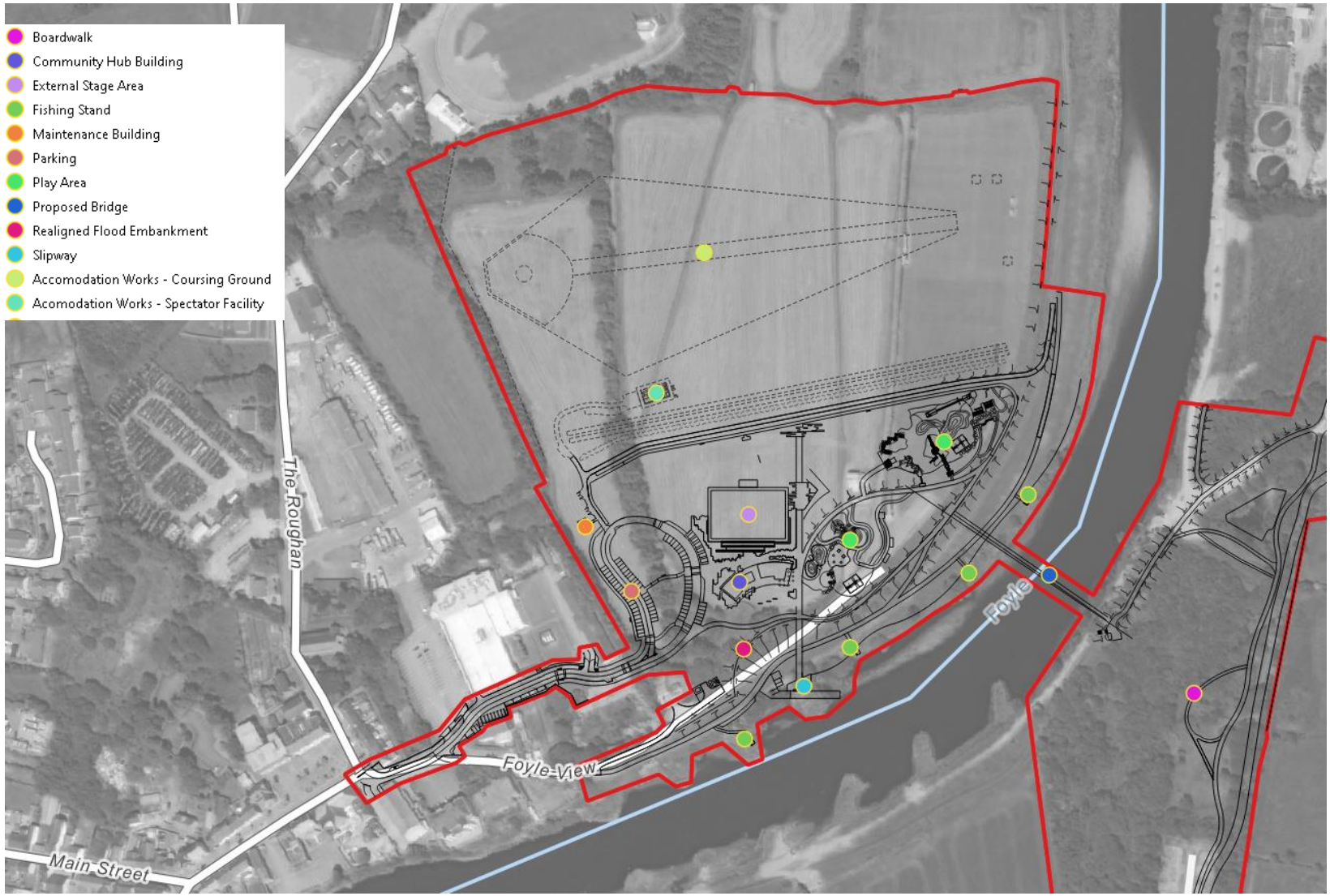
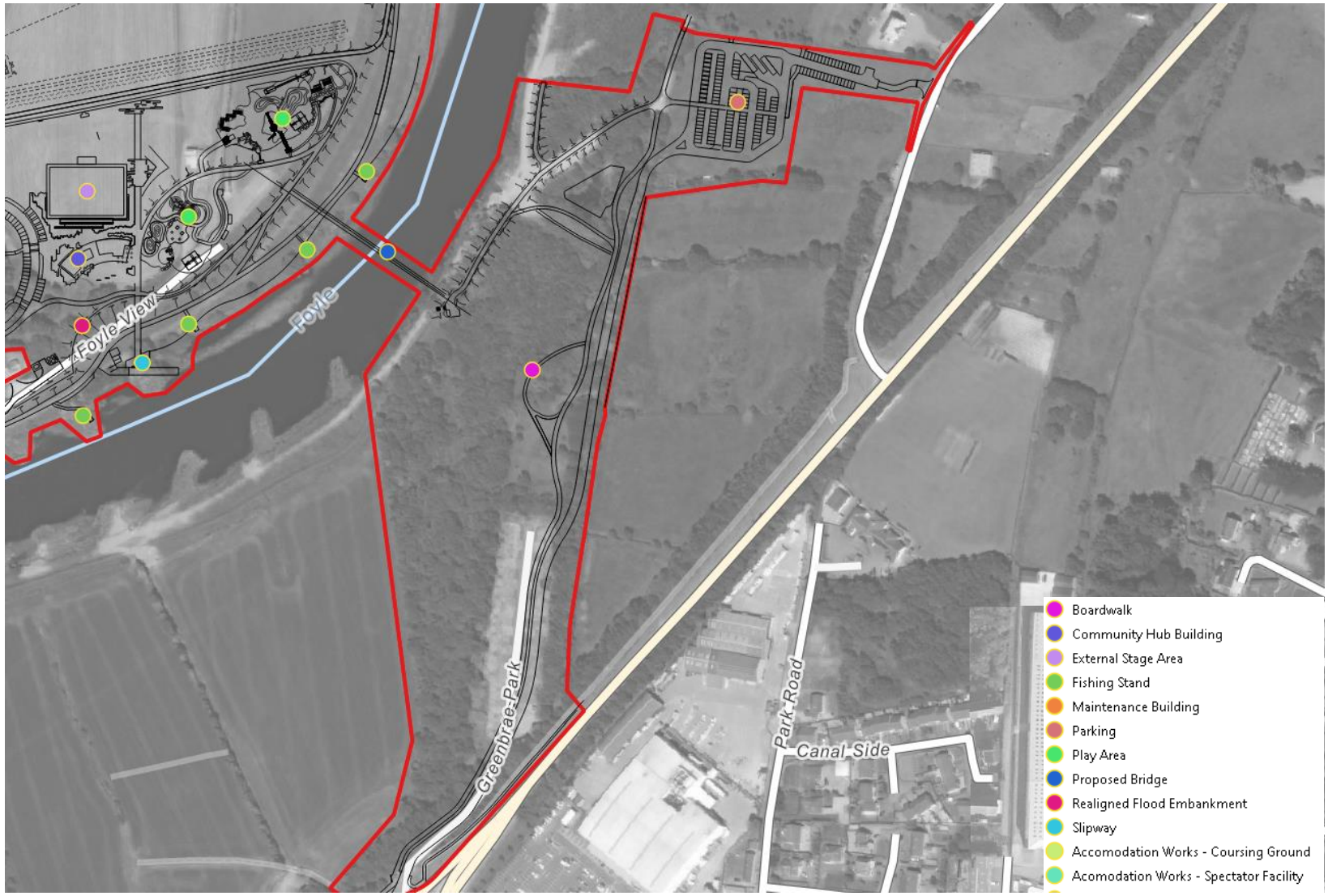


**Figure 2-3 -Proposed Development – Strabane**



## 2.4 Site Characteristics

### 2.4.1 Topography (Whole Site Context)

Ground levels derived from Land and Property Services 1m LiDAR, Ordnance Survey Ireland 2m LiDAR, and topographic survey data within the site are shown on the following Figure 2-4.

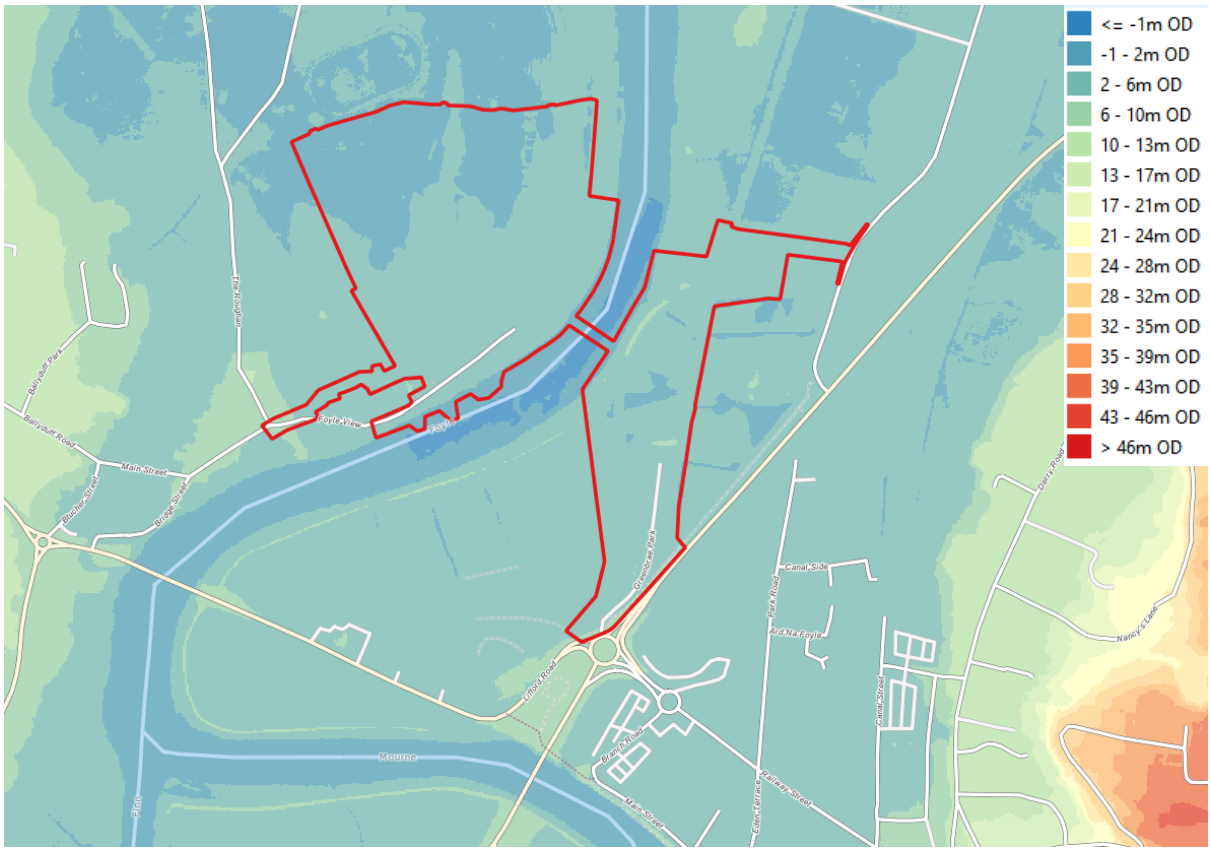



**Figure 2-4 -Topography – Whole Site & Environs**

### 2.4.2 Topography - Lifford, Co Donegal

Lifford topography is shown on Figure 2-5. Topography generally lies between 6 m OD and 2 m OD. Topography typically falls from south to north to low lying land in the north of the application site. The site is characterised by the prominent earth embankment adjacent to the River Foyle which has a typical crest height exceeding 5 m OD.

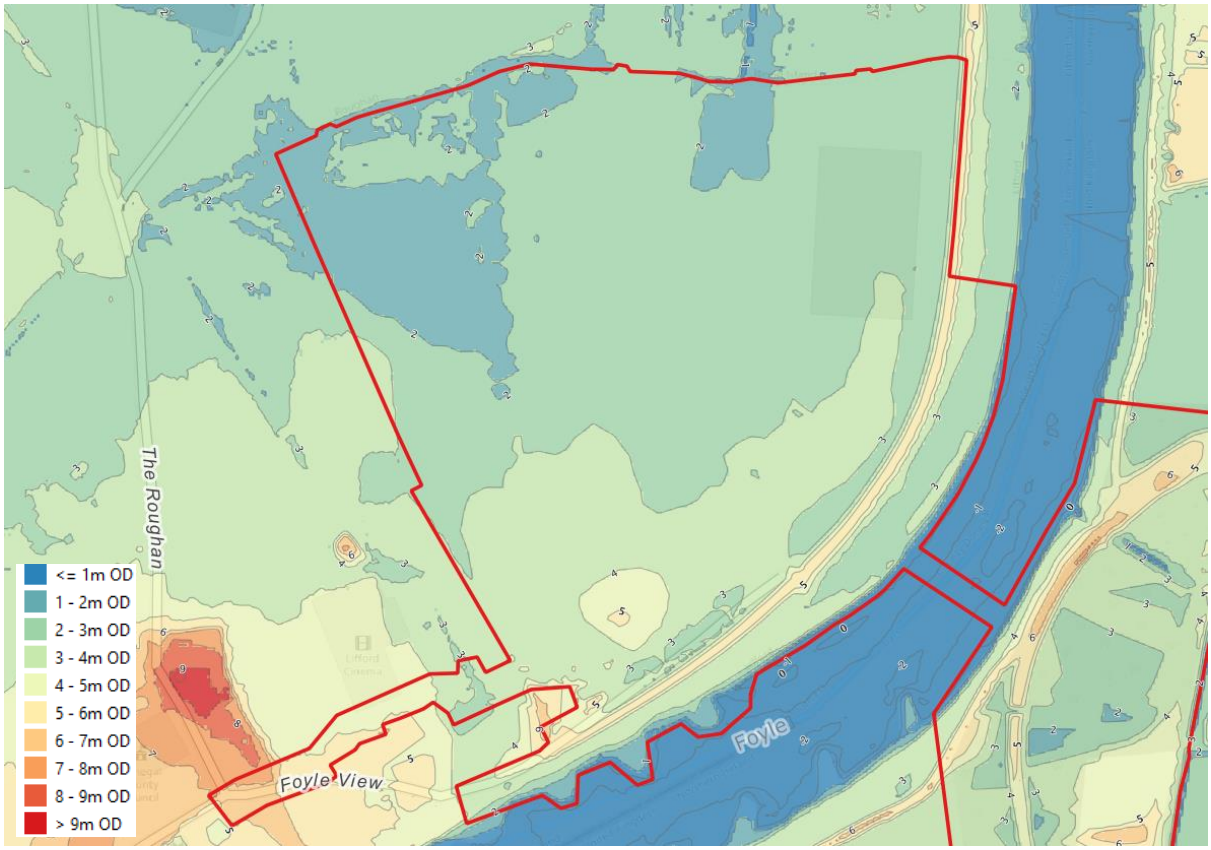



**Figure 2-5 -Topography – Lifford**

### 2.4.3 Topography - Strabane, Derry and Strabane

Strabane topography is shown on Figure 2-6. Topography generally lies between 6 m OD and 1 m OD. Significant topographic features exist at a riverside embankment adjacent to the River Foyle with typical crest height of 5-6 m OD, and an additional embankment associated with a disused railway line lying between 4-5 m OD.

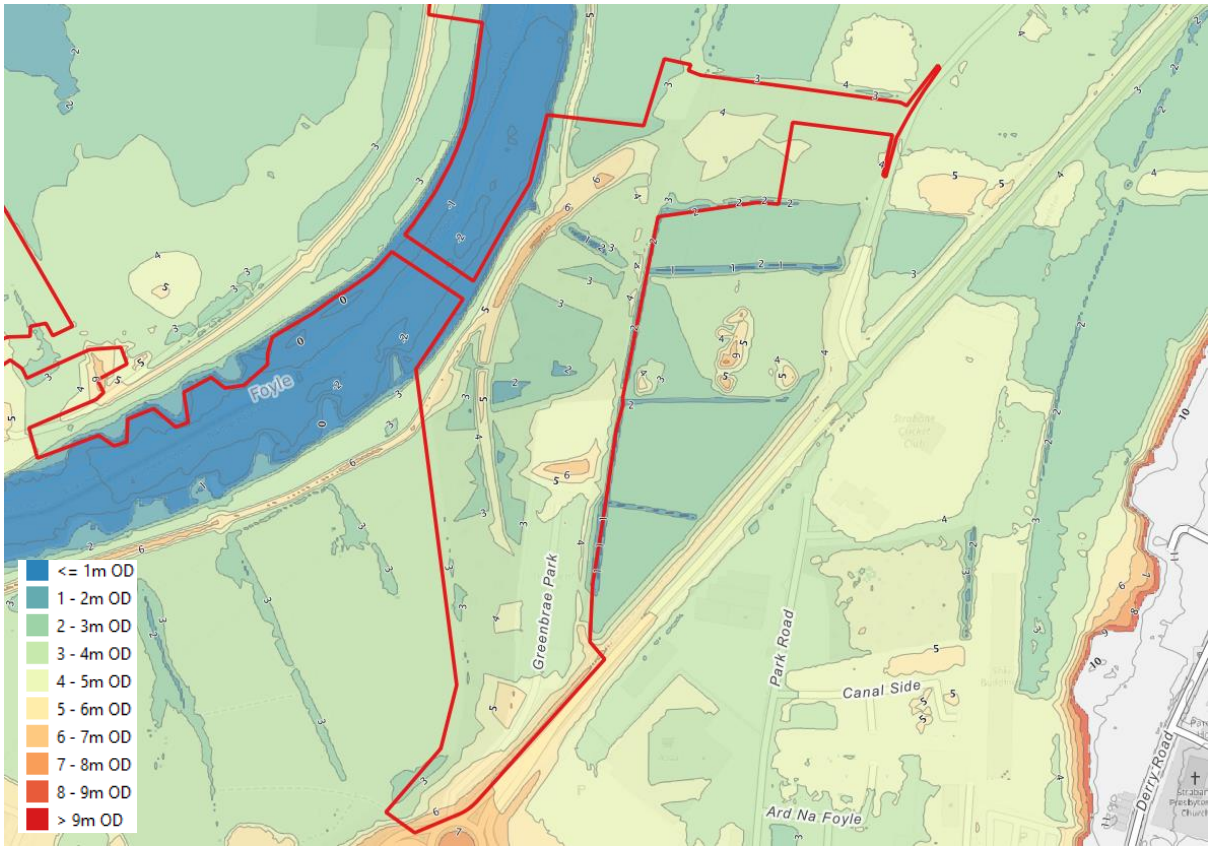



**Figure 2-6 -Topography – Strabane**

### 2.4.4 Hydrology and Watercourses

The River Foyle is common to both jurisdictions and forms the boundary between the two. Watercourses within the sites have been subject to a detailed water feature survey described in the overarching Chapter 9 – Land, Soils and Water chapter of the Environmental Impact Assessment Report.

On the Lifford site, a minor ditch / sheugh drains north to an unnamed watercourse that forms the northern application boundary. The northern boundary drain is associated with an OPW arterial drainage scheme and is known as channel C2/1 of the Deele and Swillyburn scheme.

On the Strabane site, designated watercourses known as the Park Road Drain and Nancy Burn are within or form boundaries to the site. Three existing pond / wetland areas are within the site. Drainage to/from the ponds appears to be informal with no apparent connectivity to the designated watercourses. The Nancy Burn outfall to the Foyle under is culverted under the earth embankment and its outlet is controlled by a non-return valve.

Watercourses are indicated on Figure 2-7.

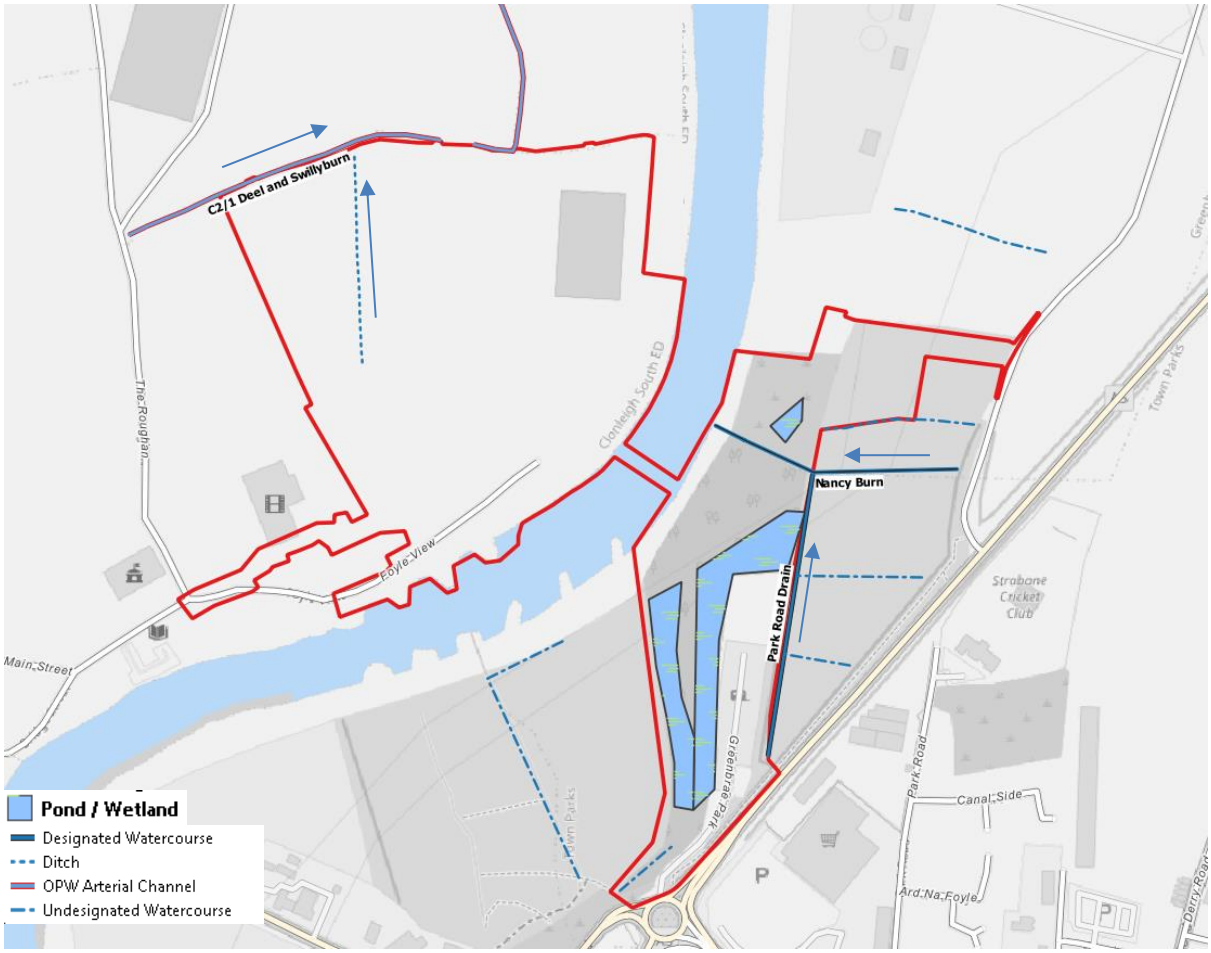



**Figure 2-7 Watercourses**

# 3 FLOOD DATA GATHERING

As part of the study data collection phase, several available sources of information were investigated to build an understanding of the potential risk of flooding to the site.

This chapter is common to both jurisdictions given the River Foyle is transboundary, and information gathered in relation to each jurisdiction may inform screening of flood sources or pathways in the other jurisdiction.

The following review highlights the key findings of the anecdotal evidence collection exercise.

## 3.1 Internet / Media / Background Search

There is a well-established history of flooding in the site locale from the Foyle system including flooding from the largest magnitude flood on record (1987). Media / planning file searches did not yield any site-specific evidence over and above information obtained separately from stakeholder consultees.

## 3.2 Department for Infrastructure (DfI) – Rivers

DfI Rivers consultation and data is relevant to the Strabane site and transboundary elements.

### 3.2.1 Pre-Application Consultation

DfI Rivers Planning Advisory and Modelling Unit (PAMU) in consultation dated 18 August 2020. A brief summary of the matters raised per policy is as follows:

- Policy FLD1: The (Strabane) site lies in the 1-in-100-year floodplain with a present-day flood level of 4.83 m OD and climate change flood level of 5.41 m OD. Policy FLD1 will not permit development within flood plains unless it meets the "Exceptions Test".
- Policy FLD2: The site contains a number of watercourses designated under the terms of the Drainage Order and the development should make provision for maintenance per paragraph 6.32 of the Policy.
- Policy FLD3: The proposed planning application exceeds the thresholds requiring a Drainage Assessment.
- Policy FLD4: Will apply to any proposed culverts to watercourses.
- Policy FLD5: Does not apply.

Correspondence is included in Appendix B.

### 3.2.2 Local Area Office / Asset Management Consultation

The local area office and was consulted through stakeholder meetings including a presentation of the proposed scheme via a meeting on 13 August 2021, with a view to obtaining any constructive feedback especially in relation to the suitability of proposed works affecting designated flood defence embankments.

DfI Rivers indicated concern in relation to introducing public access onto flood defence assets, risk to the public in the event of a failure / blowout (partial collapse) of the defence under flood conditions, liability, and effects to structural integrity of the defences.

DfI Rivers confirmed that while the embankment adjacent to the Foyle has no formal standard of protection and there is no plan to upgrade the standard of protection, it deems the structure to offer some protection and there is no plan or policy to abandon or downgrade the defence asset.

DfI Rivers acknowledged that securing its agreement to proposals to satisfy engineering concerns in relation to the effect of the scheme on the defence would be via applications under Schedule 6 of the Drainage Order, provided that there was an acknowledgement that the granting of planning permission would not compel DfI Rivers to grant its latter authorisations required by the terms of the Drainage Order.

Minutes of the meeting are included in Appendix B

### 3.2.3 Asset Information

Dfl Asset information was reviewed in relation to designated watercourses and flood defence assets.

#### *3.2.3.1 Designated Watercourses*

Dfl Rivers maintains watercourses as shown on the following

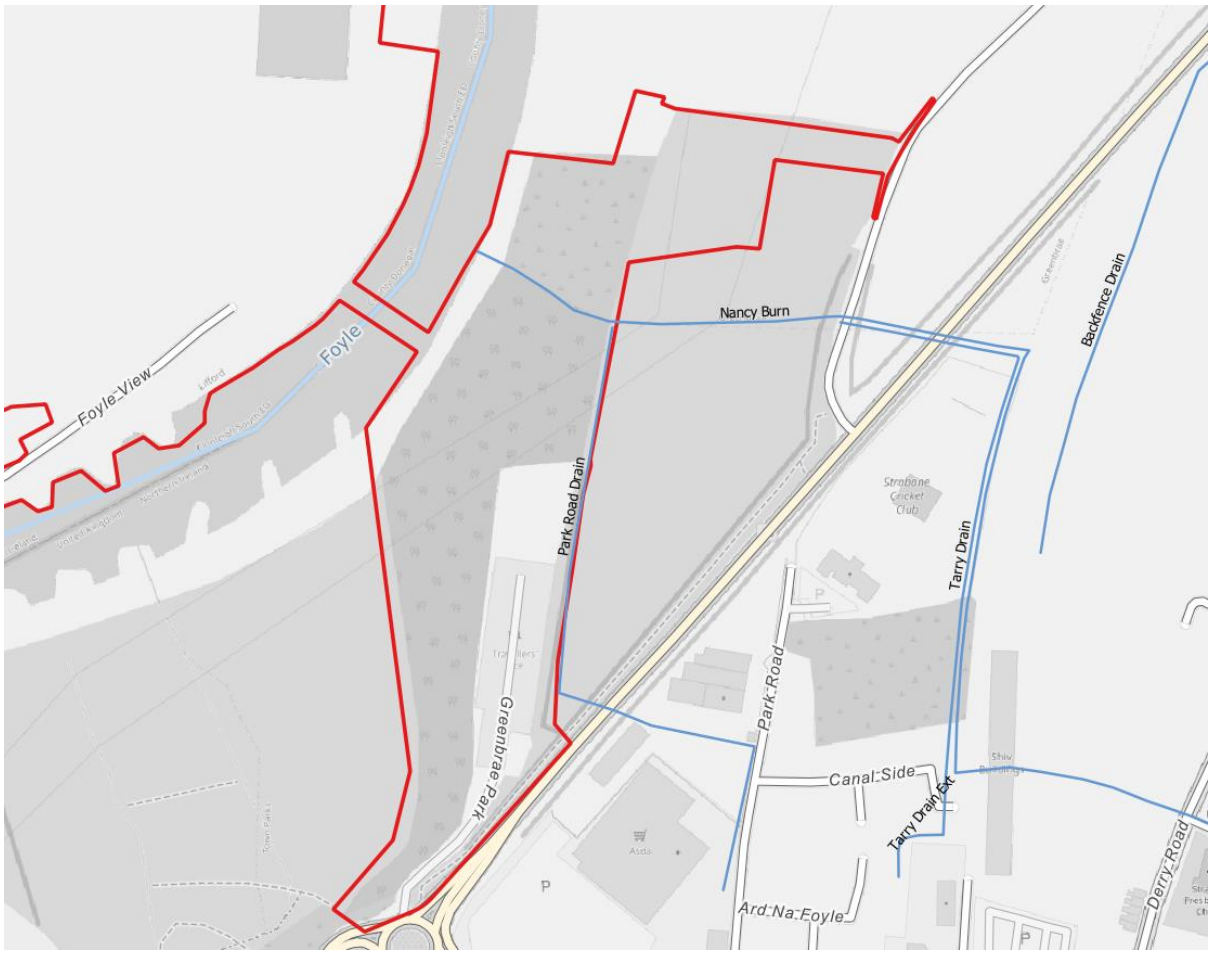



**Figure 3-1: Designated Watercourses**

#### 3.2.3.2 Flood Defences

The following Figure 3-2 indicates DfI maintained flood defence assets.

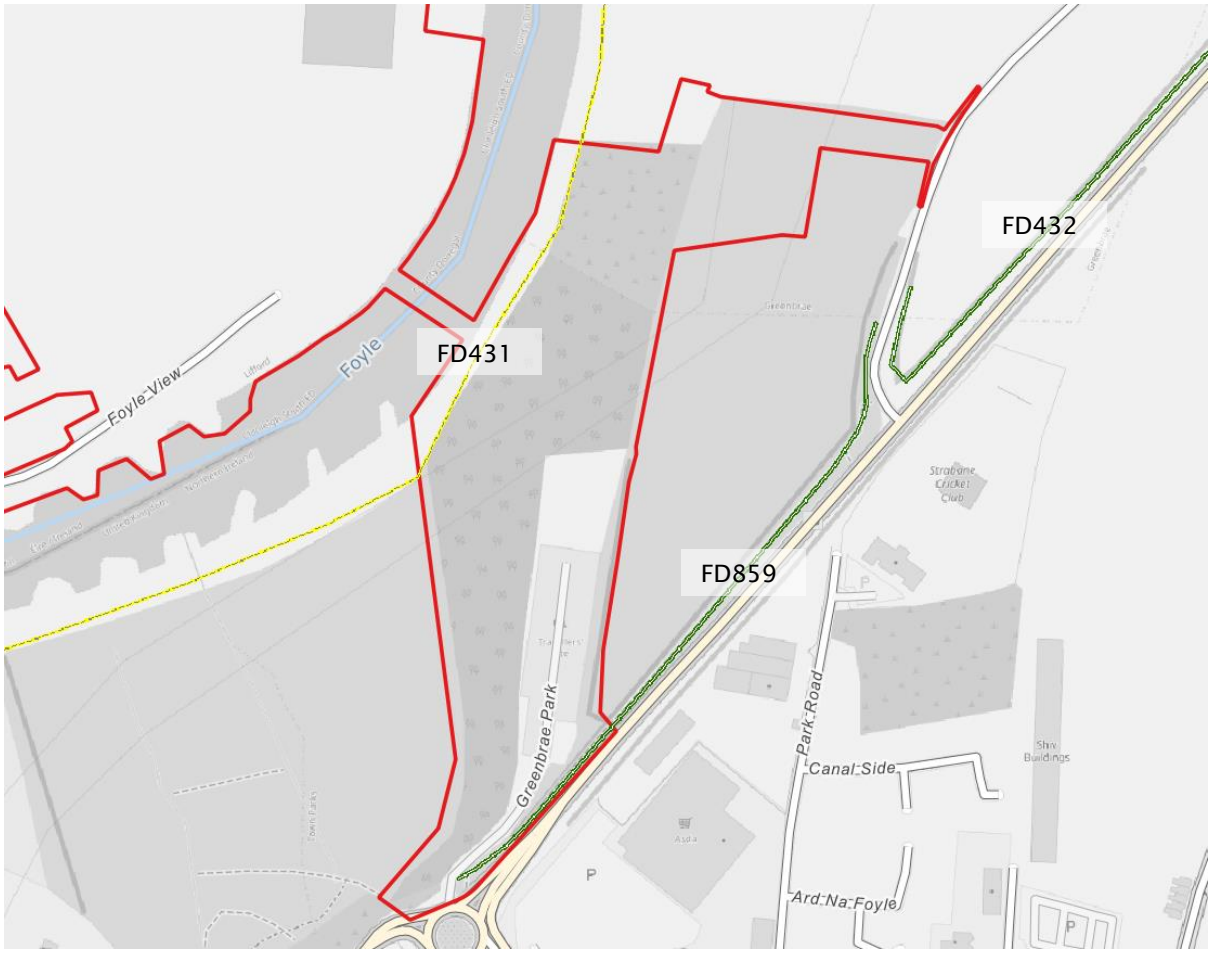



**Figure 3-2: DfI Rivers Flood Defence Assets**

Defence asset 431 is a DfI Rivers owned / maintained clay core embankment of height 3-4m. Review of flood mapping indicates the crest height is higher than adjacent flooding, however the defence offers no stated standard of protection due to it being short circuited. Latter consultation with DfI Rivers indicated that the structure of the defence is of varying quality and the defence has been prone to damage by mammal burrowing.

Defence assets 432 and 859 are DfI Rivers owned / maintained steel core embankments of height 3-4m and 5-6m respectively. Both defences offer a standard of protection of greater than or equal to 1% AEP to adjacent fluvial flooding. Benefitting lands are to the east of the Strabane site.

### 3.2.4 Flood Maps NI

As part of the FRA procedure, the location of the site was reviewed with reference to Flood Maps NI[1]. Extracts from the flood maps relevant to the assessment are shown in the following figures and are summarised as follows:

[1] Department for Infrastructure (2021). Flood Maps NI. Available from: https://www.infrastructure-ni.gov.uk/topics/rivers-and-flooding/flood-maps-ni

- The fluvial flood map derived from detailed flood modelling indicates that the Strabane site is significantly affected by the 1% AEP floodplain. The flood extents extend to indicate flooding of the Lifford site.
- The tidal flood map derived from detailed flood modelling does not extend sufficiently upstream to Strabane-Lifford. While the Foyle is likely to be tidally influenced on the reach, the 0.5% AEP flood level indicated on FMNI at New Buildings approximately 17km downstream of the site is 2.89 m OD and as such is considerably lower than predicted fluvial flooding.
- The indicative surface water flood map indicates the Strabane site is affected by localised pockets of surface water flooding for the 0.5% AEP event. The indicative model extends to indicate 3 discrete areas of surface flooding in the Lifford site.
- The Reservoir Flood Map indicates that the site is unaffected by the inundation zone of any Controlled Reservoir in Northern Ireland.
- The historic flood events viewer indicates flooding to part of the Strabane site from a flood in October 1987. The flood record extents to indicate recorded flooding of the Lifford site for the same flood event. Flood extents are derived from aerial photography.

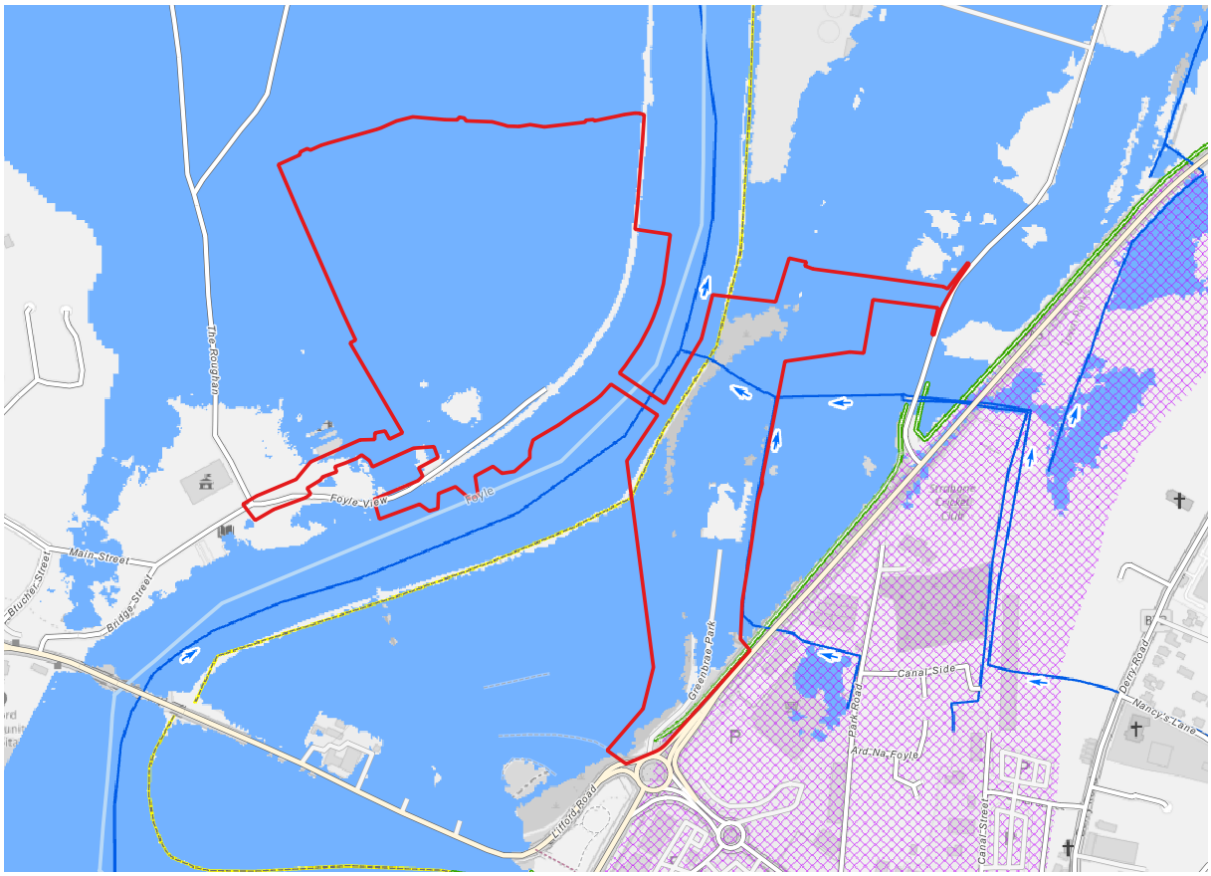



**Figure 3-3: Extract from Flood Maps (NI) – Detailed 1% AEP Fluvial Flood Extents**

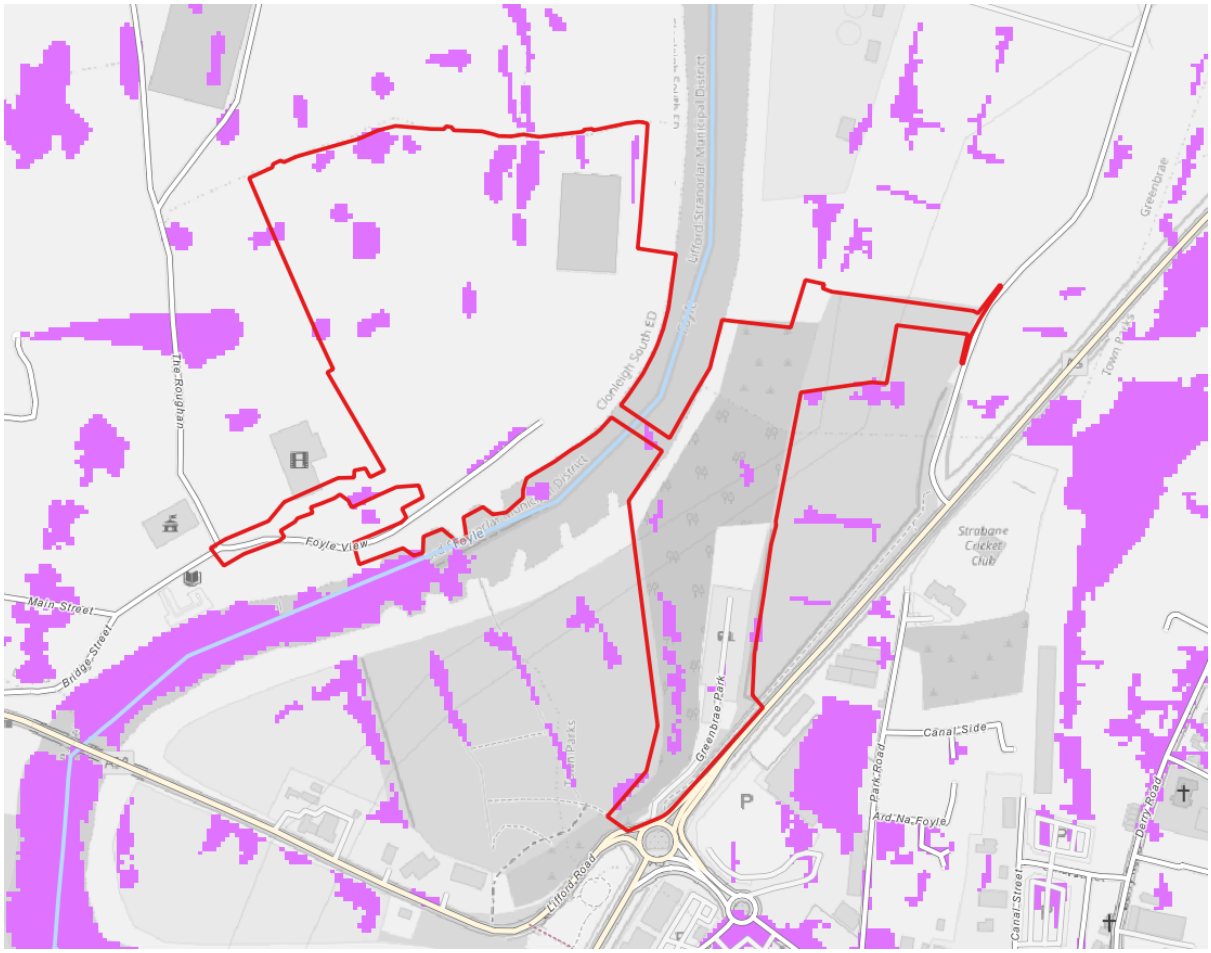



**Figure 3-4: Extract from Flood Maps (NI) – Indicative 0.5% AEP Surface Water Flood Extents**

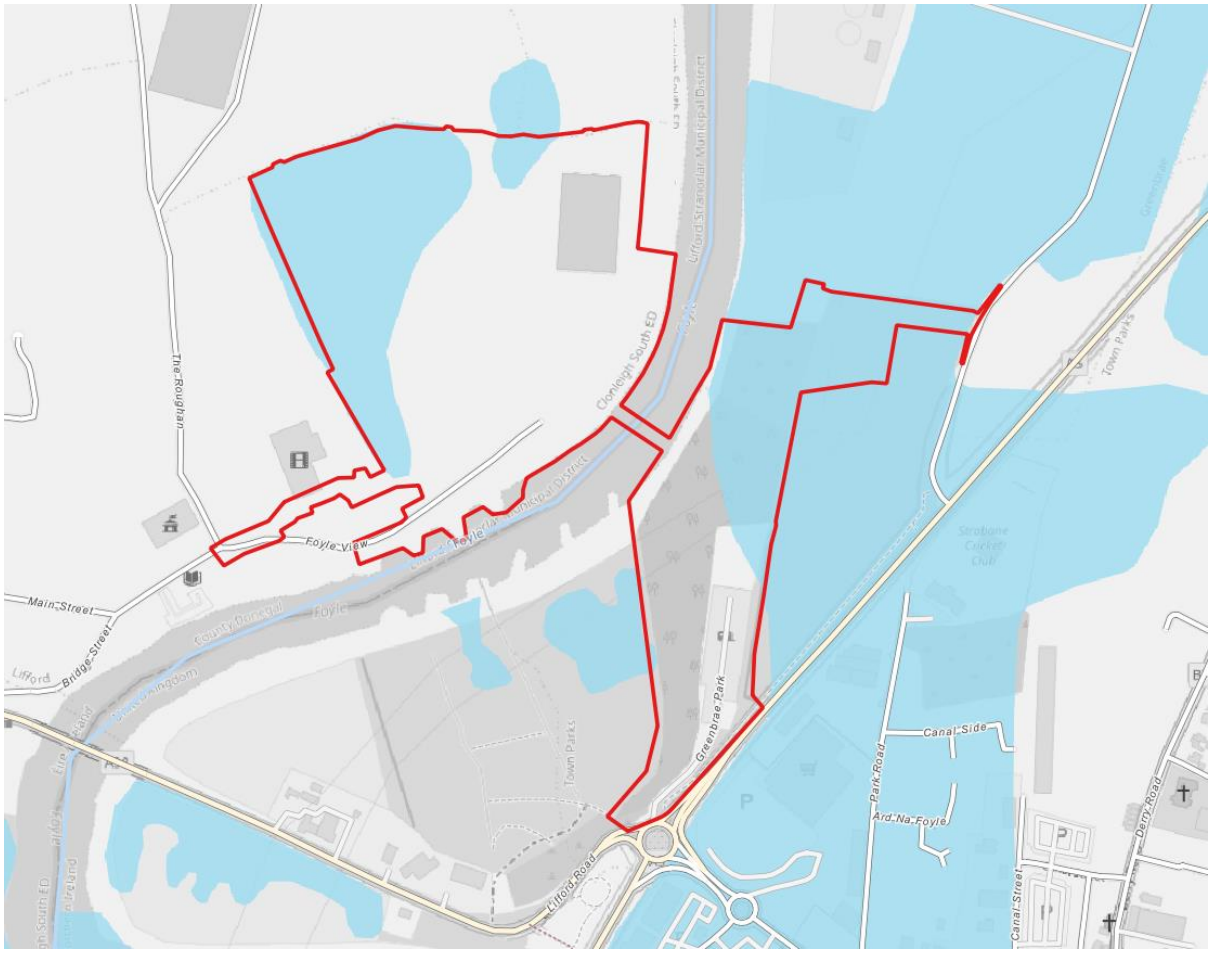



**Figure 3-5: Extract from Flood Maps (NI) – Historical Flood Extent**

## 3.3 Northern Ireland Water

### 3.3.1 PAD Consultation

NIW has indicated in its PAD reply that the proposal would not have a significant impact on existing NIW infrastructure.

### 3.3.2 Out of Sewer Flooding

Northern Ireland Water is unable to provide an indication of history of flooding from its assets for reasons of data protection.

### 3.3.3 NI Water Assets

A review of NI Water Asset information indicates a combined sewer traversing the east of the Strabane site. A sewer of unknown function drains Greenbrae Park, draining south away from the site. A digitised version of NIW records is included at the following figure.




**Figure 3-6: Northern Ireland Water Sewer Asset Information**

## 3.4 Office of Public Works Data

### 3.4.1 Preliminary Flood Risk Assessment (PFRA)

The Office of Public Works (OPW) have developed draft Flood Maps as part of the Catchment Flood Risk Assessment and Management (CFRAM) Programme.

The first stage of the CFRAM process was to produce a Preliminary Flood Risk Assessment (PFRA) that included flood mapping for the entire country. The PFRA is a preliminary assessment based on available or readily derivable information. The analysis was undertaken to identify areas prone to flooding, but the analysis is indicative, and mapping is considered to be coarse and is designed to inform further stages in the CFRAM process.

The PFRA mapping includes assessment of flooding from fluvial, coastal and surface water flooding. Extracts from those maps are shown on the following figure, with fluvial (river) flooding shown blue. The Lifford site is predicted to be affected by fluvial flooding.

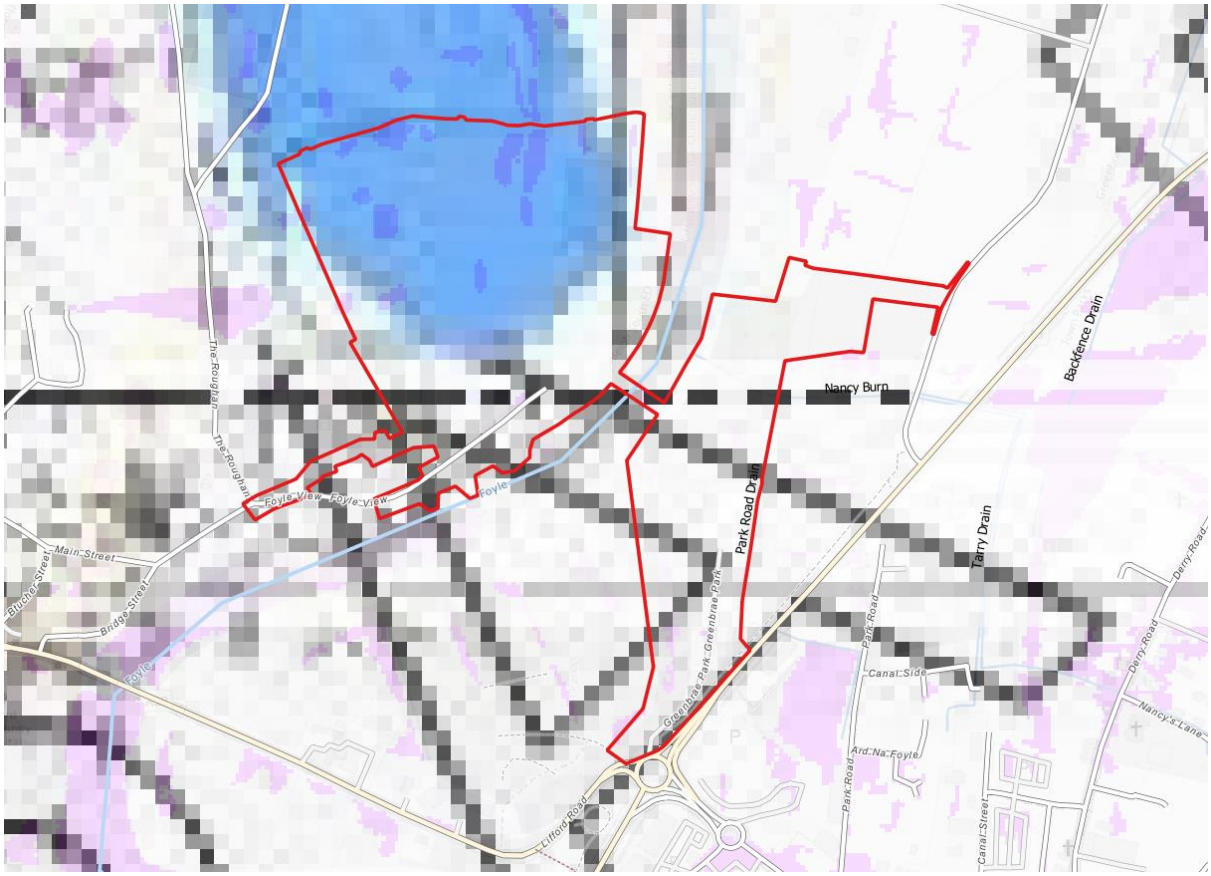



**Figure 3.7: Site vs OPW Preliminary FRA Mapping**

Fluvial flooding predicted from latter detailed CFRAM mapping (discussed subsequently) would take precedence over PFRA fluvial outlines where modelled reaches coincide.

Review of supporting technical information in relation to the production of the mapping confirms that the topographic data on which the model is based is the National Digital Height model (derived from a 25 m resolution grid) and as such is likely to be of insufficient resolution to represent local land drainage and arterial drainage scheme channels.

### 3.4.2 Catchment Flood Risk Assessment and Management (CFRAM) Programme

As part of the Catchment Flood Risk Assessment and Management (CFRAM) Programme, the OPW produced detailed flood maps for areas identified by the national Preliminary Flood Risk Assessment (PFRA) as being at significant risk of flooding. CFRAM includes mapping of flooding on the Foyle system at Lifford.

CFRAM flood outlines (per floodinfo.ie) is shown in Figure 3-8.

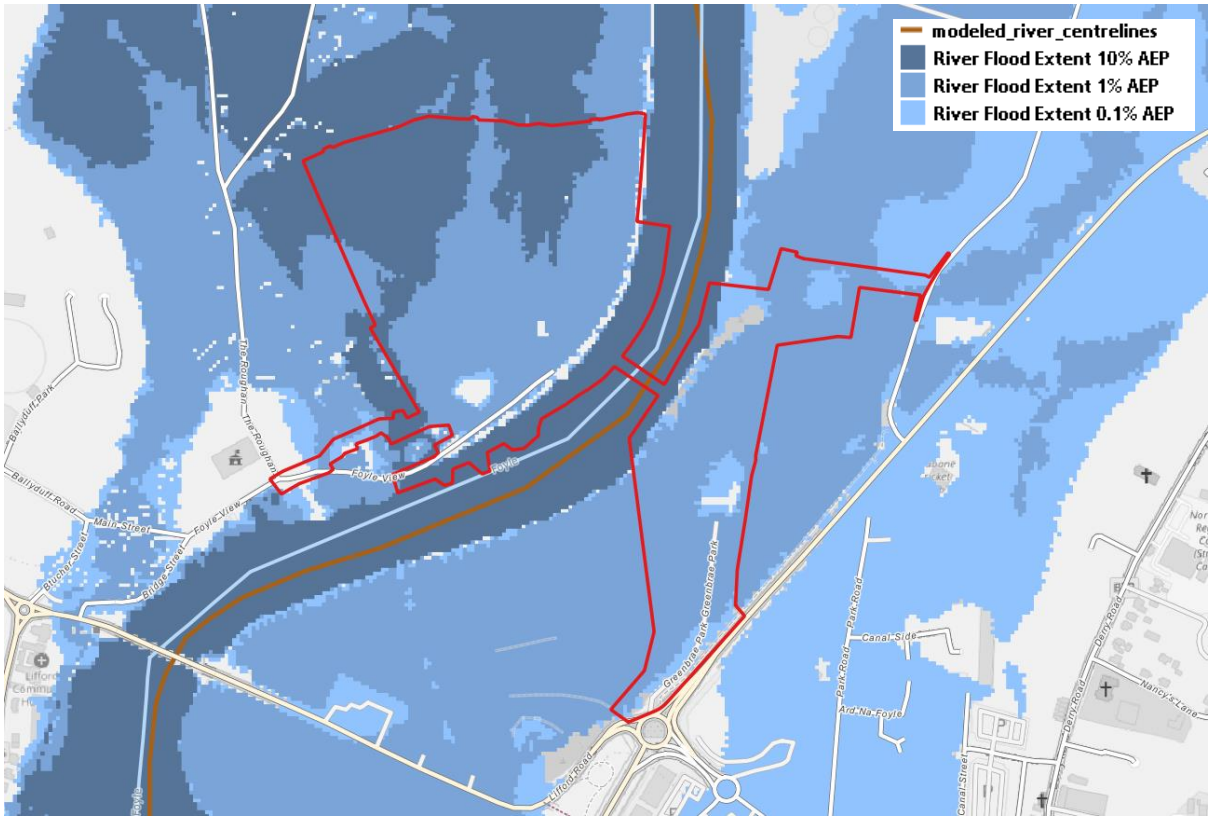



**Figure 3-8: OPW CFRAM Flood Outlines**

The Lifford site is indicated to be partly affected by the 10% AEP (10-year) event and substantially inundated for the 1% AEP (100 year) and greater magnitude floods.

The Strabane site is indicated to be substantially inundated for the 1% AEP (100 year) and greater magnitude floods.

OPW coastal flood data does not extend to the site.

### 3.4.3 OPW Past Flood Events

OPW 'Past Flood Event' mapping (available at floodmaps.ie) shows no recorded flooding in the vicinity of the site.

### 3.4.4 Arterial Drainage Assets

The Lifford site is indicated to lie within the benefitting area of an arterial drainage scheme known as the Deele and Swillyburn scheme comprising drains and channels. Drainage and embankment assets associated with the scheme are indicated on Figure 3-9.

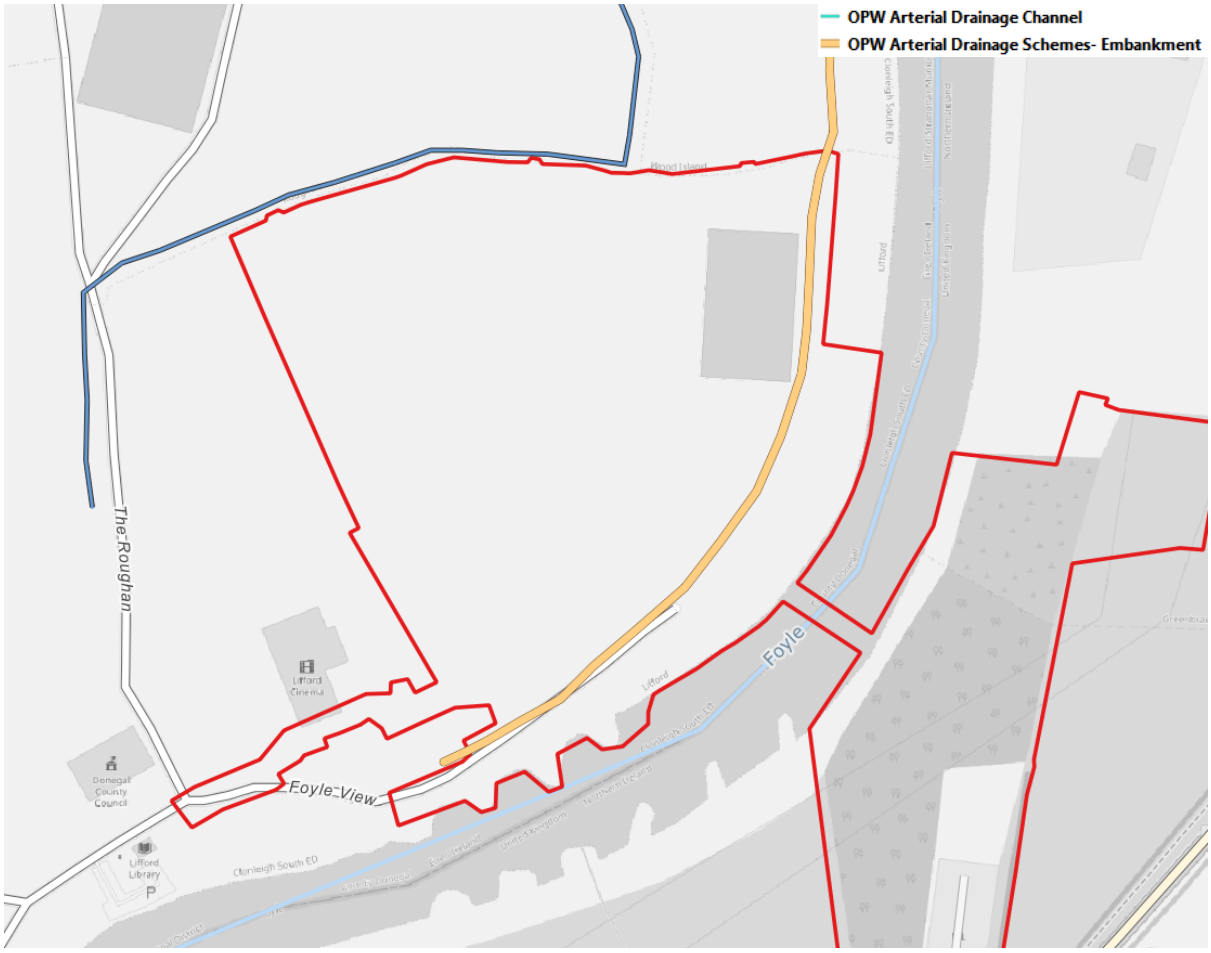



**Figure 3-9: OPW Arterial Drainage Assets**

### 3.4.5 OPW Consultation

OPW was consulted via a meeting in May 2021 to discuss the scheme and in particular its effect to existing flood defence assets. Key outcomes of the meeting were:

- Works affecting the flood embankment will be subject to Section 9 Authorisation (for works affecting an arterial drainage scheme).
- Existing maintenance is typically undertaken using a 25t long reach excavator.
- The proposed bridge will be subject to Section 50 authorisation and the standards therein.
- OPW expressed concern in relation to potential for differential settlement between re-aligned defences and existing defences.
- OPW requested clarification in relation to liability for walkway / cycleway infrastructure over flood defence assets and that details of insurances be included within any future Section 9 application to alter the flood defences.
- OPW requested clarification in relation to maintenance requirements for the embankment within the park.

### 3.4.6 Lifford Flood Relief Scheme Consultation

Donegal County Council (CC) is presently in the planning / design phase of an OPW funded Flood Relief Scheme (FRS) for Lifford. The Riverine design team has engaged with the consultant acting for Donegal CC / OPW in relation to available flood data and to ensure that the Riverine scheme is complementary to the objectives of the FRS.

Information provided / discussed at meeting with the FRS consultants, relative to assessment of flood risk at the site, is summarised as follows:

- The OPW CFRAM model was based on the DfI Rivers Foyle model with relevant watercourse and ground survey added on the Lifford side. The FRS consultants opined that both the CFRAM and DfI Rivers models would be fit for purpose for the basis of this assessment.
- There is approximate 3-year timescale difference between the Riverine CP and completion of the Lifford FRS so the FRS cannot be relied upon as part of the Riverine scheme.
- The primary source of flooding at the site is from the River Deale to the north, not the adjacent River Foyle which is separated from the site by flood defences which provide protection.
- However, the Riverine design proposals should take into account land requirements for the FRS as well as min. crest levels of embankments, particularly at the Riverine site entrance where ground levels are likely to be raised.
- The FRS consultants have run a version of the hydraulic model with an embankment that fully protects the Lifford side of the Riverine scheme, and this assessment demonstrated negligible impact on flood levels elsewhere. Therefore, changes to ground levels within the site is very unlikely to increase flooding off-site.

# 4 FLOOD RISK ASSESSMENT

## 4.1 Initial Assessment

Table 4.1 presents a screening assessment of the site for potential flooding mechanisms requiring further detailed assessment. It is based on the background information review and consultations.

**Table 4.1: Potential Flooding Mechanisms**

| Source / Pathway | | Significant? | Reason |
|---|---|---|---|
| **Fluvial Flooding** | Floodplain | Yes | OPW CFRAM flood mapping and DfI Rivers flood mapping shows that the site is in an area at risk of fluvial flooding. |
| | Flood Defence Failure | Yes | OPW and DfI data indicate that the Lifford and Strabane sites lie in areas behind adopted flood defence embankments, although neither defence offers a standard of protection of benefit to the land. |
| | Culvert / bridge Blockage | No | There is no bridge on the Foyle downstream of the site.<br>There is no culverted watercourse affecting the Lifford site.<br>The Nancy Burn watercourse is culverted under a flood embankment on the Strabane site. The consequences of flooding from failure of that culvert would not be significant in the context of flooding from the Foyle and is not a significant flood risk in isolation. |
| **Coastal Flooding** | | No | The Foyle is likely to be tidally influenced, however downstream extreme tidal flood elevations are not sufficient to cause a significant flood risk to the site in isolation.<br>Joint probability analysis of coastal influence on extreme fluvial flooding is included within the fluvial flood modelling exercise analysed in latter sections of the detailed assessment. |
| **Urban Drainage** | | No | There is no indication of urban drainage flooding / sewer incapacity from an initial evidence search. |
| **Pluvial / Surface Water Flooding** | | No | DfI Rivers Surface Water flood data indicates localised surface flood risk to the Strabane and Lifford sites. The DfI model methodology extends to Lifford and is suitable for use in that jurisdiction in this instance.<br>The predicted surface water flooding coincides with areas of proposed green space / wetlands and does not conflict with any aspect of built development and is not significant.<br>Drainage impact (to flooding elsewhere) is assessed in separate submissions. |
| **Groundwater** | | No | A detailed water features survey has identified that groundwater is tidally influenced. Shallow groundwater in permeable deposits is likely to be contiguous with water levels in the River Foyle and flood risk from this source is more appropriately assessed as fluvial, given flood defences structures are ineffective. |

| Source / Pathway | Significant? | Reason |
|---|---|---|
| **Reservoirs / Artificial Sources** | No | The combined site is unaffected by flooding from any controlled reservoir in Northern Ireland.<br>A screening assessment based on OSI mapping indicates that there are no reservoirs or other artificial impoundments near or that drain towards the site. |

## 4.2 Fluvial Flooding

### 4.2.1 Flood Model Context

Further to consultation with OPW and its consultants in relation to the Lifford Flood Relief Scheme and flood modelling work being undertaken to inform that scheme, an appropriate flood model strategy was developed to inform this project. The flood model is developed from the OPW Foyle model but to include increased definition in terms of Northern Ireland topography, and general improvements to best represent topography within the site and 1D-2D links including embankment representation. Flood model development is fully described in Appendix C.

Flood model simulations were developed and have been produced to supersede OPW CFRAM (Lifford) and DfI Rivers Flood Maps NI (Strabane) Flood data.

The following sections of this chapter present the flood risk and flood mechanisms on a site-wide basis, given that the primary flood mechanism (flooding from the River Foyle system) is transboundary. Interpretation of policy requirements in each jurisdiction are assessed separately in Chapter 5 (Lifford) and 6 (Strabane) respectively.

### 4.2.2 Pre-Development Flood Risk

Flood extent and flood depth to the lands for standards relevant to flood risk planning policies and flood protection standards (1% AEP / Q100 and 0.1% / Q1000) are shown on the following figures.

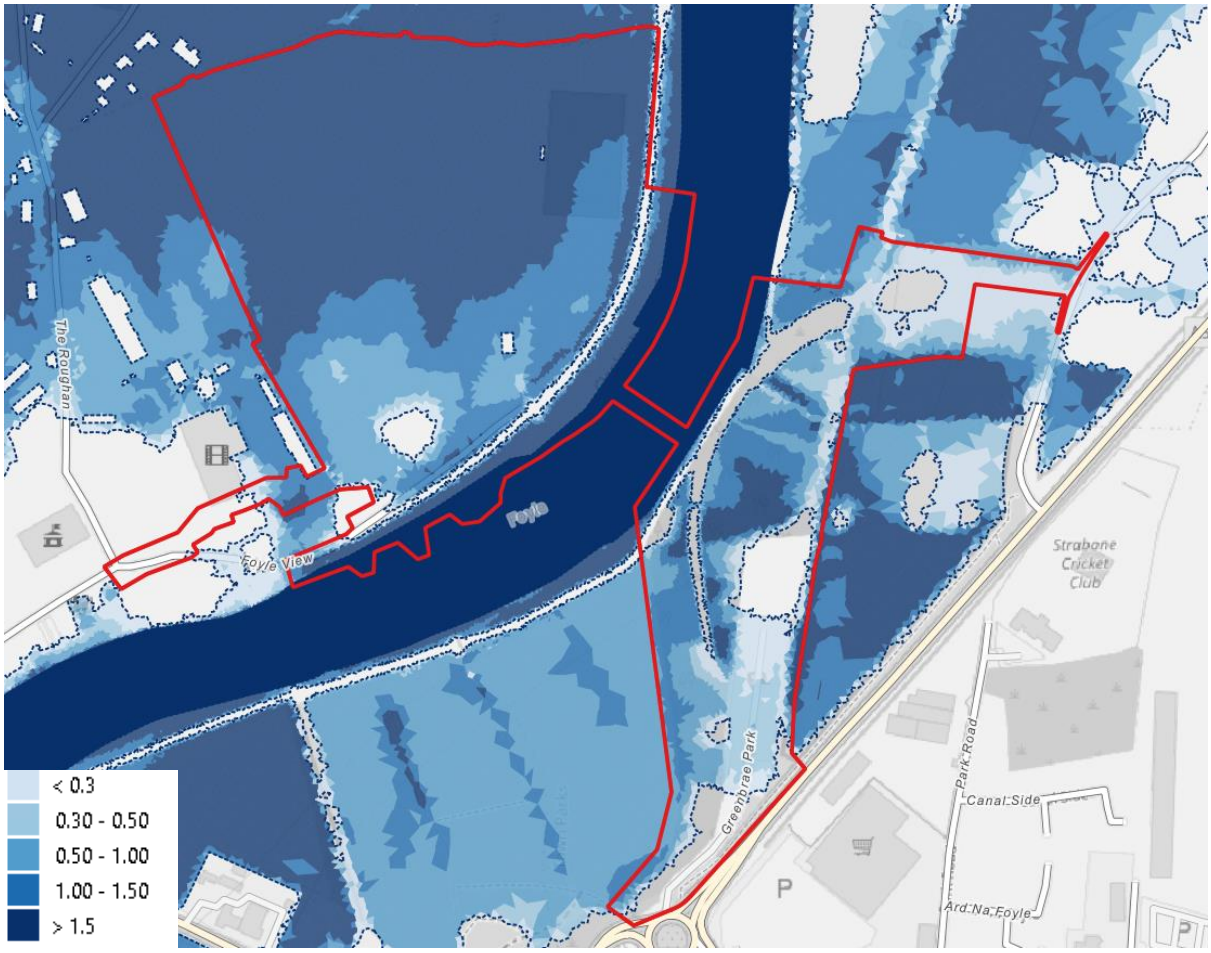



**Figure 4-1: Existing 1% AEP PD Flood Extent by Depth**

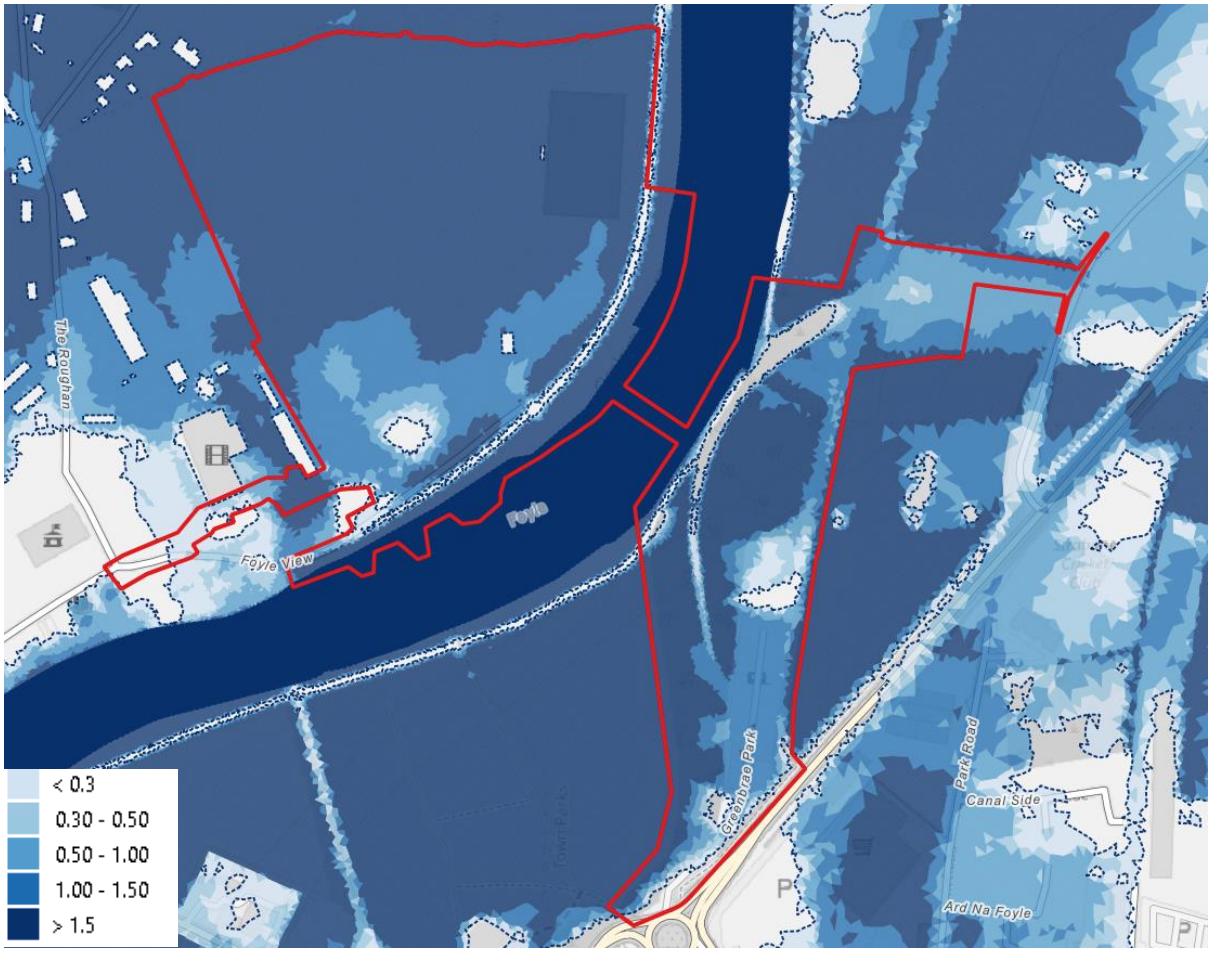



**Figure 4-2: Existing 0.1% AEP PD Flood Extent by Depth**

Interrogation of the flood model dataset confirms that flooding of the Lifford site is primarily as a result of short circuiting of flood defences to the River Deele downstream of the site, with floodwater backing up from the Foyle into that river and flowing onto the low-lying floodplain behind river-side defences.

Flooding of the Strabane site is predominantly as a result of overtopping of flood defences and the A5/N14 upstream of the site.

Flood model information is included in Appendix C. Detailed Flood Extents Mapping is provided in Appendix D.

Policy context of flood risk and mitigation of the effects of fluvial flooding, including the effect of climate change, is discussed further in Chapter 5 (Lifford) and 6 (Strabane) respectively.

### 4.2.3 Post-Development Flood Risk

The proposed development results in changes to ground levels within the site, and introduction of a new bridge spanning the River Foyle. As such the development would have potential to cause a change to flood risk and affect flood risk elsewhere.

The effect of development has been evaluated by building an iteration of the flood model, to reflect proposed land raising / excavations and groundworks, and any new structures or buildings likely to obstruct or divert floodwater. Details of the representation of the proposed scenario is described in in Appendix C. Key aspects assessed are as follows:

- Groundworks and land raising associated with proposed buildings, car parking, roads, paths and amenity areas.
- Realignment of a section of flood embankment on the Lifford site.

- Bridge abutments and a bridge pier associated with the proposed Foyle bridge crossing. The bridge pier is on the "river" side of the Lifford flood embankment, but outside the river channel.
- Earthworks / land re-grading associated with accommodation works to the north of the Lifford Riverine site.

River frontage aspects including fishing stands and a proposed slipway on the Lifford side were not modelled. The fishing stands by their nature would not have a significant hydraulic effect. The proposed slipway has been designed to be in "cut" within the bank and will cause no new obstruction in the river channel and can have no effect on flood hydraulics.

Flood extent and flood depth to the lands for standards relevant to flood risk planning policies and flood protection standards (1% AEP / Q100 and 0.1% / Q1000) are shown on the following figures.

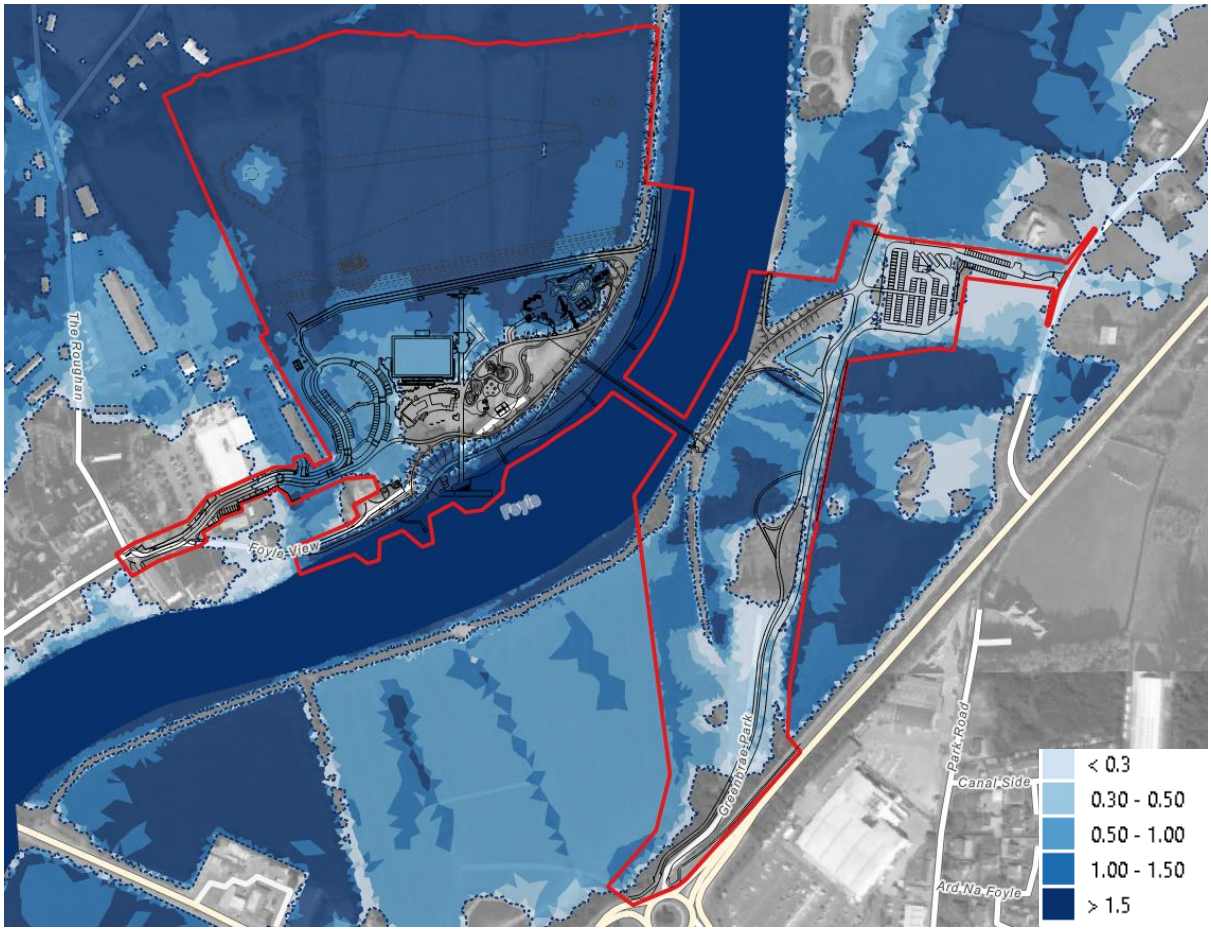



**Figure 4-3: Proposed 1% AEP PD Flood Extent by Depth**

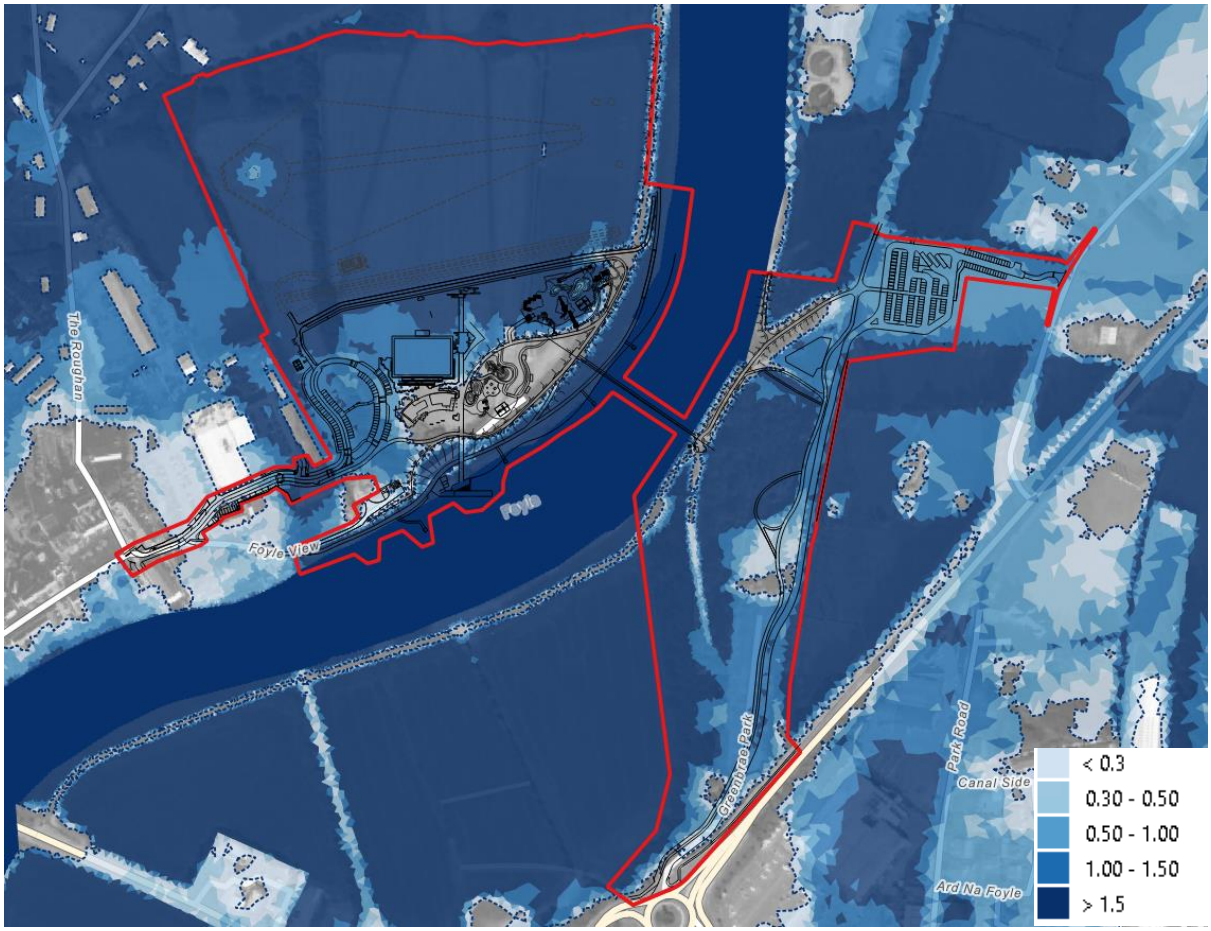



**Figure 4-4: Proposed 0.1% AEP PD Flood Extent by Depth**

The land remains subject to extensive flooding for the scenarios considered, with the notable change whereby the proposed Community Hub building (Lifford) is sited at an elevation that it is not susceptible to flooding including for the 0.1% AEP event.

Flood model information is included in Appendix C. Detailed Flood Extents Mapping is provided in Appendix D.

Risk to particular elements of the proposed development, policy context of flood risk and mitigation of the effects of fluvial flooding, including the effect of climate change, is discussed further in Chapter 5 (Lifford) and 6 (Strabane) respectively.

### 4.2.4 Effect of the Development

A key planning test in both jurisdictions in terms of suitability of the development, is that it would not be permitted to cause an adverse effect to flood risk elsewhere. It is relevant to consider this on a whole-site basis given potential for trans-boundary effect.

The effect of development has been evaluated by comparison of pre- and post- development flood model datasets. Model outcomes are shown on the following Figure 4-5.

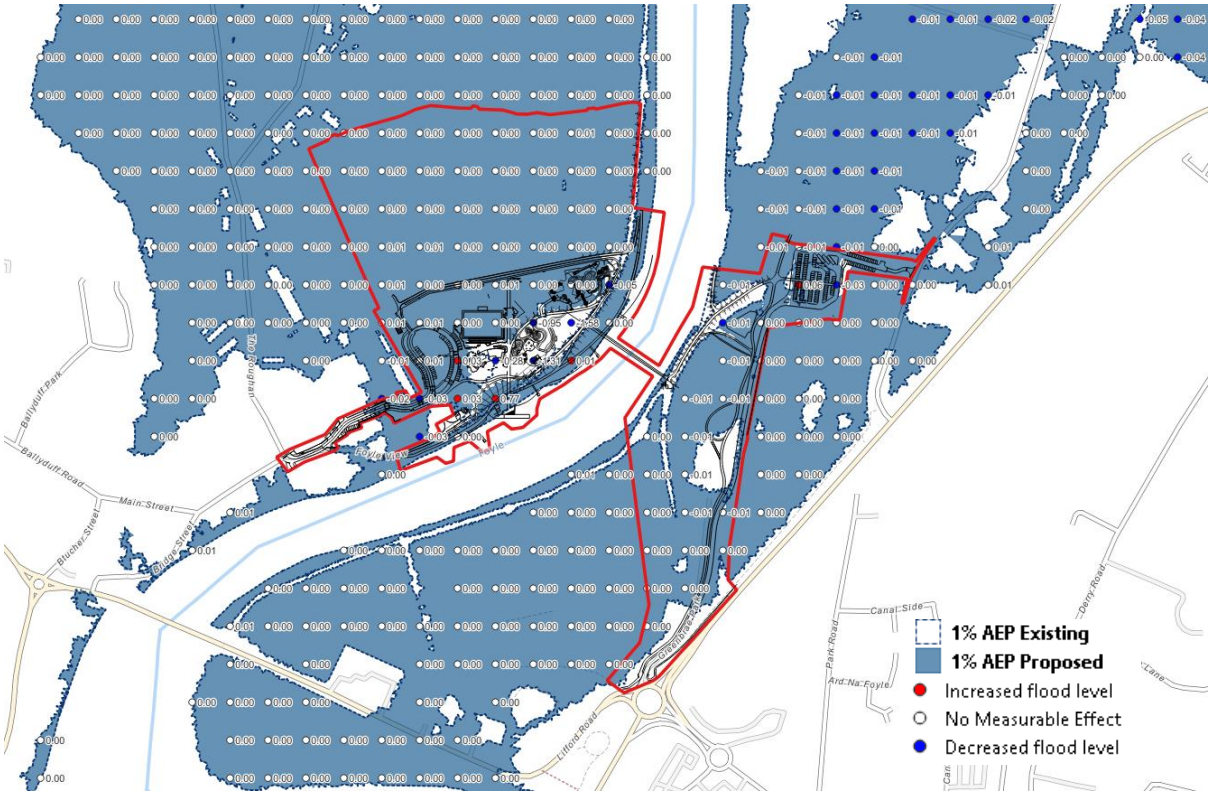



**Figure 4-5: Effect of Development (Extent / Water Elevation) – 1% AEP PD**

In summary, analysis of the whole model dataset confirms that for the scenario considered (relevant to planning policy / guidelines in both jurisdictions) there is no measurable affect attributable to the development outside the application site in either jurisdiction. Localised effects within the site are predicted, however these are acceptable in principle and are reflected in proposed predicted water levels that inform mitigation and flood resilience.

## 4.3 Flood Defence Breach

Risk of flooding from a flood defence breach, and mitigation to reduce the likelihood and hazard arising from a breach, is discussed on a site-specific basis in Chapter 5 (Lifford) and 6 (Strabane) respectively.

# 5 POLICY CONTEXT – LIFFORD, CO. DONEGAL

## 5.1 Planning Guidelines

The requirements for Flood Risk Assessments are generally as set out in Appendix A of the OPW document *The Planning System and Flood Risk Management – Guidelines for Planning Authorities*, 2009 (hereafter referred to as the 'OPW Guidelines'). Further guidance is provided in the OPW's Climate Change Sectoral Adaptation Plan, 2019, and CIRIA Research Project 624 Development and Flood Risk – Guidance for the Construction Industry, 2004.

Planning guidelines applicable to the site are implemented in the County Donegal Development Plan 2018-2024, specifically through Section 5.4: Flooding.

### 5.1.1 Flood Zones

The Development Plan was prepared in accordance with the requirements of the OPW Guidelines and adopts an identical Flood Zone standard to the national planning guidelines. Flood Zones are the extents of design flood events that determine whether development is appropriate from a flood risk point of view; they are defined in both the OPW Guidelines and development plan as follows:

- Flood Zone A – where the probability of flooding from rivers and the sea is highest (greater than 1% or 1-in-100 for river flooding or 0.5% or 1-in-200 for coastal flooding).
- Flood Zone B – where the probability of flooding from rivers and the sea is moderate (between 0.1% or 1-in-1000 and 1% or 1-in-100 for river flooding and between 0.1% or 1-in-1000 year and 0.5% or 1-in-200 for coastal flooding).
- Flood Zone C – where the probability of flooding from rivers and the sea is low (less than 0.1% or 1-in-1000 for both river and coastal flooding).

The OPW Guidelines clarify that Flood Zones are to be used to determine the suitability of proposed developments and are to be derived from 'present day' hydrological estimates. The OPW Guidelines also state that Flood Zones are generated without the inclusion of climate change and that, in addition to flood zoning, developments should be designed to be resilient to the effects of climate change.

## 5.2 County Donegal Development Plan 2018-2024

The County Donegal Development Plan 2018-2024 has been consulted as part of this assessment and the most relevant policies are as follows:

- **F-P-1:** All development proposals shall comply with the OPW Guidelines. In doing so, the planning authority shall assess developments in accordance with the sequential approach and precautionary principle and use Draft Flood Risk Management Plans (and any associated flood risk mapping) prepared as part of the CFRAM programme, or any other flood risk datasets or mapping it considers appropriate, for the assessment of flood risk.
- **F-P-2:** Applicants / developers are required to submit, where appropriate, an independent Flood Risk Assessment in accordance with the OPW Guidelines or any subsequent related publication and / or surface water drainage calculations carried out by suitably qualified persons.
- **F-P-3:** Applicants / developers are required to submit, where appropriate, evidence of compliance with the Justification Test set out in Section 5.15 of the OPW Guidelines or any subsequent related publication.
- **F-P-4:** Development shall not be permitted where flood or surface water management issues have not been, or cannot be, addressed successfully and / or where the presence of unacceptable residual flood risks remain for the development, its occupants, and / or property or public infrastructure elsewhere.
- **F-P-5:** The Council shall promote the use of Sustainable Drainage Systems (SuDS), flood attenuation areas, controlled release of surface water, and use of open spaces and semi-permeable hard surfaces for appropriate development proposals.
- **F-P-6:** The Council shall consider development of long- and short-term flood remediation works, including embankments, sea defences, drainage channels, and attenuation ponds, to alleviate flood risk and damage to livelihood, property, and business in accordance with appropriate environmental best practice and policies.

- **F-P-7:** The Council shall not to permit developments that would hinder the maintenance of rivers or drainage channels.

## 5.3 Vulnerability Classification

The proposed development is summarised in Section 2.3. Based on the classification criteria provided in the OPW Guidelines, the proposal comprises non-residential / commercial development and extensive park areas with the vulnerability classification shown in Table 5.1.

**Table 5.1: Vulnerability Classification**

| Type | Use | Classification |
|---|---|---|
| Community Hub Building | Commercial | Less Vulnerable |
| Foyle Bridge | Local Transport / Access | Less Vulnerable |
| Park / Pedestrian Pathways / Play Areas / Green Space / Outdoor performance space | Open Amenity Space | Water Compatible |

## 5.4 Sequential Approach

The Sequential Approach outlined in the OPW Guidelines requires development be sited in areas of lowest risk of flooding as far as possible. Development proposals for the site have followed a Sequential Approach by locating development of highest vulnerability (community hub building) in the southwest of the site where risk of flooding is lowest as shown on the OPW CFRAM map and confirmed by site specific hydraulic modelling.

## 5.5 Justification Test

While the Sequential Approach has been followed, due to the nature of the floodplain at the site and the requirement to facilitate access across the River Foyle, part of the less vulnerable development at the site has been sited in Flood Zone A.

Therefore, a Justification Test that is consistent with the site-specific FRA has been prepared and submitted under separate cover. The Justification Test outlines that the development is restricted to previously developed and / or appropriate areas, incorporates required flood risk mitigation (described subsequently in this report), and does not pose a risk of flooding to lands elsewhere.

## 5.6 Existing (Pre-Development) Fluvial Flooding

### 5.6.1 Existing Flood Risk - Present Day

Previous Figure 4-1 and Figure 4-2 indicates existing flood risk to the site. The site is substantially inundated within floodwater during the existing, present-day scenario for both the 1% AEP and 0.1% AEP events. The primary route of flooding impacting the site is out-of-bank flooding from the River Deele to the north as the site is protected by flood defences along the River Foyle.

In-channel flood levels in the River Foyle range from 5.03 – 4.67 m OD and 5.42 – 5.07 m OD for 1% AEP and 0.1% AEP floods respectively. Flood levels within the site are reduced due to their being dictated by the secondary flood route from the Deele. Flood levels in the site are 4.3 and 4.57 m OD for 1% AEP and 0.1% AEP floods respectively.

Full flood extents maps indicating flood elevations are provided in Appendix D.

### 5.6.1 Existing Flood Risk – Flood Zones

Previous Figure 4-1 and Figure 4-2 indicates confirm that the site is effectively undefended, and that the majority of the site lies in Flood Zone A. A detailed Flood Zone map is provided at map FL01, Appendix D.

## 5.7 Proposed (Post-Development) Fluvial Flooding

### 5.7.1 Preamble

The proposed development includes land raising within Flood Zone A and Flood Zone B within the Lifford site associated with the work described in Section 4.2.3, page 27.

The following report sections assess flood risk to the development as proposed and determine the effect of the development proposal on flood risk elsewhere.

### 5.7.2 Principle of Development

The majority of the development lies in the existing Flood Zone A, including parts of the proposed Community Hub building. The proposal is submitted on the basis that the Justification Test for those aspects not complying with the Sequential Approach is agreeable to the planning authority.

### 5.7.3 Risk to the Development – Present Day Hydrology

Previous Figure 4-3 and Figure 4-4 indicates present day flood of the site. The site is substantially inundated within floodwater during the existing, present-day scenario for both the 1% AEP and 0.1% AEP events from the River Foyle / Deele system.

In-channel flood levels in the River Foyle range from 5.03 – 4.67 m OD and 5.42 – 5.07 m OD for 1% AEP and 0.1% AEP floods respectively. Flood levels within the site are reduced due to their being dictated by the secondary flood route from the Deele. Flood levels in the site are 4.3 and 4.57 m OD for 1% AEP and 0.1% AEP floods respectively.

Additional flood risk from the minor watercourse to the northern boundary is discounted, where flooding from that channel would be dictated by downstream Deele / Foyle water levels.

Full flood extents maps indicating flood elevations for the proposed scenario are provided in Appendix D.

The following Table 5.2 schedules predicted flood depths and water elevations at key proposed receptors proposed as part of the development within the Lifford site.

**Table 5.2: Flood Levels & Depths at Receptors – Proposed Scenario / Present Day**

| Location | 1% AEP | | 0.1% AEP | |
|---|---|---|---|---|
| | Water Level (mOD) | Mean / Max Flood Depth (m) | Water Level (mOD) | Mean / Max Flood Depth (m) |
| Community Hub | N/A (4.32 adjacent) | N/A | N/A (4.59 adjacent) | N/A |
| Outdoor Events Space / External Stage | 4.30 | 0.85 - 1.26 | 4.57 | 1.15 - 1.54 |
| Car Parking | 4.30 | 0.8 – 1.2 | 4.57 | 1.18 – 1.68 |
| Junior Play Area | N/A (4.30 adjacent) | N/A | N/A (4.57 adjacent) | N/A |
| Senior Play Area | 4.30 | 1.2 - 1.8 | 4.57 | 1.4 - 2.1 |
| Maintenance Building | 4.30 | 1.1 - 1.3 | 4.57 | 1.4 - 1.6 |
| Fishing Stands | 5.1-- 4.9 | 2.1 | 5.58 – 5.38 | 2.5 |
| Accommodation Works – Spectator Building | 4.30 | 2.2 - 2.5 | 4.58 | 2.4 - 2.8 |

Given the significant flood risk to the site, additional consideration has been given to flooding of the site for less extreme flood events than those required by the planning guidelines. Modelling of a 10% AEP (1 in 10 year) flood has been undertaken and a flood map extract is shown at the following Figure 5-1.

That assessment tends to confirm that those aspects of greatest significance in terms of risk to users / occupants (community hub, play areas, outdoor events space) are unaffected by predicted high probability flooding. 10% AEP flood levels are up to 3.9 m OD and would cause flooding of up to 0.76m, primarily affecting access to Lifford (via Three Rivers) and car parking areas.

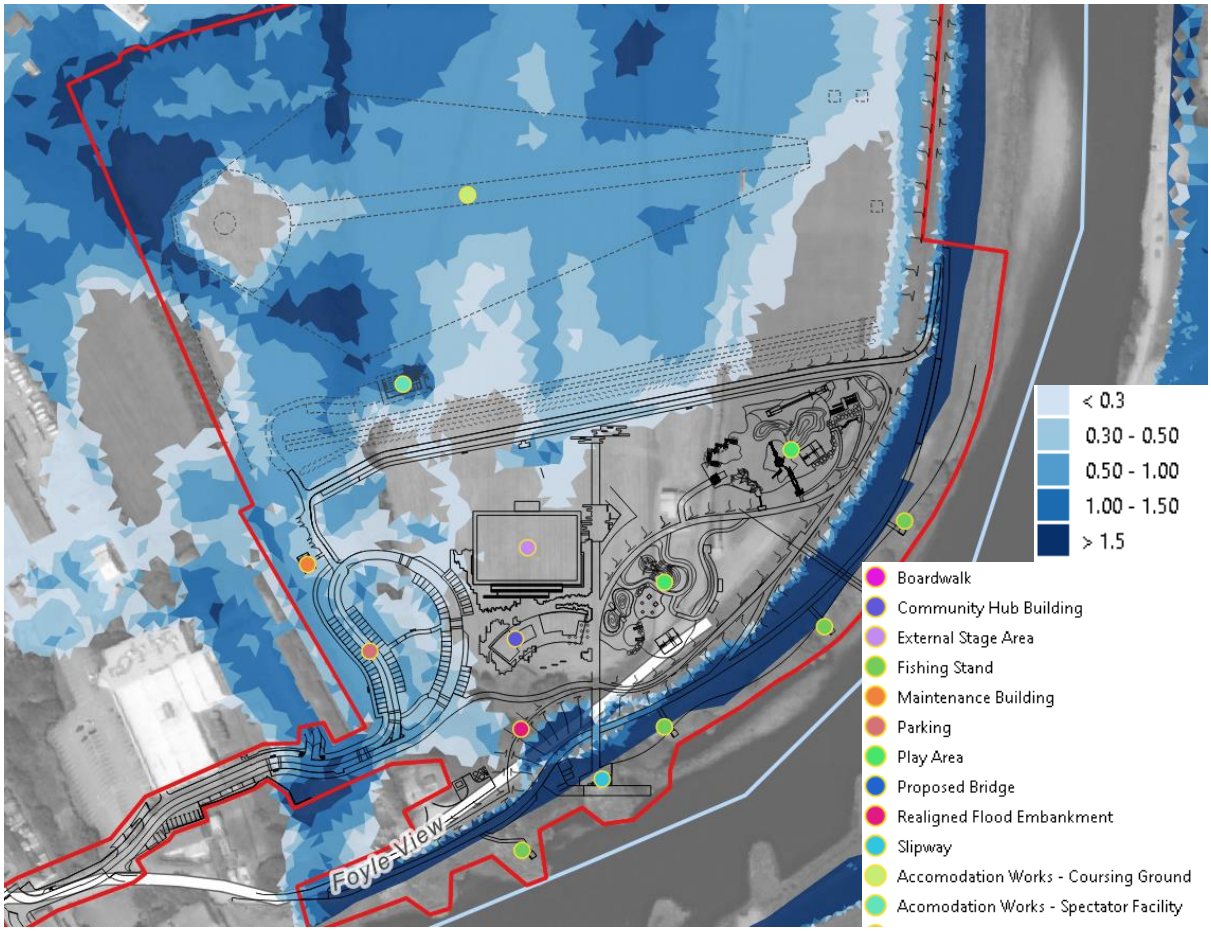



**Figure 5-1: Proposed 10% AEP PD Flood Extent by Depth - Lifford**

### 5.7.4 Proposed Flood Risk – Climate Change Hydrology

The OPW Guidelines require site-specific FRAs to consider increased flood risk to proposed developments under climate change (CC) scenarios. OPW guidance suggests using a Mid-Range Future Scenario, which represents a 20% increase in flood flows and / or 0.5 m increase in mean sea level, where applicable.

An estimation of the effect of climate change on flooding at the site has been derived from the detailed site-specific hydraulic model by adding 20% to the present-day design flows. Table 5.3 shows the predicted post-development climate change flood levels at the site. Allowance for climate change causes a typical increase in flood level of 0.25 m within the site for the 1% AEP flood magnitude.

**Table 5.3: Flood Levels & Depths at Receptors – Proposed Scenario / Climate Change**

| Location | 1% AEP | | 0.1% AEP | |
|---|---|---|---|---|
| | Water Level (mOD) | Mean / Max Flood Depth (m) | Water Level (mOD) | Mean / Max Flood Depth (m) |
| Community Hub | N/A (4.61 adjacent) | N/A | N/A (5.05 adjacent) | N/A |
| Outdoor Events Space / External Stage | 4.55 | 1.1 – 1.5 | 4.95 | 1.5 - 1.9 |
| Car Parking | 4.57 | 1.1 - 1.7 | 5.05 | 1.5-2.0 |
| Junior Play Area | 4.55 | N/A | 4.95 | 0.3 - 1.4 |
| Senior Play Area | 4.55 | 1.4 - 2.1 | 4.95 | 0.8 - 2.5 |
| Maintenance Building | 4.55 | 1.4 – 1.5 | 4.95 | 1.8 - 1.9 |
| Fishing Stands | 5.55 – 5.28 | 2.1 - 2.4 | 5.85 – 5.67 | 2.5 – 2.7 |
| Accommodation Works – Spectator Building | 4.55 | 2.5 – 2.7 | 4.95 | 2.9 - 3.2 |

#### *5.7.4.1 Mitigation*

Risks to the development comprise:

- Damage to fixtures, fittings and finishes, and parked vehicles.
- Significant flood hazard to occupiers (visitors).
- Hazard to the environment, in the events of leaks or spillages in flood conditions.

Mitigation of fluvial flood risk and the effect of climate change to the proposed development, including design measures already "built in" to the proposal assessed herein, are as following

- **Finished Levels – Community Hub Building:** OPW Guidelines and SFRA require freeboard to be applied to relevant design flood levels when setting finished floor levels (FFLs) and finished ground levels (FGLs).

  Generally, the industry standard / best practice freeboard of 500 mm is applied as a minimum requirement. No freeboard is applicable to water compatible development and mitigation of risk

to the material form of those elements shall be by using a flood resilient palette of materials and finishes. The proposed community hub is deemed "less vulnerable" and as such freeboard would typically be applied to the Flood Zone A (1% AEP) level.

In this instance, an enhanced freeboard is provided whereby the proposed building (FFL 5.1 m OD) includes **>500mm freeboard to the Zone B (0.1% AEP) flood level**. The freeboard provided ensures resilience to 1% AEP Climate Change floods.

Building design shall ensure that thresholds and openings are sited at a level resilient to any residual risk of surface water flooding. Ideally, finished ground levels should be designed so that ground falls away from dwellings. Where adjacent ground unavoidably falls towards a building, drainage design should ensure that water is diverted away from building structures.

- Mitigation of damage to fixtures, fittings and finishes shall be by ensuring that the development uses flood resilient materials and fixtures. Flood resilient design shall take into account relevant guidance including CIRIA C624 'Development and Flood Risk Guidance for the Construction Industry' and BS 85500:2015 – Flood Resilient Construction in the absence of Irish equivalents.

  Hard and soft landscaping is inherently flood resilient. For other aspects more vulnerable to floodwater damage, care will be taken to take appropriate measures to reduce the consequences of flooding by e.g., siting equipment (e.g., lighting) at a flood resilient level (Flood Zone A + 500mm freeboard) or as high as practicable and giving consideration to sealed joints / junctions and use of waterproofing systems.
- **Boundary treatments** shall be of a type that permit free passage of floodwater, to avoid impounding or re-routing floodwater and flow paths on the site.
- Mitigation of hazard to occupiers / visitors will be by implementation of a robust **Flood Evacuation and Management Plan** (FEMP). Donegal County Council (the applicant) has a role in conjunction with the OPW as emergency coordinators and would have a role in managing the response to predicted flooding across the County. The FEMP shall seek to evacuate and limit further access to the site prior to flooding and will include measures to manage refuge on the site in the event of flash flooding. The FEMP will have a particular focus on managing access and egress / evacuation from the Community Hub building which would be unavoidably cut off in the event of flooding. A preliminary FEMP is included at Appendix E.
- Mitigation of **risk to the environment** shall be by careful consideration in management plans of the storage and handling of chemicals, fertilisers and other contaminants. Where chemicals are to be stored on site (in the proposed maintenance building) then the Flood Management Plan will require their removal or other safe storage at a flood resilient elevation prior to a flood.

### 5.7.5 Effect of on Flood Risk Elsewhere

The potential effect of the development elsewhere has been minimised through the design development process, where land raising is limited wherever practicable to areas where access to embankments is required, and to ensure flood resilience of water compatible and less vulnerable development but where the user profile would be more vulnerable (e.g., junior play area).

The effect of the combined development, including transboundary effects, on flooding to the site and elsewhere for the 1% AEP (Present Day) flood is established at Section 4.2.4 (page 29) and associated Figure 4-5. That assessment concludes that for that critical flood magnitude, there is no offsite effect, and the proposed development is acceptable.

Additional consideration is given specific to the Lifford site where there is a requirement to assess effects up to a 0.1% AEP magnitude flood (Flood Zone B). The planning guidelines permit water compatible and less vulnerable development in Flood Zone B, without requiring mitigation (noting that by contrast, the Guidelines make specific requirements for mitigation of flood risk elsewhere due to development in Flood Zone A) and as such there is an inherent expectation in the Guidelines that there will be an effect elsewhere for low probability flooding and that it is acceptable. The effect of development for low probability flooding has been assessed by simulating the proposed development model geometry for the 0.1% AEP flood. The outcome is shown on the following Figure 5-2.

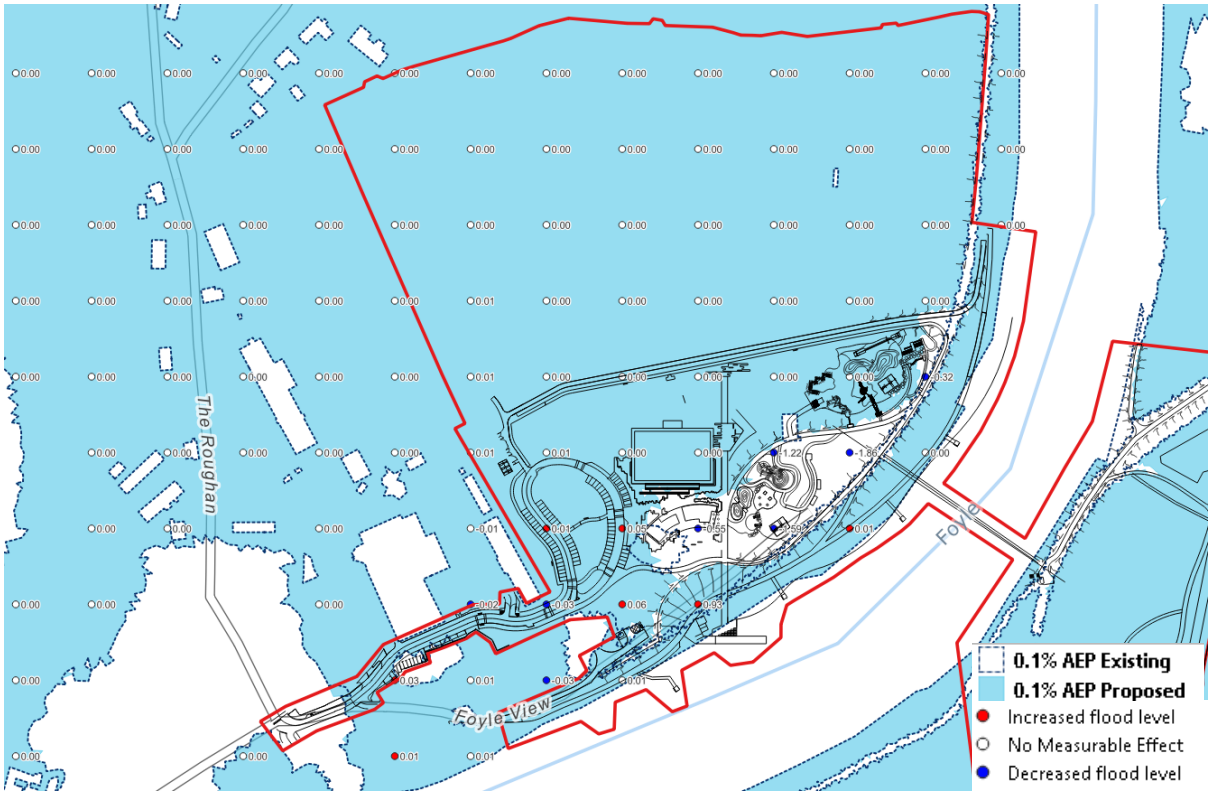



**Figure 5-2: Effect of Development (Extent / Water Elevation) – 0.1% AEP PD, Lifford**

A measurable effect and slight increase in flood level are predicted for the 0.1% AEP scenario south of the site access adjacent to the Three Rivers complex and adjacent residential and commercial / industrial developments at Foyle View. Detailed analysis of the full model dataset in that area indicates an effect of 0.01-0.015m (10-15mm) in an area where existing flood depths are typically 0.25- 0.3m. The magnitude of change is within model tolerances for prediction of water levels, however given the proposal results in loss of flood storage, the effect is assessed (in accordance with the precautious principle) as a relatively nominal increased flood risk in a highly localised area, already experiencing flood depths of up to 0.3m.

Existing (pre-development) flood extents and depths in that area, as well as flood routing, are shown on the following Figure 5-3. Interrogation of model results confirms that pre- and post-development flooding is as a result of the north bank of the Foyle being overtopped for the 0.1% AEP flood, with an overland flow route away from the riverbank to the north. Overtopping of the bank is widespread, both within the application boundary adjacent to the Lifford site entrance and further upstream.

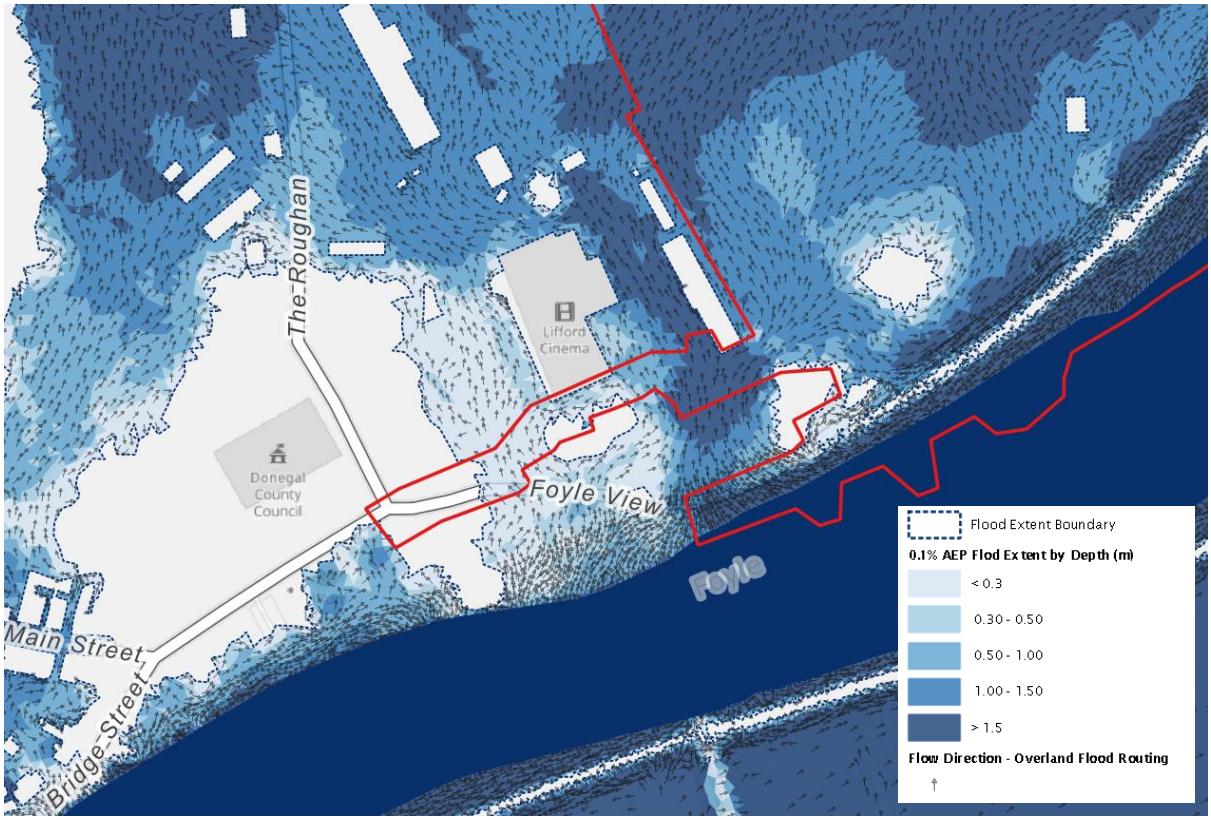



**Figure 5-3: Existing Scenario 0.1% AEP PD – Flood Extents / Flood Routing, Foyle View**

There is no expectation that the future (planned) Lifford Flood Relief Scheme would affect overbank flooding from the Foyle, where it's likely Standard of Protection would nominally be the OPW standard 1% AEP (present day) flood required for similar recent schemes.

The flooding / effect of on flooding is as a result of water overtopping the Foyle, and flood routing being altered by changes in ground levels where floodwater flows into and the Riverine Community Park site. Therefore no further mitigation is viable; i.e., there is no available land within the Lifford site in which to offer level-for-level / volume for volume floodplain reprofiling connected to the area affected, and no measures within the confines of the site to prevent overtopping of the Foyle bank, that could be effective in omitting the observed effect.

As noted previously above, 'less vulnerable' and 'water compatible' development is appropriate in Flood Zone B and is required to achieve freeboard to design flood levels which has an unavoidable effect elsewhere for low probability flooding.

## 5.8 Proposed Flood Risk – Flood Defence Failure

OPW Guidelines state that development in defended areas maintain a residual risk in the event of a flood defence failure or exceedance of the flood defence asset.

In this instance, while the Lifford site is undefended for reasons of short-circuiting of the flood embankment and backing up from the Foyle via the Deele, model results have established that under flood conditions in-channel flood levels in the Foyle are retained at a level higher than flood levels on the "land" side of the defence embankment.

There is no reliable information available in relation to present condition of the flood defences. OPW has indicated informally that embankments are likely to have a condition rating of 3-5, indicating poor to very poor condition. As such potential for a flood defence breach cannot be discounted.

In the event of a breach, the maximum feasible flood level on the site would be the "retained" in-channel flood level; in this instance 5.03 m OD (1% AEP) and 5.42 m OD (0.1% AEP), those being flood levels at

the upstream site extent. In reality, flood events in the site would reduce from this peak as flooding dispersed over the broad floodplain.

Such a flood would increase flood depths over the site but would not cause a material increase in flood hazard to the site, where the existing (non-breach) flood hazard is already significant and a danger to all occupants. The proposed Community Hub building would be unaffected by the 1% AEP breach flood.

#### *5.8.1.1 Mitigation*

Works to the existing flood embankments are integral to the proposed scheme. Mitigation that is likely to reduce the likelihood of embankment / flood defence failure is as follows:

- The proposed development will maintain or increase existing embankment crest levels on the Lifford site and will be informed by ongoing consultation and revision to suit the ongoing design of the OPW / Donegal County Council sponsored Lifford flood relief scheme.
- All works affecting the flood embankments are to be subject to detailed geotechnical assessment and design and will ensure that the embankments are structurally sound sufficient to allow proposed paths, tracks and associated trafficking. The proposed development is likely to locally improve the structural condition of the embankment.
- All work affecting flood embankments will be subject to Section 9 authorisation from OPW. The granting of that permission is separate to the granting of planning permission, and there is surety that the scheme cannot proceed without OPW having assurance that the proposed development will not meet its requirements in relation to flood defence assets.
- The proposed development makes provision for access to maintain the flood defence embankment.
- The embankment is to be adopted by Donegal County Council and maintained as part of the Riverine Park.

Mitigation for fluvial flooding generally, and in particular the development of a Flood Evacuation Management Plan, will be similarly effective in reducing risk to users and materials on the site. The FEMP will acknowledge that there may be a particular risk of rapid inundation in the event of flood defence failure, and this will inform flood evacuation procedures.

## 5.9 Effect of Works to Watercourses

Accommodation works on the Lifford site comprise abandonment of an existing sheugh and replacement in a new ditch to the west. The re-grading / earthworks associated with forming the new coursing ground ensure that drainage function previously provided by the redundant sheugh is maintained by the new ditch.

Prior to construction, a detailed survey shall be undertaken of any other drainage connections relying on the sheugh, and new connections will be formed to the new ditch. The proposed ditch shall have an equivalent or greater capacity than the redundant sheugh and will not affect flooding on the site or elsewhere. The proposed ditch will be subject to any necessary OPW authorisation required by the provisions of the Arterial Drainage Act, bearing in mind that the ditch outfall is to an arterial drainage channel.

The proposed configuration is shown on the following figure.

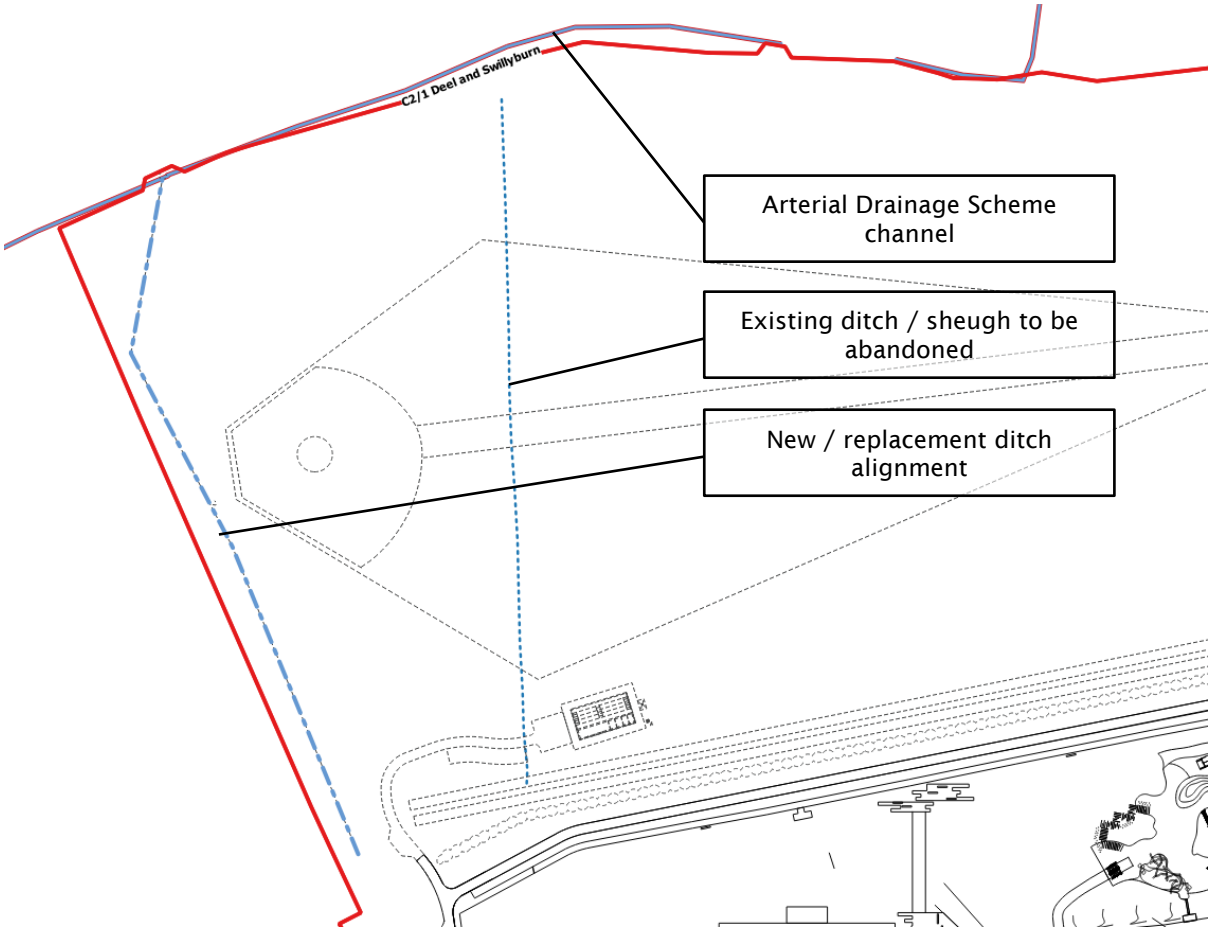



**Figure 5.4: Accommodation Works – Proposed Replacement Ditch**

## 5.10 Proposed Foyle Bridge

The proposed Foyle bridge is a clear span structure spanning between flood embankments on the Strabane and Lifford sites. The bridge includes a single structural pier sited on the Lifford bank but outside the river channel. Proposed scenario flood modelling includes bridge abutments and the bridge pier as obstructions and as such the effect of the bridge structure can satisfactorily be assessed as acceptable within the wider development proposal.

The proposed bridge is a transboundary element and as such will be subject to statutory consents in both Ireland and Northern Ireland and will meet the more onerous of the technical standards required by either jurisdiction.

- OPW Section 50 requirements would require the bridge deck soffit to be not less than the adjacent / upstream in-channel 1% + Climate Change flood level + 300mm freeboard.
- DfI Rivers Schedule 6 (Drainage Order) requirements would require the bridge deck soffit to be not less than the adjacent / upstream in-channel 1% + Climate Change flood level + 600mm freeboard.

The proposal shall therefore comply with the Northern Ireland / DfI Rivers requirements and will comply with OPW requirements by default. The required soffit level shall be (5.43 + 0.6m) 6.03 m OD.

## 5.11 Surface Water Flooding

### 5.11.1 Pluvial Runoff onto Site

Potential for surface water runoff causing flooding onto the site has been screened out as insignificant, refer to Table 4.1, page 24.

### 5.11.2 Pluvial Runoff from Site

Topography dictates that any uncontrolled runoff from the site would flow towards and be collected by the arterial drainage scheme channel to the north. There is no potential to cause a significant direct pluvial flood risk to adjacent lands / development.

New development will increase the impermeable area of the site. The proposal will lead to an increase in the overall impermeable area of the site, thus resulting in an increase to the rate and volume of runoff from the site, when compared to the existing scenario.

#### *5.11.2.1 Mitigation*

The effect of surface water flood risk to the site and elsewhere shall be by means of an **effective surface water drainage network and surface water management**. Surface water drainage design will be as per the requirements of the Donegal County Council Development Plan 2018-2024 and to the standards of Donegal County Council Water Services Department.

The Development Plan Policy F-P-5 states that the Council shall promote the use of Sustainable Drainage Systems (SuDS), flood attenuation areas, controlled release of surface water, and use of open spaces and semi-permeable hard surfaces for appropriate development proposals.

SuDS components shall be considered in relation to the nature and character of the site. The nature of SuDS suitable for the site will be subject to outline and detailed design. The SuDS design should demonstrate how water quantity and quality are dealt with, as well as make provision for amenity and biodiversity where practicable.

A planning-stage SuDS Drainage Strategy is submitted in support of the Planning Application separately.

The local authority as site owner / manager shall be responsible for **maintenance** of drainage networks at the site and will ensure that maintenance of the drainage system is provided for. Detailed drainage layout for the site is to ensure that key SuDS features requiring maintenance are located in accessible public locations. Maintenance plans for drainage assets should include (where applicable):

- Cyclical (min. annual) check of all surface water drainage features – in particular, clearing of debris.
- Cyclical (min. annual) visual inspection of any surface or underground features – blockages and obstructions to be removed by jetting as required.

# 6 POLICY CONTEXT – STRABANE, DERRY AND STRABANE

## 6.1 Requirements of Revised PPS15 – Planning and Flood Risk

This assessment is intended to address the following particular policies, bearing in mind DfI Rivers Planning Advisory opinion expressed in its August 2020 pre-application consultation reply.

**Table 6-1 Policy Screening**

| Policy | Initial Assessment | Policy Applies? |
|---|---|---|
| FLD 1 - Development in Fluvial & Coastal Flood Plains | The site is substantially affected by the 1% AEP fluvial flood extents | Yes |
| FLD 2 - Protection of Flood Defence & Drainage Infrastructure | The proposed development includes work on and adjacent to designated flood defences.<br>The proposal includes development adjacent to designated and undesignated watercourses. | Yes |
| FLD 3 – Development and Pluvial Flood Risk Outside Flood Plains | Surface water flooding and management / discharge of surface water from the site are detailed in a Drainage Assessment submitted separately. | |
| FLD 4 – Artificial Modification of Watercourses | The proposed development includes a new clear span crossing of the River Foyle.<br>There are no proposals to modify / culvert the designated watercourses at the site as part of the development. | Yes |
| FLD 5 - Development in Proximity to Reservoirs | The site is unaffected by the inundation one of any controlled reservoir. | No |

## 6.2 FLD 1 - Development in Fluvial & Coastal Flood Plains

### 6.2.1 Principle of Development

The majority of the development lies in the undefended 1% AEP floodplain. The proposal is submitted on the basis that it is to be deemed an exception to Policy FLD1 as the development in the undefended floodplain and *use of the land for…outdoor recreation, amenity open space or for nature conservation purposes, including ancillary buildings.*

For avoidance of doubt, no playgrounds for children are proposed on the Strabane site.

### 6.2.2 Risk to the Development

Fluvial flooding to the site is discussed in detail in 4.2 (page 25 forward).

#### *6.2.2.1 Existing Flood Risk - Present Day*

Previous Figure 4-1 and Figure 4-2 indicates existing flood risk to the site. The site is substantially inundated within floodwater during the existing, present-day scenario for both the 1% AEP and 0.1% AEP

events. The primary route of flooding impacting the site is out-of-bank flooding from the River Foyle to the west of the site.

In-channel flood levels in the River Foyle range from 5.05 – 4.67 m OD adjacent to the site for the 1% AEP present day hydrology flood.

Flood levels within the Strabane site range from 4.2 – 3.8 m OD with a mean flood level on the "defended" side of 4.1 m OD. The mean flood depth is 0.85m ranging to a maximum of 3.5 m OD.

Given the significant flood risk to the site, additional consideration has been given to flooding of the site for less extreme flood events than those required by the planning guidelines. Modelling of a 10% AEP (1 in 10 year) flood has been undertaken and confirms that the area where development is proposed is unaffected by high probability flooding.

#### *6.2.2.2 Proposed Scenario Flood Risk – Climate Change Hydrology*

The required standard for flood protection (and assessment of risk) per current DfI Rivers technical advice is the 1% AEP (Q100) flood including 20% climate change.

In-channel flood levels in the River Foyle range from 5.4 – 5.04 m OD adjacent to the site for the 1% AEP climate change hydrology flood.

Climate change flood levels within the Strabane site range from 5.2 – 4.5 m OD with a mean flood level on the "defended" side of 4.4.9 m OD. The mean flood depth is 1.39 m ranging to a maximum of 4.7 m.

The following Table 6.2Table 5.2 schedules predicted flood depths and water elevations at key proposed receptors proposed as part of the development within the Strabane site.

**Table 6.2: Flood Levels & Depths at Receptors – Proposed Scenario / Climate Change**

| Location | 1% AEP | |
|---|---|---|
| | Water Level (mOD) | Mean / Max Flood Depth (m) |
| Car Park | 4.7 – 4.5 | 0.73 / 1.16 |
| Boardwalk | 4.9 | 0.6 |
| Site Entrance Road (Greenbrae Park) | 5.19 – 4.8 | 1.2 / 3.0 |
| Site Entrance Road (Park Road) | 4.6 | 1.0 – 1.27 |

Risks to the development comprises

- Damage to fixtures, fittings and finishes, and parked vehicles.
- Significant flood hazard to occupiers (visitors).

#### *6.2.2.3 Mitigation*

Mitigation of fluvial flood risk and the effect of climate change to the proposed development, including design measures already "built in" to the proposal assessed herein, are as following

- There are no proposals to raise finished levels with the intended purpose of improving flood resilience or reducing risk to the development, in order to minimise displacement or re-routing of floodwater elsewhere.
- Mitigation of damage to fixtures, fittings and finishes shall be by ensuring that the development uses **flood resilient materials and fixtures**. Flood resilient design shall take into account

relevant guidance including CIRIA C624 'Development and Flood Risk Guidance for the Construction Industry' and BS 85500:2015 – Flood Resilient Construction.

Hard and soft landscaping is inherently flood resilient. For other aspects more vulnerable to floodwater damage, care will be taken to take appropriate measures to reduce the consequences of flooding by e.g., siting equipment (e.g., lighting) at a flood resilient level (1% AEP Climate Change flood level + 600mm freeboard) or as high as practicable and giving consideration to sealed joints / junctions and use of waterproofing systems.

- **Boundary treatments** shall be of a type that permit free passage of floodwater, to avoid impounding or re-routing floodwater and flow paths on the site.
- Mitigation of hazard to occupiers / visitors will be by implementation of a robust **Flood Evacuation and Management Plan**. Derry and Strabane District Council (the applicant) has a role as emergency coordinators and would have a responsibility for managing the response to predicted flooding across the district. The FEMP shall seek to evacuate and limit further access to the site prior to flooding. A preliminary FEMP is included at Appendix F.

### 6.2.3 Effect of on Flood Risk Elsewhere

The effect of the combined development, including transboundary effects, on flooding to the site and elsewhere for the 1% AEP flood is established at Section 4.2.4 (page 29). Detailed "effect of development" flood mapping is included at Appendix D.

Detailed flood modelling confirms that the proposal will have no measurable effect on flooding elsewhere and as such no further mitigation is required.

## 6.3 FLD 2 - Protection of Flood Defence & Drainage Infrastructure

### 6.3.1 Protection of Flood Defences

The designated flood defence on the Strabane site has a crest height above the adjacent design flood in the River Foyle but is short-circuited / bypassed on lands upstream of the site. Flood levels on the main Foyle channel are therefore slightly higher than flooding on the "land" side of the site, where floodwater tends to flow east away from the main river channel to lower lying flood storage.

DfI Rivers confirmed that while the embankment adjacent to the Foyle has no formal standard of protection and there is no plan to upgrade the standard of protection, it deems the structure to offer some protection and there is no plan or policy to abandon or downgrade the defence asset.

There is no reliable information available in relation to present condition of the flood defences. DfI Rivers indicated anecdotally that the defence has been prone to "blow outs" in the vicinity and is prone to mammal burrowing. Potential for a flood defence breach cannot be discounted.

Additional risk to the site in the event of a flood defence breach is not significant given the base flood depths already experienced on the site. A particular risk would exist to any users trapped on the embankment crest in the event that the embankment failed at that location during a flood.

#### *6.3.1.1 Mitigation*

Works to the existing flood embankments are integral to the proposed scheme, including development of a path and landing for the proposed Foyle bridge. Mitigation that is likely to reduce the likelihood of embankment / flood defence failure and ensure that the flood defence assets are protected is as follows:

- The proposed development will maintain or increase existing embankment crest levels on the Strabane site.
- All works affecting the flood embankments are to be subject to detailed geotechnical assessment and design and will ensure that the embankments are structurally sound sufficient to allow proposed paths, tracks and associated trafficking. The proposed development is likely to locally improve the structural condition of the embankment.
- All work affecting flood embankments will be subject to Schedule 6 (Drainage Order) authorisation. The granting of that permission is separate to the granting of planning permission, and there is surety that the scheme cannot proceed without DfI Rivers having assurance that the proposed development will not meet its requirements in relation to protection of its flood defence assets.

- The proposed development makes provision for access to maintain the flood defence embankment and will not affect access to the Foyle bank.
- Matters around maintenance and roles / responsibilities / liabilities are to be addressed through detailed consultation with DfI Rivers in the course of obtaining relevant required statutory consents.

### 6.3.2 Works to Watercourses

There are no plans to alter the designated watercourses on the Strabane site. Where the detailed design causes need to alter watercourses (in particular where any work to improve the Foyle flood defence embankment affects the Nancy Burn outfall) then all works shall be subject to prior authorisation by DfI Rivers under Schedule 6 of the Drainage Order.

### 6.3.3 Watercourse Maintenance

The proposed development causes no new built development or hard boundary treatment that would impede maintenance of watercourses versus existing provisions and as such the requirements of Paragraph 6.32 are satisfied.

The applicant as site operator shall be required to fulfil their obligations as riparian landowner to designated watercourses on and adjacent to the site and facilitate maintenance by DfI Rivers.

Residents / occupants should be made aware of the need to report blockages or build-up of debris in the river channel to DfI Rivers – to be directed to the local Area office.

## 6.4 FLD 4 – Artificial Modification of Watercourses

The proposed Foyle bridge is a clear span structure spanning between flood embankments on the Strabane and Lifford sites. The bridge includes a single structural pier sited on the Lifford bank but outside the river channel. Proposed scenario flood modelling includes bridge abutments and the bridge pier as obstructions and as such the effect of the bridge structure can satisfactorily be assessed as acceptable within the wider development proposal.

The proposed bridge is a transboundary element and as such will be subject to statutory consents in both Ireland and Northern Ireland and will meet the more onerous of the technical standards required by either jurisdiction.

- OPW Section 50 requirements would require the bridge deck soffit to be not less than the adjacent / upstream in-channel 1% + Climate Change flood level + 300mm freeboard.
- DfI Rivers Schedule 6 (Drainage Order) requirements would require the bridge deck soffit to be not less than the adjacent / upstream in-channel 1% + Climate Change flood level + 600mm freeboard.

The proposal shall therefore comply with the Northern Ireland / DfI Rivers requirements and will comply with OPW requirements by default. The required soffit level shall be (5.43 + 0.6m) 6.03 m OD.

No other works are planned affecting designated or undesignated watercourses on the Strabane site.

# 7 SUMMARY & SCHEDULE OF MITIGATION

## 7.1 Summary of Findings

The site is substantially affected by fluvial flooding. The majority of the Lifford site lies in Flood Zone A as defined by the OPW Planning Guidelines. The Strabane site is within a 1% AEP fluvial floodplain and Policy FLD1 of Revised Planning Policy Statement 15 applies. The development is proposed on the basis that the overarching use of the land for outdoor recreation is compliant with respective planning policies and guidelines. Exception / justification tests are to be supplied separately to establish the acceptable principle of development. Mitigation is proposed to relevant aspects of the development to manage and reduce flood risk.

Consideration has been given to potential for additional risk due to flood defence failure. The sites lie behind flood defence embankments but do not benefit from a substantial standard of protection. In the event of a flood defence failure, it is unlikely that additional flood risk would result to the site when compared to the "design" flood, given existing predicted flood depths. Mitigation proposed to address fluvial flooding will be similarly effective, and additional measures are proposed to manage risk of failure to defences on the site.

Fluvial flood depths are significant and pose a significant hazard to users. The site will require careful active management with regards to control of access and egress to/from the site during flood conditions or periods when flooding in the River Foyle is likely.

No other significant flood mechanism exists at the lands.

## 7.2 Summary of Design & Mitigation Measures

The following section summarises the measures incorporated within the proposal submitted in support of the planning application, and to be further developed in any detailed design post-determination of the planning application / in securing other necessary OPW and DfI Rivers authorisations.

**Table 7.1: Summary of Risks and Mitigation**

| Identified Flood Mechanism | Consequence | Mitigation Measure | Strabane | Lifford |
|---|---|---|---|---|
| Fluvial Flooding (incl. effect of climate change, effect of flood defence breach) | Risk to Property (Buildings) | Design Levels – Buildings | N/A – no buildings proposed | Community hub building is sited at a sufficient level to prevent flooding up to a 0.1% AEP + Climate Change flood |
| | Risk to Property (landscaping / amenity aspects) | Flood Resilient Construction | Landscape development to include flood resilient construction / selection of flood resilient palette of materials and finishes. Vulnerable equipment (M&E, lighting etc) to be sited at a flood resilient level (1% AEP + Climate Change or greater). | |
| | Risk to Property | Porous Boundary Treatments | Boundary treatments shall be of a type that permit free passage of floodwater, to avoid impounding or re-routing floodwater and flow paths on the site. | |
| | Risk to Users | Flood Evacuation and Management Plan | Management of the site including control of access / egress / evacuation of the site in response to predicted flooding; emergency refuge areas and flood response. | |
| | Risk to the Environment (spills / washout during flood events) | Storage and handling of chemicals, fertilisers and other contaminants | N/A – no storage facilities proposed | Management plans to control use and storage of pollutants / removal off site or to flood resilient level prior to flooding. |
| Proposed Bridge | Risk to Property (proposed bridge) and flood risk elsewhere | Bridge Design | Proposed bridge to be a clear span crossing with single pier arrangement (as assessed) which is confirmed to have no adverse effect to flooding elsewhere.<br>Bridge to have a soffit level of the greater of OPW and DfI Rivers standards, i.e., upstream 1% AEP flood level (5.43) + 0.6m freeboard, 6.03 m OD. | |
| | Risk to Property (proposed bridge) | Bridge Authorisation | Bridge to be subject to DfI Rivers authorisation under Schedule 6 of the Drainage Order | Bridge to be subject to OPW authorisation under Section 50 of the Arterial Drainage Act. |

| Identified Flood Mechanism | Consequence | Mitigation Measure | Strabane | Lifford |
|---|---|---|---|---|
| Effects to Flood Embankments | Risk to Assets (existing embankments)<br>Risk to Property and Users (in event of failure) | Works to Flood Defences and Authorisations | Development / embankment upgrades to be subject to detailed geotechnical design.<br>All works to embankments to be subject to DfI Rivers authorisation through Schedule 6 of the Drainage Order.<br>Proposed development to make provision for access to maintain the flood defence embankment and will not affect access to the Foyle bank.<br>Matters around maintenance and roles / responsibilities / liabilities are to be addressed through detailed consultation with DfI Rivers in the course of obtaining relevant required statutory consents. | Development of works affecting embankments to be informed by ongoing work to develop Lifford Flood Relief Scheme.<br>Development / embankment upgrades to be subject to detailed geotechnical design.<br>All works to embankments to be subject to OPW Section 9 Authorisation.<br>Scheme to make provision for access to maintain flood defence assets; Donegal County Council to adopt and maintain flood defence embankments as part of the Riverine project.<br>Flood Evacuation / Management Plan to include provisions noting potential for rapid inundation in the event of flood defence failure. |
| Proposed ditch re-alignment | Risk to property and risk to adjacent lands / property | Ditch design and Authorisation | N/A | Proposed ditch to be sized to have equivalent or greater capacity than existing.<br>Detailed survey to be undertaken of any other drainage connections relying on the existing sheugh, and new connections formed to the new ditch.<br>Proposed to be subject to any necessary OPW authorisation required by the provisions of the Arterial Drainage Act. |

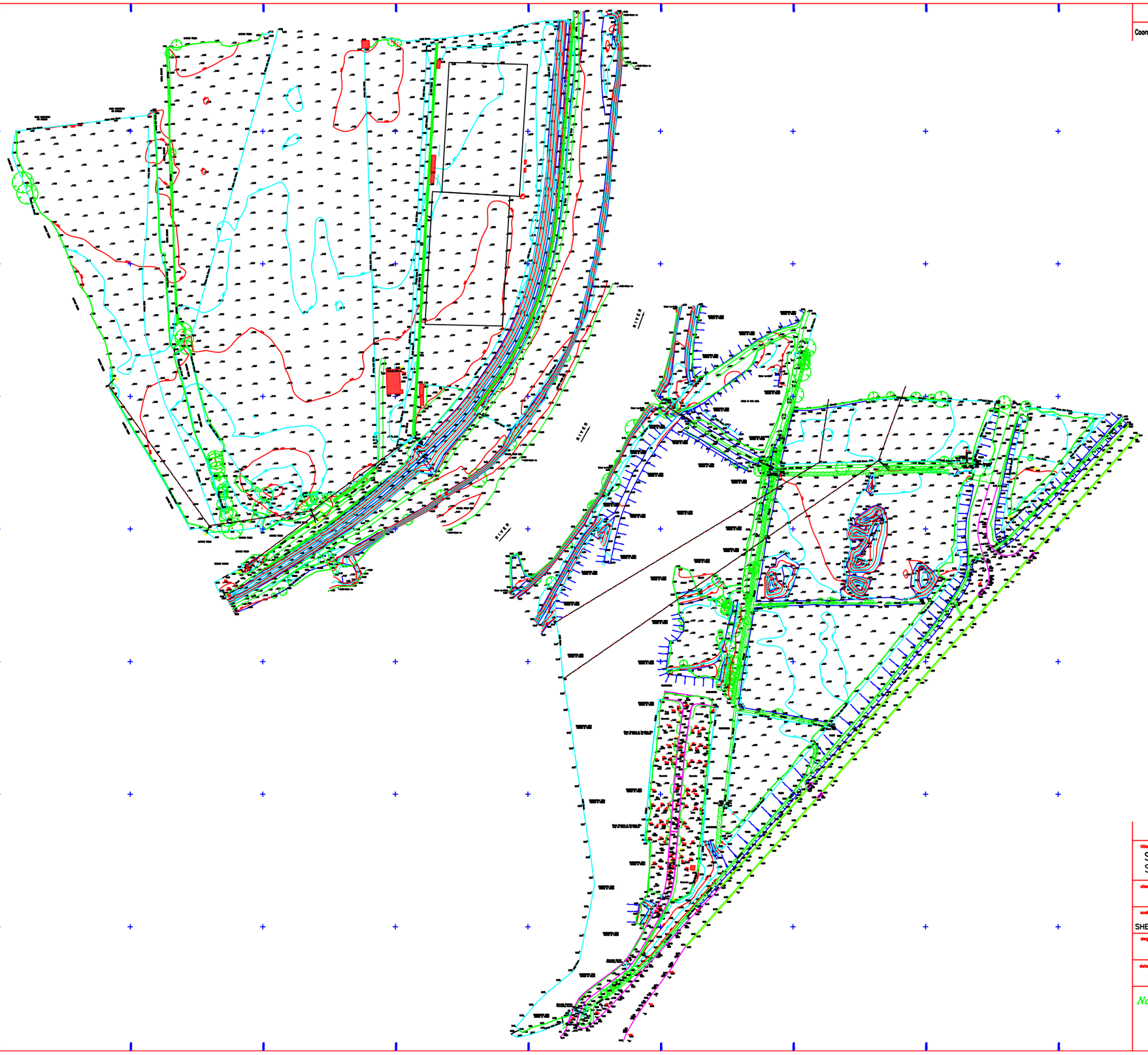
| Identified Flood Mechanism | Consequence | Mitigation Measure | Strabane | Lifford |
|---|---|---|---|---|
| Surface Water Flooding | Risk to property and risk to adjacent lands / property | Drainage / SuDS plan | Runoff to be managed to a pre-development / greenfield equivalent rate and to a standard of protection to meet DfI Rivers standards.<br>Discharge to be subject to DfI Rivers authorisation under Schedule 6 of the Drainage Order (refer to separately submitted Drainage Plan and FLD3 Drainage Assessment.) | Surface water drainage design to be as per the requirements of the Donegal County Council Development Plan 2018-2024 and to the standards of Donegal County Council Water Services Department.<br>Drainage approach to use SUDS principles.<br>(Refer to separately submitted Drainage Plan) |
| Designated watercourse Maintenance | Risk to the development / drainage assets | Provision for maintenance | Development causes no new built development or hard boundary treatment that would impede maintenance of designated watercourses | N/A |

# Appendix A

# Survey and Key Proposal Drawings

## Notes

Coordinates to Irish Grid, levels to Ordnance Datum.




This drawing or any part thereof must not be copied or used in whole or in part without the consent of North West Land Survey

title
SITE SURVEY OF LANDS AT STRABANE & LIFFORD.

client
DERRY CITY & STRABANE DISTRICT COUNCIL.

| scale | surveyed by |
|---|---|
| 1:500 SHEET=1:1000@A0 | IT |
| dwg no. 1171602 | drawn by IT |
| date 19 OCT 2016 | checked by IT |

*North West Land Survey*

Unit 3, The Vale Centre
Greysteel, BT47 3QE
Tel: 028 7181 2060
Email: ian@northwestlandsurvey.co.uk




## LEGEND

### SOFTWORKS

- Existing Trees & Planting — To be retained and protected during works in accordance with BS5837
- Existing Trees & Planting — To be removed. Groups identified in the absence of individual trees
- Proposed Native Trees — Refer to planting schedule
- Proposed Native Wetland Trees — Refer to planting schedule
- Proposed Specimen Trees — Refer to planting schedule and details ref: De_912+911
- Proposed Hedgerow planting — Refer to planting schedule and details ref: De_908
- Proposed Amenity Grassland — Refer to planting schedule
- Proposed Wildflower — Refer to planting schedule
- Proposed Woodland Wildflower — Refer to planting schedule
- Proposed Riverside Edge Mix — Refer to planting schedule. To be pregrown and supplied as turf
- Proposed SUDS Mix — Refer to planting schedule. To be pregrown and supplied as turf
- Proposed Native shrubs — Refer to planting schedule.
- Proposed Ornamental shrubs — Refer to planting schedule.
- Proposed Grass Mounding — Refer to planting schedule (Amenity Grassland)

### SURFACES

- **Proposed Asphalt** — To pedestrian and Cycleway. For detail refer to engineers drawing
- Proposed Asphalt — To pedestrian and Cycleway. For detail refer to engineers drawing
- Natural Stone Paving — Refer to detail ref: De_900
- Proposed Boardwalk — Refer to detail ref: De_903
- Reinforced Grass — Refer to detail ref: De_902
- Proposed Gravel Path — Refer to detail ref: De_902
- Proposed Slipway Surface — Refer to detail ref: De_904 also engineers drawings for detail.
- Wetpour Safety Surfacing — Refer to detail ref: De_902
- Reinforced Grass Safety Surfacing — Refer to detail ref: De_902
- Play Bark Safety Surface — specifically for play areas
- Stone Clusters (Play Park) — Refer to detail ref: De_905

### FEATURES

- Existing Walls — To be retained
- Existing Fencing — To be retained / replaced as required
- 2.4m Security Fencing — Paladin fencing
- Metal Estate Fencing — Refer to detail ref: De_907 for fencing and De_914 for Gates
- Stock Proof Fencing — Refer to detail ref: De_906
- Steps and Terracing — Refer to detail ref: De_913
- Proposed Benches — Refer to detail ref: De_909
- Bicycle stand locations — Typical Sheffield stand
- Proposed Litter Bins — 100L Bins with single 300L recycled bin adjacent to Community Pavilion
- Proposed Metal Gates — Refer to detail ref: De_914
- **Vehicular Upstand Kerb** — 125mm upstand. Pre Cast Concrete
- **Vehicular Flush Kerb** — Pre Cast Concrete
- **Pin Kerb** — Pre Cast Concrete

### MISCELLANEOUS

- Riverine Community Park Boundary
- Accommodation Works
- Proposed Bridge
- Water

### LEVELS

- (4.3) — Existing Levels
- +5.3 — Proposed Levels

## NOTES

1. All measurements shown are in metres, and all levels are to ordnance datum unless otherwise indicated

2. All Coordinates are to Irish Grid (TM65), unless otherwise noted.

3. All hatches are indicative and do not relate to the actual laying or planting pattern

4. Layout should be read in conjunction with all other drawing information and reports.

5. All new kerbs adjacent to exsiting roads will require a 300mm reinstatement strip within the carriageway running the entire length

6. For proposed drainage refer to engineers layout

7. For lighting and all electrical requirements refer to M&E drawings

8. Walking Routes & Connections
All main areas within the park will be fully accessible.

9. Riverside Access
note to be added

10. Planting
The general planting strategy is to use a primarily native planting palette introducing some specimen trees to add formality and interest within the avenue and around the Community Hub. The shrub planting proposed around the Community Hub will be mostly ornamental grasses planted through with some ornamental structural plants to provide year round colour and interest. Where possible existing areas of native planting will be increased and supplemented to create diversity and improve ecological benefit. Also refer to Planting Schedule.

11. Play Areas
The Play areas have been located next to the existing embankment making the most of connecting paths and using graded terracing to maximise accessibility through the play spaces. Play equipment within both the Junior / Senior play areas will also be considered to ensure broadest age range and ability is catered for. Also refer to the section drawing ref: 700 which illustrates section through the inclusive Hightower in the Senior Play Area.

12. Suds
Attenuation basin locations and extents shown indicatively. Basins will be planted with a mix of native wet woodland (indicated with trees) and marginal type planting (indicated with hatch) to highlight their location and integrate them as an attractive feature within the overall site context.

13. Accommodation Works
For layout & detail please refer to engineers and architects packages

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Ordnance Survey Ireland mapping data used with permission: in association with Donegal County Council - OS License 2003/07/CCMA/Donegal County Council. Copyright Ordnance Survey Ireland, Government of Ireland.

| Rev | Date | Description | App |
|---|---|---|---|
| P00 | 16.02.2021 | Issued for screening | DM |
| P01 | 15.02.21 | This is a concept design that illustrates the main elements to be delivered within the park. The exact location, layout and smaller details of the park may change during the detailed design phase. | DM |

Quantity Surveyors
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Belfast, BT1 3AJ
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info@sammon.eu
www.sammon.eu

Landscape Architects
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The Paul Hogarth Company Ltd
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www.PaulHogarth.com

Project Manager, Civil & Structural Engineers
McAdam Design Ltd
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admin@mcadamdesign.co.uk
www.mcadamdesign.co.uk

Funder
Peace Northern Ireland - Ireland
European Regional Development Fund

Client
Comhairle Contae Dhún na nGall
Donegal County Council
Derry City & Strabane District Council
Comhairle Chathair Dhoire & Cheantar an tSratha Báin
Derry Cittie & Strabane Disstrick Council

Project Status: PLANNING

Project: RIVERINE COMMUNITY PARK

Drawing: LIFFORD LANDSCAPE LAYOUT

Scale: 1:500@A0

| Drawn | Checked | Approved |
|---|---|---|
| DM | DM | AH |
| Date 12.02.2021 | Date 12.02.2021 | Date 15.02.21 |

Project · Organisation · Zone · Level · Type · Role · Number · Revision
1383 · TPHC · ZO · XX · DR · LA · 101 · DRAFT

Project Number: 1383
Status code & Description: PLANNING

All dimensions are in metres. Figured dimensions to be taken in preference to scaled dimensions. Dimensions to be checked on site. © 2021 McAdam Design Ltd.

River Foyle

Marsh

Wetland

SUDs

Existing Water Level
+(2.00)

Overhead Electric Lines

Park Road

Barnhill Road

## Proposed Car Park
A sufaced car park which will provide approximately 120 spaces and 10 disabled bays. There will also be provision for coach bays which can double as loading and offloading if required.

## Bridge Landing
At the bridge landing there is a proposed seating area to make the most of the spectacular vantage point.

## Proposed Boardwalk
The existing landscape in Strabane has naturalised having benefited from many years of neglect. In this respect it holds many important ecologically sensitive assets. To ensure that these can provide visitor experience at a distance the boardwalk enables access at a sensible distance and is elevated to ensure that wildlife retains uninterrupted and safe passage.

## Pathway Converging
To make the most of connections both to the Strabane North Greenway and pathway routes within the park. Junctions ensure that desire lines are managed so that walking routes are identifiable. This also reduces possibility of people walking over the planted areas.

## Wildlife Gates
Gates to be located every 10m within proposed fencelines and hedging. These will provide safe access for variety of wildlife to ensure access to their feeding ground to the east.

## Existing Planting
The Strabane site is typified by a naturalised and overgrown landscape evolved from its former use as a quarry. The site now represents an ecologically sensitive landscape that brings along many benefits which contribute positively to the proposed parkland. Existing planting provides a unique and biodiverse habitat which is acknowledged within the proposals ensuring that these identified areas are safeguarded. Access therefore is limited and planting will be encouraged to continue to grow. Where required and not affected by A5 route - additional native whip planting will be proposed

## Existing Planting
New Tree Planting will be proposed in areas that does not conflict with the long term consequence of the A5 and where it is agreed beneficial.

## Halting Site
The former halting site is identified as the location for the approach road to the proposed carpark. The proposals include removing the existing concrete base and reinstating in a mixture of wildflower native grass. This can be aloud to naturalise until such times the proposed A5 link road influences the arrangement.

## Entrance
it is proposed that the site will be accessed from the Barnhill Road roundabout both for vehicles, cyclists and pedestrians.

## Emergency / Event Entrance & Exit
Emergency access onto Park Road, as required aswell as an overflow on event days.

Match Line to drawing ref:
1383-TPHC-ZO-XX-DR-LA-xxxx_revP00

Match Line to drawing Insert (see right)

Match Line to drawing Insert (see left)

## Drawing Insert
**Scale 1:500 @ A0**

N

## LEGEND
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- Proposed Native shrubs — Refer to planting schedule.
- Proposed Ornamental shrubs — Refer to planting schedule.
- Proposed Grass Mounding — Refer to planting schedule (Amenity Grassland)

### SURFACES
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- Proposed Asphalt — To pedestrian and Cycleway. For detail refer to engineers drawing
- Proposed High Friction Surface — To pedestrian crossing Strabane carpark For detail refer to engineers drawing
- Natural Stone Paving — Refer to detail ref: De_900
- Proposed Boardwalk — Refer to detail ref: De_903
- Reinforced Grass — Refer to detail ref: De_902
- Proposed Gravel Path — Refer to detail ref: De_902
- Proposed Slipway Surface — Refer to detail ref: De_904 also engineers drawings for detail.
- Wetpour Safety Surfacing — Refer to detail ref: De_902
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- Vehicular Upstand Kerb — 125mm upstand. Pre Cast Concrete
- Vehicular Flush Kerb — Pre Cast Concrete
- Pin Kerb — Pre Cast Concrete

### MISCELLANEOUS
- Riverine Community Park Boundary
- Accommodation Works
- Proposed Bridge
- Water

### LEVELS
- (4.3) — Existing Levels
- +5.3 — Proposed Levels

## NOTES
1. All measurements shown are in metres, and all levels are to ordnance datum unless otherwise indicated

2. All Coordinates are to Irish Grid (TM65), unless otherwise noted.

3. All hatches are indicative and do not relate to the actual laying or planting pattern

4. Layout should be read in conjunction with all other drawing information and reports

5. All new kerbs adjacent to existing roads will require a 300mm reinstatement strip within the carriageway running the entire length

6. For proposed drainage refer to engineers layout

7. For lighting, electrical requirements refer to M&E drawings

8. Walking Routes & Connections
All main routes within the park boundary will provide DDA compliant access

9. Riverside Access
Note to be added

10. Planting
The general planting strategy is to use primarily a native planting palette introducing some specimen trees within the new car park to add formality. Where possible existing areas of native planting will be increased and supplemented to create diversity and improve ecological benefit. This planting will be suggested from the naturalised fauna surveyed

11. Suds
Attenuation basin locations and extents shown indicatively. Basins will be planted with a mix of native wet woodland (indicated with trees) and marginal type planting (indicated with hatch) to highlight their location and integrate them as an attractive feature within the overall site context.

12. Bridge
Note to be added

13. Invasive Weeds
Note to be added

14. No Topographic Survey Information
The principles have been considered on the basis of site visits and discussion with the engineers, ecologist, client and community groups. However, there is a substantial area of the Project Area (see hatch) that is unsurveyed (due to poor access). In this respect assumptions have had to have been made with regard detailed proposals. Levels, existing vegetation extent, type as well as extent of wetland are underlined.
on this basis the amount of tree cover identified as removed is unclear. Removed trees indicated are limited to where the survey is clear and loss is certain.

15. A5
Note to be added, if required

*The revision cloud highlighted areas of the park which were inaccessible for the*

*This is a concept design that illustrates the main elements to be delivered within the park. The exact location, layout and number of the bits of the park may change during the detailed design phase.*

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| Rev | Date | Description | App |
|---|---|---|---|
| P00 | 16.02.2021 | Issued for screening | DM |
| P01 | 10.06.2021 | Issued for Information | DM |

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Project Manager, Civil & Structural Engineers
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www.mcadamdesign.co.uk

Funder
Peace Northern Ireland - Ireland
European Regional Development Fund

Client
Comhairle Contae Dhún na nGall
Donegal County Council
Derry City & Strabane District Council
Comhairle Chathair Dhoire & Cheantar an Ghoirtha Báin
Derry Cittie & Strabane Destrick Council

Project Status: DRAFT

Project: RIVERINE COMMUNITY PARK

Drawing: STRABANE LANDSCAPE LAYOUT

Scale: 1:500@A0

| Drawn | DM | Checked | DM | Approved | AH |
|---|---|---|---|---|---|
| Date | 12.02.2021 | Date | 12.02.2021 | Date | 15.02.21 |

Project · Organisation · Zone · Level · Type · Role · Number · Revision
1383 · TPHC · ZO · XX · DR · LA · 102 · P00

Project Number: 1383

Status code & Description: PLANNING

All dimensions are in metres. Figured dimensions to be taken in preference to scaled dimensions. Dimensions to be checked on site. © 2021 McAdam Design Ltd.

# Appendix B

# Stakeholder Correspondence / Data

Department for Infrastructure
An Roinn Bonneagair
www.infrastructure-ni.gov.uk

**Dfl Rivers Planning Advisory Unit**

44 Seagoe Industrial Estate
CRAIGAVON
Co. Armagh
BT63 5QE
Tel: 028 3839 9118

FAO Sarah Barrett
Derry City and Strabane District Council
Planning Department
98 Strand Road,
Derry
BT48 7NN

Your Ref: LA11/2020/0446/PAD
Our Ref: IN1-20-10413

Date: 12/08/2020

Dear Madam,

**Re: Riverine Community Park at Park Road, Strabane.**

Thank you for your consultation dated 22nd July 2020 regarding the above proposal. Dfl Rivers have assessed the application and our comments are as follows:-

**PPS15 Policy FLD 1 Development in Fluvial (River) and Coastal Flood Plains**
Flood Map (NI) indicates that the site lies within the 1 in 100 year fluvial flood plain which has a level of 4.83.

PPS 15, FLD 1, states that the Planning Authority will not permit development within flood plains unless it meets the 'Exceptions Test'. If the Planning Authority deems this to be an exception under FLD 1 Dfl Rivers would request that the applicant carries out a Flood Risk Assessment to demonstrate that all sources of flood risk to and from the proposed development have been identified; and there are adequate measures to manage and mitigate any increase in flood risk arising from the development. The Planning Authority should refer to PPS 15, Annex D, paragraph D7.

The planning authority should be aware that the Department for Infrastructure updated its Technical Flood Risk Guidance in relation to allowances for climate change in Northern Ireland on 25th February 2020.

The Flood Hazard Map (NI) shows the predicted 1 in 100 year climate change flood level to be 5.41.

INVESTORS IN PEOPLE

The Guidance and associated documentation can be accessed or downloaded via the Department for Infrastructure's web page as follows:- https://www.infrastructure-ni.gov.uk/publications/technical-flood-risk-guidance-relation-allowances-climate-change-northern-ireland

**PPS15 Policy FLD 2 Protection of Flood Defence and Drainage Infrastructure**
The site contains a number watercourses designated under the terms of the Drainage Order Northern Ireland 1973.

1. The River Foyle flows adjacent to the western boundary.
2. The Nancy Burn traverses the site at its northern section.
3. The Park Road Drain flows adjacent to the eastern boundary.

Under 6.32 of the policy a maintenance strip is required. The applicant should contact the local Dfl Rivers area staff to establish their needs. The maintenance strip should be level, marked up on all layout drawings and be protected from impediments (including tree planting permanent fencing and sheds), land raising or future unapproved development by way of a planning condition. Clear access and egress should be provided at all times

The site may be affected by undesignated watercourses of which we have no record, in the event of an undesignated watercourse being discovered, Policy FLD 2 will apply.

**PPS15 Policy FLD 3 Development and Surface Water (Pluvial) Flood Risk Outside Flood Plains**
PPS 15 FLD3 states that a drainage assessment will be required for all development proposals that exceed the following thresholds:

1. Residential development comprising 10 dwelling units or more.
2. A Development site in excess of 1 hectare.
3. New hard-surfacing exceeding 1000m$^2$.

As this application exceeds **point 2** of these thresholds, Dfl Rivers would require the submission of a drainage assessment as part of a new consultation for our consideration. The drainage assessment should be appropriate to the scale and nature of the proposed development and the risks involved.

**In carrying out the drainage assessment the applicant should acquire from the relevant authority evidence that the proposed storm water run-off from the site can be safely discharged. If the proposal is to discharge into a watercourse then an application should be made to the local Dfl Rivers office for consent to discharge storm water under Schedule 6 of the Drainage (NI) Order 1973.**

If it is proposed to discharge storm water into an NI Water system then a Pre-Development Enquiry should be made and if a simple solution cannot be identified then a Network Capacity Check should be carried out.

Correspondence with both authorities should be included in the drainage assessment regardless of the outcome.

Detailed guidance on the aims and content of a Drainage Assessment can be found in Planning Policy Statement (Planning and Flood Risk) – Annex D.

**PPS15 Policy FLD 4 Artificial Modification of Watercourses**
This policy may be applicable to this site. Under FLD 4 of Planning Policy Statement 15, artificial modification of a watercourse is normally not permitted unless it is necessary to provide access to a development site or for engineering reasons. This is a matter for the Planning Authority.

Any culverting approved by the Planning Authority will also be subject to approval from Dfl Rivers under Schedule 6 of the Drainage Order 1973. These two approvals do not go hand in hand.

**PPS15 Policy FLD 5 Development in Proximity to Reservoirs**
Not applicable based on the information provided.

**Under the terms of Schedule 6 of the Drainage (Northern Ireland) Order 1973 the applicant must submit to Dfl Rivers, for its consent for any proposal to carry out works which might affect a watercourse such as culverting, bridging, diversion, building adjacent to or discharge of storm water etc. Failure to obtain such consent prior to carrying out such proposals is an offence under the aforementioned Order which may lead to prosecution or statutory action as provided for.**

I trust you find the foregoing to be helpful but should you require any further information or clarification please contact me at the above address.

Please quote our reference number above on any future correspondence.

Yours faithfully,

**Trevor Mills**
**Planning Advisory and Modelling Unit**

**Infrastructure Planning**
Westland House
Old Westland Road
Belfast
BT41 6TE

Tel: 028 90354813 Ext 20646
www.niwater.com

Derry and Strabane
Local Plannning Office
Orchard House
40 Foyle Street
Londonderry
BT48 6AT

Your Ref:
LA11/2020/0446/PAD

Our Ref:

Date: 4 August 2020

Dear Sir / Madam.

**PLANNING CONSULTATION REFERENCE – LA11/2020/0446/PAD**

NI Water would advise as follows –

This proposed development would not have a significant impact on existing NI Water infrastructure. Consultation with NIW is required at an early design stage by means of a Pre-development Enquiry to determine how this proposal may be served.

Yours faithfully

**Alan Moore**
Infrastructure Planning

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## Kyle Somerville

**From:** Clare Morris <[redacted]>
**Sent:** 17 August 2021 10:16
**To:** Thompson, George (DfI); Buchanan, Stephen (DfI); McElmeel, Dermott; Kyle Somerville; David Anderson
**Cc:** Murphy, JB
**Subject:** E2256 Riverine CP: DfI Rivers Consultation [Meeting Summary]

All,

Thank you very much for attending the consultation meeting on Friday 13th August.

For your records, please find attached (via Sharefile) the following, as presented / discussed at our meeting:

- 210813 DfI Rivers Update.pdf
- 21.05.27 PACC Boards_RevP01

Summary of key concerns recorded as follows:

1. The issue around Public Liability and proposed use of cycle/walkway
2. Long term operation and maintenance – DfI do not have resources to reinstate pathway infrastructure as generally embankment repairs are from "bottom – up"
3. Maintaining structural integrity and performance of embankment through construction period and through use.

Summary of Opportunities, Actions and Considerations:

- The Riverine proposal, as attached, is present as developed design for planning submission. Detailed design will address structural and geotechnical technical design requirements for all embankment works.
- The existing embankment was not designed to accommodate a walking/cycling route along the crest. It is designed as a Q5 flood embankment to prevent flooding of agricultural land. DfI Rivers have no future ambitions to increase existing crest height.
- Riverine proposals to consider the prevention of wildlife burrows through the embankment.
- Riverine proposals to consider mitigation measures to prevent embankment "blow-out" during flood events. @Thompson, George (DfI), please can you forward a record of recent blow outs for information.
- Potential joint-funding opportunity with DfI Rivers : DCSDC for the provision of sheet piled core – CM to raise with DCC / DCSDC.
- Planning approval is generally conditioned by licence approval at detailed design - On-going consultation between Riverine Project Team and DfI Rivers will be required throughout the preparation and submission of the various schedule 6 applications.
- CM to establish a working group to ensure DfI Rivers remain informed and engaged through detailed design. Working Group to include George Thompson & Shane Grant (SG's contact details received with thanks from SB).

Regards

**Clare Morris**
Chartered Engineer

McAdam
ENHANCING LOCAL COMMUNITIES

# Request for Information (with Dates) GC/CM
# MS Teams Call 31/05/2021 pg1/2 [R1]

- (EOWC 31/05/21) Walkover results from OPW's recent visit
  - Walkover suggests condition score 3, 4+
  - **GC to forward CM report and scoring matrix following Lifford FRS Steering Group scheduled 10th June.**

- (EOWC 31/05/21) OPW Standard Details for: Realignment of the embankment, reinstatement of the embankment at the bridge and the tie/connection to the existing embankment.
  - Construction of existing embankments c1960s.
  - OPW do not hold Standard Detail drawings / general Design Standards.
  - **[R1] GC to provide a sample specification which was used elsewhere. However, McAdam to propose a site-specific design based on SI and Geotechnical Design.**

- (EOWC 31/05/21) Can OPW confirm the existing make-up and freeboard within the embankment and can as built drawings be provided?
  - OPW do not hold Standard Detail drawings / general Design Standards.
  - Crest height will not be lowered and will be maintained as existing levels.
  - McAdam to propose site specific design with design narrative within the Section 9 Application.

- (EOWC 07/06/21) Current maintenance methodology and type of machinery and equipment used
  - OPW complete surveys every 5years.
  - For maintenance exercises, 25t long reach excavator, tractor / trailer are used.

- (EOWC 07/06/21) What is acceptable / not acceptable in terms of planting, particularly on park-side.
  - Generally grass and wildflower mix are acceptable in terms of maintenance.
  - Any larger trees, shrubs will be subject to geotechnical considerations (e.g., root zones

- (EOWC 07/06/21) Section 50 for discharge of storm water into Lifford Drain/R. Deele. Attenuation Strategy 1:100+20%.
  - Section 50 is required for the Bridge Crossing.
  - **GC to forward Section 50 Information brochure.**

# Request for Information (with Dates) GC/CM
# MS Teams Call 31/05/2021 pg1/2 [R1]

- (EOWC 26/06/21) Are we required to complete the realignment of the embankment before we remove the existing?
  - McAdam shall be responsible in ensuring the integrity of the scheme is maintained during construction.
  - McAdam to include mitigation measures in CEMP which may include phasing of the works and as to when the existing embankment is removed.

- (EOWC 26/06/21) Do OPW have any preference into the construction of the abutment of the bridge within the existing embankment (which is to be reinstated)? Can the abutment be extend throughout the embankment and what are the reinstatement requirements.
  - OPW do not hold Standard Detail drawings / general Design Standards.
  - McAdam to propose solution with Design Narrative and with particular consideration to differential settlement between new and existing.

- (EOWC 26/06/21) There is a potential for temporary works (e.g., associated with the crane and bridge construction). Discuss approach.
  - McAdam are currently in the process of discussing construction phasing including enabling works for crane platform and bridge construction.
  - McAdam shall submit a Section 50 Application to OPW for the bridge construction which will include: Drawings, Design narrative, CEMP, Programme

- Any Other Business
  - **CM to discuss with DCC Riverine Team insurances, in particular who is liable for the walkway/cycle infrastructure on embankment (note - details of insurances are to be include in Section 9 Application to OPW for realignment / alternations to the existing flood defence).**
  - **CM to discuss with DCC Riverine Team operation and maintenance requirements of the embankment within the Riverine Park boundary including business as usual operation and maintenance and works associated with repairs.**
  - McAdam shall consider in the design of the embankment, future maintenance and/or access, reinstatement and buildability of future (upgrade) works to embankment.

- End of Call

| | |
|---|---|
| **Project** | **Riverine Community Park** |
| **Minutes** | Lifford FRS : Riverine Data Meeting |
| **Date/Time** | 11th December 2020 @ 0915 |
| **Location** | Microsoft Teams |

**Attendees**

From Lifford FRS Project Team

| | | |
|---|---|---|
| Stephen Patterson | (SP) | Senior Associate - RPS |

From Riverine Community Park Project Team

| | | |
|---|---|---|
| Clare Morris | (CM) | Project Coordinate - McAdam Design |
| Anthony McCloy | (AMC) | Managing Director – McCloy Consulting |
| Paul Singleton | (PS) | McCloy Consulting |
| Duncan Hartwick | (DH) | McCloy Consulting |

**Circulation**

As above+
SP to circulate to wider Lifford FRS Project Team
CM to circulate to wider Riverine Community Park Project Team

| Item | Description | Action |
|---|---|---|
| **1.0** | **Aim** | |
| 1.1 | To discuss the availability of existing Technical Data as the Riverine project moves into developed design. | |
| 1.2 | This meeting was arranged as a precursor to future whole team Lifford FRS : Riverine project meetings, which will be established once the Riverine developed design stage is underway. | |
| **2.0** | **Existing CFRAM Model** | |
| 2.1 | The CFRAM Model was developed from a previously completed DfI River Model. No model build report for the DfI River Model was made available and therefore the confidence rating of the existing CFRAM Model could not be established nor the model relied upon to develop the Lifford FRS. | |
| 2.2 | Spot checks undertaken by RPS indicated that there are no significant inconsistencies between the older DfI topographical survey (estimated to be 15+ years old) and the new survey commissioned for the purposes of Lifford FRS Model model build. The new topographical survey is considered to be the most up to date and accurate data available. | |
| 2.3 | The CFRAM Model was built using Info Works ICM. | |
| **3.0** | **New Lifford FRS Model** | |
| 3.1 | RPS are in the process of a new Lifford FRS Model build, due for release spring/summer 2021. It is likely that the release of the Lifford FRS Model will exceed the Riverine Flood Risk Assessment (FRA) & Planning Programme. | |
| 3.2 | AMC queried whether an early release of the Lifford FRS Model would be viable (prior to full checks and approval by OPW). AMC noted that any model provided with draft extents would be used at project risk and solely to inform Riverine FRA tasks. Any early release of this data would be at the discretion of OPW. | |
| 3.3 | Action – SP to raise with OPW, the possibility of early release of Lifford FRS Model to the Riverine Project. | SP |

## 4.0 Topographical Survey Data

4.1 RPS procured a new topographical survey to cover the extents of the Lifford FRS study area (including the river bed) in August 2020. SP advised that the topo-data plus vector mapping are expected prior to Christmas. CM requested if the topographical survey data could be shared with the Riverine Project to ensure continuity of data across the shared project areas.

Action – SP to raise with OPW, the possibility of sharing the new topo-data with the Riverine Project. SP

## 3.0 Existing Embankment to the River Foyle

3.1 The Riverine Project Team have requested incorporation of the existing embankment along the R.Foyle within the Lifford FRS. The embankment exceeds the 1:1000 AEP event levels.

3.2 To inform the developing design, the Riverine Project Team are considering a condition assessment (including visual inspections and ground investigations) of the embankment. The outputs of the condition assessment would inform the required rehabilitation works to repurpose the (historic railway) embankment as a structurally sound and reliable flood defence.

3.3 Note – the main flooding mechanism of the Riverine Park area (Lifford) is the R.Deele.

## 4.0 Collaboration

4.1 Both SP and CM reiterated the preferences for collaborative working and the importance of mutual support given the very public and interwoven nature of both projects.

**End**

# Appendix C

# Hydraulic Modelling Method Statement

## PREAMBLE

The River Foyle has been previously modelled in the vicinity of the site by both DfI Rivers and the OPW.

The DfI Rivers Lower Foyle model, which covers the Strabane side of the study area, was licenced from DfI Rivers and critically reviewed as part of this assessment.

The CFRAMs Lifford model, which was developed as part of the North Western – Neagh Bann CFRAM study, comprises a further development of the DfI Lower Foyle model and covers both the Lifford and Strabane sides of the study area. This model was provided by the OPW for reasons of collaboration in relation to the Lifford Flood Relief Scheme and utilised to undertake this assessment. The CFRAMs Lifford model was critically reviewed and updated in the vicinity of the site to allow a more accurate determination of flood levels at the site.

## EXISTING HYDRAULIC MODELS

### DfI Rivers Lower Foyle Model

The existing DfI Rivers model of the Lower Foyle River employs a 1D-2D modelling approach to represent interactions between in-channel and out of bank flows, as well as overland flooding.

The model was developed using an Infoworks ICM model and applying unsteady state techniques. The Infoworks ICM software used was version v7.5.

The model covers lands on the Northern side of the site only, with some areas on the ROI side included as storage areas within the model. The extent of the model domain, including the modelled watercourses, 2D zone and storage areas, is shown in the figure below.

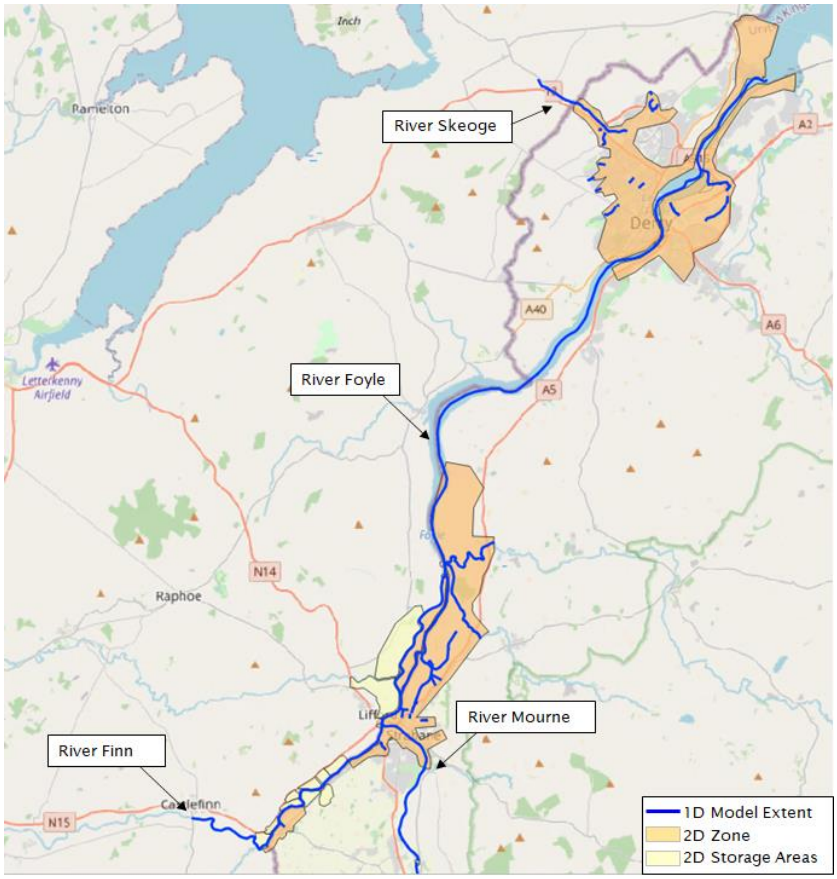



**Figure C- 1 DfI Rivers Lower Foyle Model Extent**

## North Western – Neagh Bann CFRAM Lifford Model

The existing CFRAM Lifford model also employs a 1D-2D approach to capture in-channel and out of bank flows and interactions.

The model was developed using an Infoworks ICM model and applying unsteady state techniques. The Infoworks ICM software used was version v7.0.

The model covers lands on both the Northern and Southern sides of the site. Assessment into the development of the CFRAMs Lifford model highlighted that the basis of the model was the DfI Rivers Lower Foyle model. The CFRAMs model comprised further development of the DfI model to expand it to cover the ROI side. The development included addition of the River Deele.

The extent of the model domain, including the modelled watercourses and 2D zone is shown in the figure below.

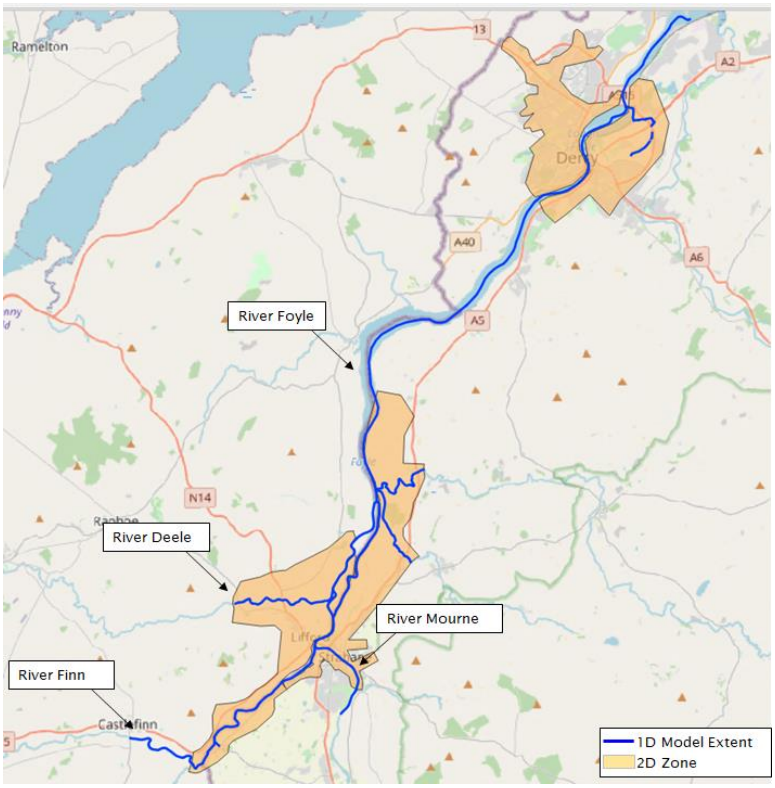



**Figure C- 2 NW CFRAMs Lifford Model Extent**

## MODEL REVIEW AND LIMITATIONS

Upon receipt of both the DfI Rivers' and CFRAM model files, a detailed review was undertaken. The review included a comparison of both models and highlighted a number of differences between the two. The main differences identified are outlined below:

- DfI Rivers model covers NI lands only, CFRAMs model covers both NI and ROI lands.
- DfI Rivers model includes the River Skeoge within the 1D, CFRAMs model includes this River as part of the 2D zone. As the CFRAMs model covers lands within Lifford, the River Deele is modelled within the 1D, it is not included in the DfI model.
- Within Strabane, the DfI Rivers' ground model is based on 2m Lidar, the ground model applied to the area in the CFRAMs model is at 5m resolution.
- In both models, the Strabane 2D zone extends into an area covered by Derry LiDAR. The DfI Rivers model incorporates the Derry data into the Strabane 2D Zone, allowing the more recent Derry height data to take precedence over the Strabane dataset in any overlapping areas. The CFRAM model does not incorporate Derry height data into the Strabane 2D zone and, as a result, ground levels in this area are set to 0 m OD. The different areas of LiDAR coverage within the Strabane 2D Zone are shown in figure below.
- DfI Rivers model included terrain sensitive meshing within the 2D zone, this was not included in the CFRAMs model meshing.

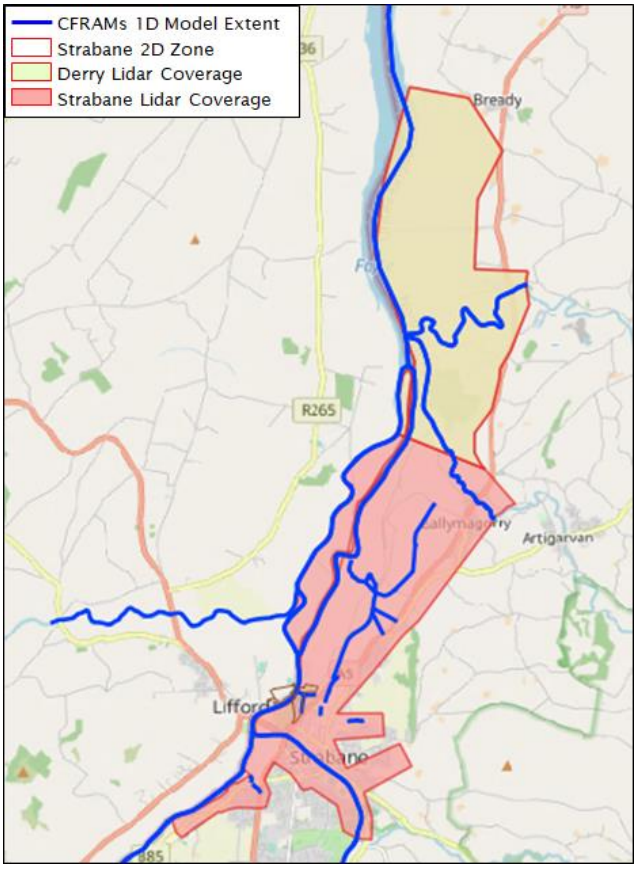



**Figure C- 3 Strabane / Derry LiDAR Coverage**

The review of the DfI and CFRAMs Lifford models highlighted a number of differences in model set up, model parameters and ground models used. The differences are likely to lead to inconsistencies between model results.

A comparison of the results for the 1% AEP present day scenario for both models showed the DfI Rivers model produced a greater flood extent and higher flood depths compared to the CFRAMs model. This could be a result of the differences outlined above, and also due to the fact that as the DfI Rivers model only covers NI, it does not account for overland flow, storage and interactions with the Lifford floodplain.

The CFRAMs Lifford model is a development of the DfI Rivers Lower Foyle model. Considering this, and the fact that it covers both NI and ROI lands, the CFRAMs model was adopted for use in this assessment. A review of the CFRAMs Lifford model highlighted a number of limitations. The main limitations are outlined below:

- The model was found to diverge from the DfI River's model from which it was developed. The differences have been discussed above.
- Embankments located along the River Foyle are modelled within the 1D, it is more suitable to include these defences within the 2D and employ high resolution height data and terrain sensitive meshing.
- Definition of the riverbanks was found to be low. It will be more accurate to better define the banks, again using high resolution height data.

## MODEL DEVELOPMENT

The following summarises updates committed to the CFRAMs Lifford model for the assessment:

### Baseline model validation

- The model was opened in Infoworks ICM v7.0 and updated to run on the latest software version available at time of assessment (v2021.1)
- Model was rerun following updating, prior to any further changes to verify that the version update would not influence results. Model simulations were carried out for the 10% AEP, 1% AEP and 0.1% AEP events for the present-day scenario and for the 1% AEP and 0.1% AEP events for the Mid-range and High-end future scenarios. The results were then checked for comparison against the CFRAM results to validate the baseline scenario.

### Ground model updates at 2m resolution

The second phase of the model development involved incorporating higher resolution and more detailed height data to the model 2D zone. The updates to the model undertaken at this stage of the development are outlined below.

- Within the Strabane 2D zone (see previous figure), the ground model was resampled to a 2m resolution grid to reflect the resolution of the height data used in the DfI Rivers model. The Derry dataset was not incorporated at this time to allow only the impact of reducing the resolution of the original CFRAMs ground model to be assessed.
- A second scenario was created in which ground model was further updated to allow detailed land survey data to be patched in at the location of the site. The survey data was incorporated into both the Strabane and Lifford ground models. Both updated ground models were defined at a 2m resolution.
- Both scenarios were simulated for the 1% AEP present-day scenario to assess the impact of reducing the ground model resolution within the Strabane 2D Zone and the effect of incorporating the detailed survey data into the site.

### Ground model updates at 1m resolution

The next step in the model development involved employing height data of a higher resolution within the Strabane area, incorporating height data within the Derry region of the Strabane 2D zone and including terrain sensitive meshing. This phase of the model development is outlined below.

- The base scenario was re-meshed to include terrain sensitive meshing with a maximum height variation of 1m. This allowed for a more suitable comparison with further model updates. Model simulations were carried out for the 1% AEP present-day scenario to assess the impact of including terrain sensitive meshing on model results.
- The base scenario was further updated to allow separate ground models for Strabane and Derry to be included in the model. The ground model covering Strabane was unchanged and best available 1m resolution LiDAR was used for the Derry area. This model was adopted as the revised baseline model and simulations were carried out for the 1% AEP present-day scenario to allow for comparison with further model updates.
- The Strabane ground model was updated using 1m resolution LiDAR data.

- An alternative scenario was created in which additional modifications were made to the ground model to include the detailed land survey patched in at the location of the site on both Strabane and Lifford.
- Both scenarios were simulated for the 1% AEP present-day scenario to assess the impact of higher resolution height data within the Strabane area and the impact of including the detailed survey data within the site area.

River Foyle embankments

The baseline model incorporates embankments along the River Foyle as part of the 1D model. Due to the updated ground model detail and inclusion of terrain sensitive meshing, the embankments are better represented within the 2D component of the model. The model was further developed to account for this as follows:

- The river reach in the vicinity of the development site was updated to remove the embankments from the 1D.
- Additional mesh zones were applied to represent the embankments in the vicinity of the site. Maximum triangle areas were set to 5m$^2$ with minimal triangle areas set to 1m$^2$.
- Right banks were updated based on the 1m grid Strabane ground model and left banks were updated based on the 2m grid Lifford ground model.
- A second scenario was created in which the ground models in the site area were updated with detailed survey data. Where required, bank lines were updated based on these ground models. This model update was the final existing baseline scenario and would be used for comparison against the proposed scenario.
- Both scenarios were ran using for the 1% AEP present-day scenario and results checked to assess the impact of the changes made.

Proposed Development

A copy of the baseline existing model was used to create a proposed development scenario. For this scenario, both the Strabane and Lifford ground models were updated with proposed ground levels within the site area.

Model simulations for both the existing and proposed scenarios were carried out for the 1% AEP, 0.1% AEP present day and climate change (+20% / MRFS) events.

## HYDROLOGICAL ASSESSMENT

A review of the Flood Maps NI and CFRAMs hydrology for the River Foyle was undertaken. 1% AEP flood flows at a node adjacent to the proposed site boundary are indicated as 1380.7m$^3$/s and 1451.43 m$^3$/s by the FMNI and CFRAMs flood mapping, respectively. On the basis of this, the CFRAMS hydrology was adopted for this assessment and is considered precautionary.

## HYDRAULIC MODEL SIMULATION

The hydraulic model for the site has the purpose of providing peak water levels from the derived design flow estimated for the River Foyle in the vicinity of the site. The modelling has established the capacity of the watercourse within the proposed development site.

In accordance with the precautionary principle, the most conservative flood levels predicted at the site have been used for the purposes of this initial flood risk assessment.

## 1-DIMENSIONAL RIVER REACHES

### River Sections

Existing bed levels of open reaches of the River Foyle remain unchanged from the CFRAMs Lifford model. Bank lines have been modified to remove embankments from the 1D. Bank levels of the river reach have been updated in the vicinity of the site based on updated ground models. For the remainder of the model extent, bank levels are unchanged from the CFRAMs model.

### Structures

All existing structures (including invert levels) were retained as per the original CFRAMs Lifford model.

## 2-DIMENSIONAL SURFACE MODEL AREAS

### Topography

For the extent on the model located in ROI, out of bank topography for the original CFRAMs Lifford model was based on 2m resolution LiDAR. For the NI model components, out of bank topography was based on 5m resolution Strabane LiDAR and 1m resolution Derry LiDAR. As previously discussed, an area contained within the Strabane 2D Zone which is covered by Derry LiDAR was not assigned height data in the original Lifford model.

A number of ground model refinement scenarios were assessed as part of the model development. The first update involved refining the terrain information for Strabane by resampling the ground model to a 2m resolution grid. A second updated involved further refinements based on 1m resolution LiDAR data. Additional ground model updates were made to incorporate the missing Derry 1m resolution height data. A further scenario was assessed in which both the Strabane and Lifford ground models were updated based on detailed land survey data.

Out of bank topography for the final update, which will be used to represent the existing scenario, was therefore based on a 2m resolution grid covering the ROI lands, two separate 1m resolution grids covering Strabane and Derry and land survey data within the entire site area.

For the proposed scenario, the final existing topography was updated within the site area based on proposed development ground levels.

### 2D Zone

The existing 2D zone used in the CFRAMs Lifford model was updated to facilitate separate ground models for Strabane and Derry to be used in the model. All other parameters including triangle size were unchanged from the original model setup.

Mesh zones were applied covering the site area. A maximum triangle size for the mesh zones was set to 25m$^2$ and the minimum triangle size was set to 1m$^2$.

Additional mesh zones were applied covering the embankments within the vicinity of the site to better define the terrain in this area and capture the defences. A maximum triangle size for the mesh zones was set to 5m$^2$ and the minimum triangle size was set to 1m$^2$.

The existing 2D zone was exported and the resulting break lines used when meshing the 2D zone for the proposed development scenario. This ensured consistency between the models, with the meshes being unchanged for both scenarios.

### Boundary Conditions

The boundary conditions were retained as per the original CFRAMs model.

### Surface Roughness

The Manning's n Roughness value applied to the 1D and 2D model domains remains unchanged from the original CFRAMs model.

## FLOOD SCENARIOS

A number of flood scenarios have been simulated as part of this assessment. These are outlined below.

Initial model simulations were carried out to validate the baseline scenario against the existing CFRAMs Lifford model. Three events were considered for the present-day scenario:

- 50% AEP
- 1% AEP
- 0.1% AEP

For the 20% CC / MRFS two events were considered:

- 1% AEP
- 0.1% AEP

After each stage of the model development, the 1% AEP present day scenario was simulated, and the results used to evaluate the effect of each change compared to the baseline model.

For the final baseline simulations, the ground models were refined based on both the recent Lidar and land survey data. The following flood scenarios were simulated for this case:

- 1% AEP
- 0.1% AEP
- 1% AEP + 20% CC / MRFS
- 0.1% AEP + 20% CC / MRFS

## MODEL RESULTS

Please refer to Appendix D for detailed flood maps produced from this assessment.

### Initial model validation

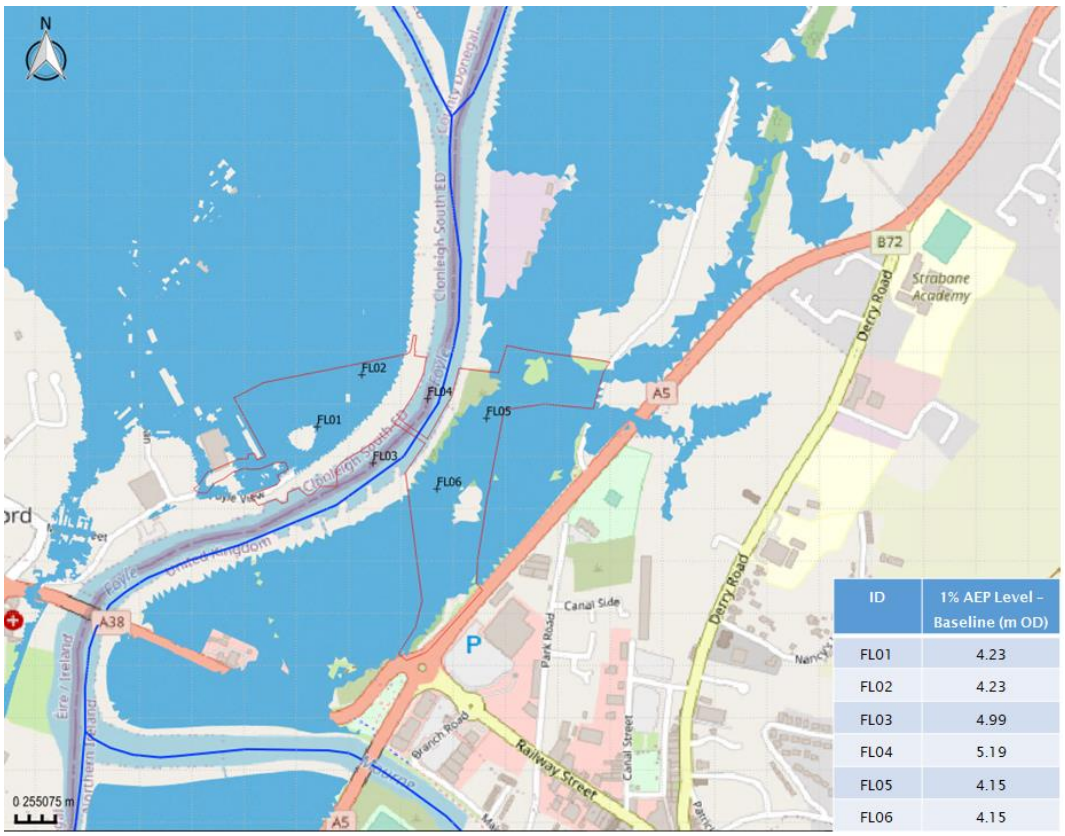
Model results for the initial baseline scenario, prior to any updates, were comparable with CFRAM results. Flood extents and depths for the flood scenarios considered matched the results from the original CFRAM model. It was concluded that the software version change introduced no change in findings.

### Effect of updates to model terrain - 2m resolution

The CFRAMs Lifford model terrain was initially refined based on 2 scenarios and the impact of the ground model updates on flood extents and levels within the site assessed. 1% AEP fluvial flood extents for each scenario, including the original baseline scenario, are presented in the following figures. Flood depths at locations within the proposed development site are also shown on the figures. In the second figure presented below Scenario Update 1 refers to resampling of the Strabane ground model to a 2m grid, in the third figure presented below Scenario Update 1b refers to both resampling of the Strabane ground model and inclusion of land survey data within the site.

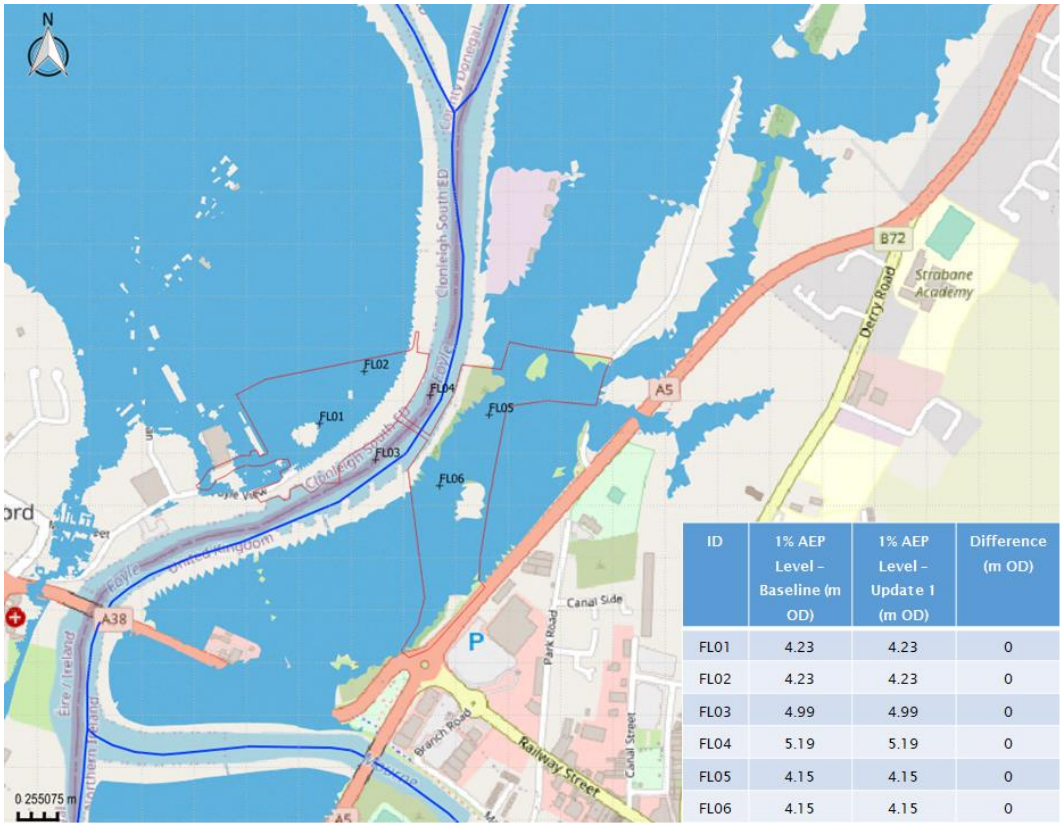
Results indicate that updating the Strabane ground model with the 2m resolution LiDAR data resulted in no significant change from the original baseline model. The flood extent and flood levels for the 1% AEP PD scenario were observed to be unchanged from the baseline scenario.

Further refinement to the model terrain using detailed land survey led to minor increases in out of bank flood depths within the site. Within the channel, flood levels were unchanged from the baseline scenario. On the Strabane side changes of up to 0.07m were noted, whilst changes in levels on the Lifford side were in the range of 0.02m. Minor changes in the flood extent were also noted. In particular, flooding across the A5 was not observed in Update 1b. This is a result of areas of high ground levels located to the left side of the road which are picked up by the land survey but not in the 2m resolution LiDAR data.



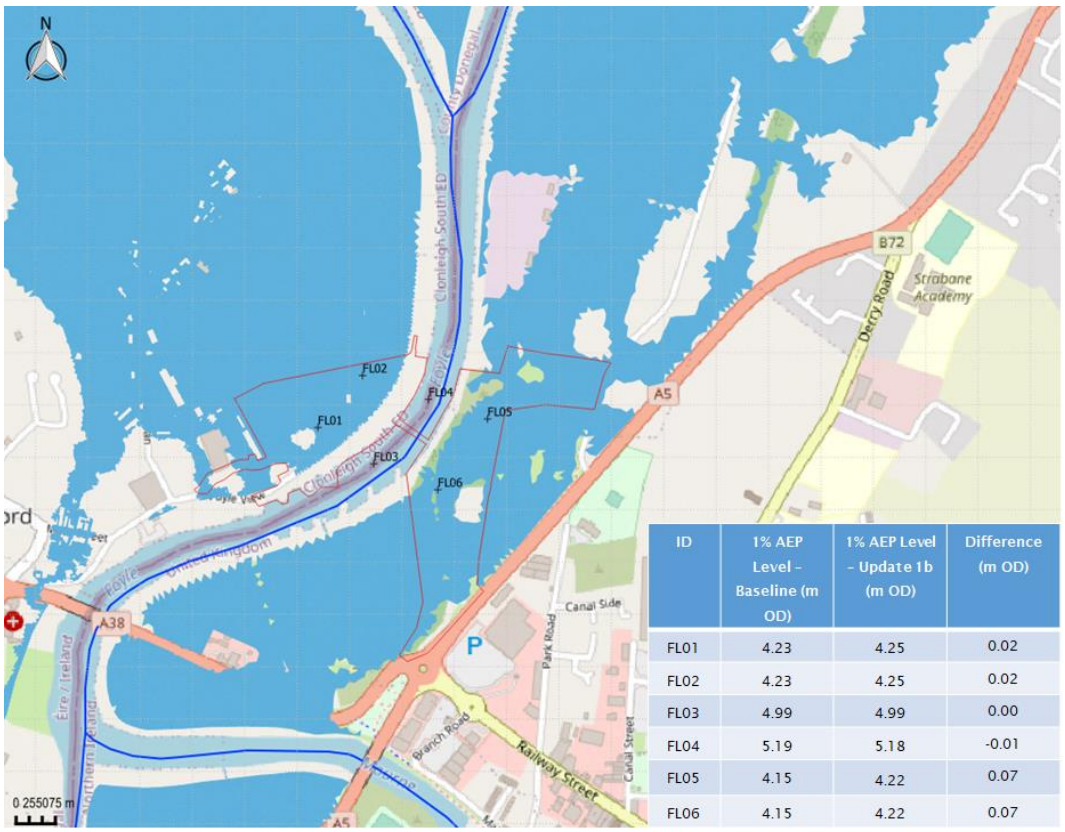

| ID | 1% AEP Level – Baseline (m OD) |
|---|---|
| FL01 | 4.23 |
| FL02 | 4.23 |
| FL03 | 4.99 |
| FL04 | 5.19 |
| FL05 | 4.15 |
| FL06 | 4.15 |

**Figure C- 4 1% AEP PD - Flood extent map – Initial Baseline Scenario**




| ID | 1% AEP Level – Baseline (m OD) | 1% AEP Level – Update 1 (m OD) | Difference (m OD) |
|---|---|---|---|
| FL01 | 4.23 | 4.23 | 0 |
| FL02 | 4.23 | 4.23 | 0 |
| FL03 | 4.99 | 4.99 | 0 |
| FL04 | 5.19 | 5.19 | 0 |
| FL05 | 4.15 | 4.15 | 0 |
| FL06 | 4.15 | 4.15 | 0 |

**Figure C- 5 1% AEP PD - Flood extent map - Update Scenario 1**




| ID | 1% AEP Level – Baseline (m OD) | 1% AEP Level – Update 1b (m OD) | Difference (m OD) |
|---|---|---|---|
| FL01 | 4.23 | 4.25 | 0.02 |
| FL02 | 4.23 | 4.25 | 0.02 |
| FL03 | 4.99 | 4.99 | 0.00 |
| FL04 | 5.19 | 5.18 | -0.01 |
| FL05 | 4.15 | 4.22 | 0.07 |
| FL06 | 4.15 | 4.22 | 0.07 |

**Figure C- 6 1% AEP PD - Flood extent map - Update Scenario 1b**

## Effect of updates to model terrain - 1m resolution

The CFRAMs Lifford model terrain was further refined based on 2 scenarios and the impact of the ground model updates on flood extents and flood levels assessed. In the following figures the scenarios are denoted as Update Scenario 2, i.e., update of the Strabane ground model with 1m resolution LiDAR, and Update Scenario 2b, i.e., update of the Strabane ground model with 1m resolution LiDAR and inclusion of existing land survey data within the site.

To allow for a like for like comparison, the original baseline model was updated to include terrain sensitive meshing and previously missing Derry height data. This updated model will be used as the new baseline scenario in the following analysis.

Flood extents for the revised baseline scenario are shown in the figure below. Comparison of model results for the original and revised baseline scenario highlighted results are sensitive to terrain sensitive meshing. Whilst the 1% AEP flood extent remined largely unchanged from the original baseline extent, increases in flood levels were observed both within the channel and the Strabane floodplain. As the terrain in the area is varied, with large embankments located along the banks of the Foyle, including the terrain sensitive meshing is considered the more accurate approach.

Results indicated that updating the Strabane ground model with 1m resolution LiDAR (see the second figure presented below) led to in an increase in levels of 0.03m and 0.02m at FL01 and FL02, respectively. On the Strabane site, changes of up to 0.39m were observed at FL06.

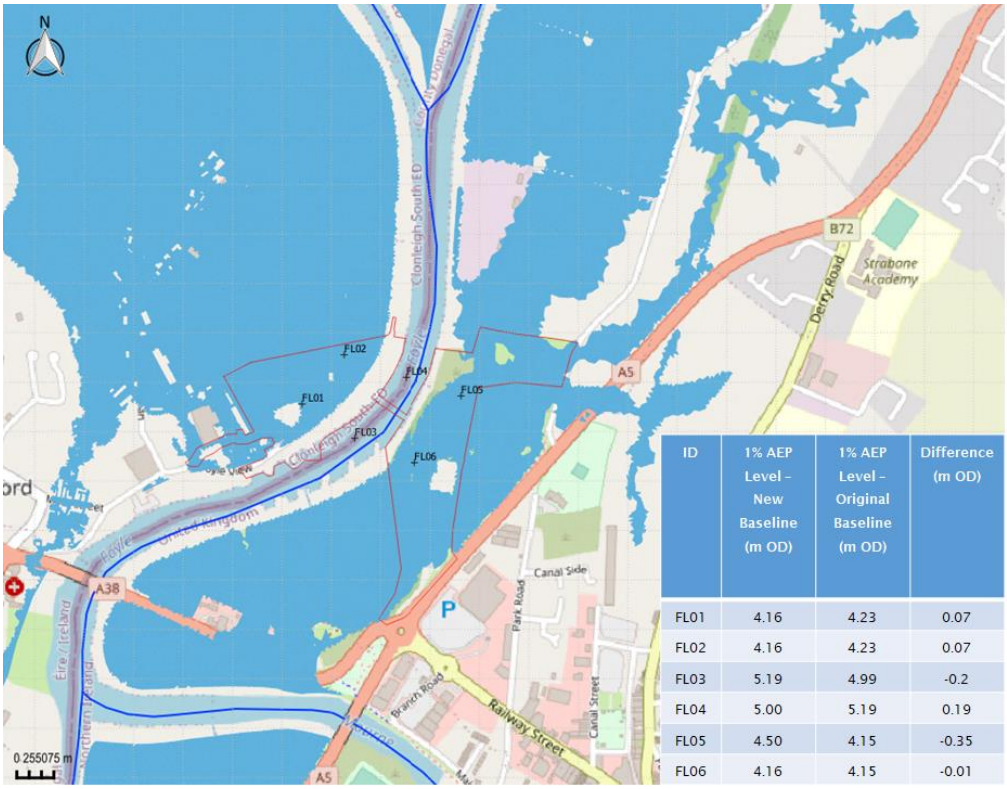
The increase in flood levels at FL06 is directly related to the height data used in the model. A comparison of the CFRAM Strabane ground model (resampled to a 2m grid) and the 1m resolution LiDAR is shown below. Figure C10 depicts the 1m resolution height data minus the 2m resolution data.

A notable difference in ground levels is seen, with changes of up to ± 2.5 m found within the site. The 1m resolution data captures in greater detail the embankments along the River Foyle as well as areas of high and low ground to the south of the site near FL06. Flooding on the Strabane side of the site is largely due to overtopping of the right bank of the River Mourne, with the flow path in a North easterly

direction through the site. Variations in ground levels to the lower end of the south obstruct and divert the flow path, leading to higher flood levels at FL06.

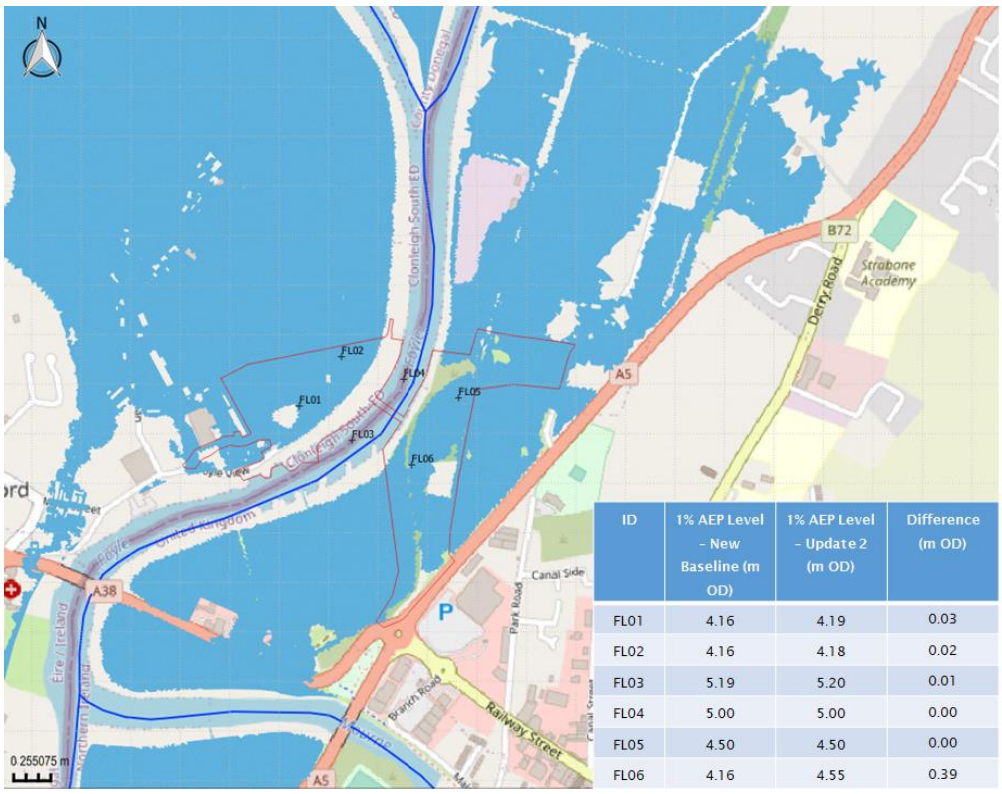
Further refinement to the model terrain using detailed land survey led to increases of c 0.08m in out of bank flood levels within the Lifford side of the site. The updated ground model did not result in changes to in channel levels. On the Strabane side of the site, flood levels were reduced by c 0.25m at FL05 and increased by c 0.09m at FL06. It is noted that inclusion of the land survey data into the Strabane ground model reduces flood levels at FL06 from those found in the Update 2 scenario. The flood extent was found to be similar to that produced from update 2, with no flooding observed across the A5.

A comparison of the CFRAM Strabane ground model (resampled to a 2m grid) and the 1m resolution LiDAR with land survey data included is shown below. In the figure, differences are calculated as 1m resolution height data with survey data included minus the 2m resolution data. The survey data is considered to be more accurate and is therefore used in the final ground models.



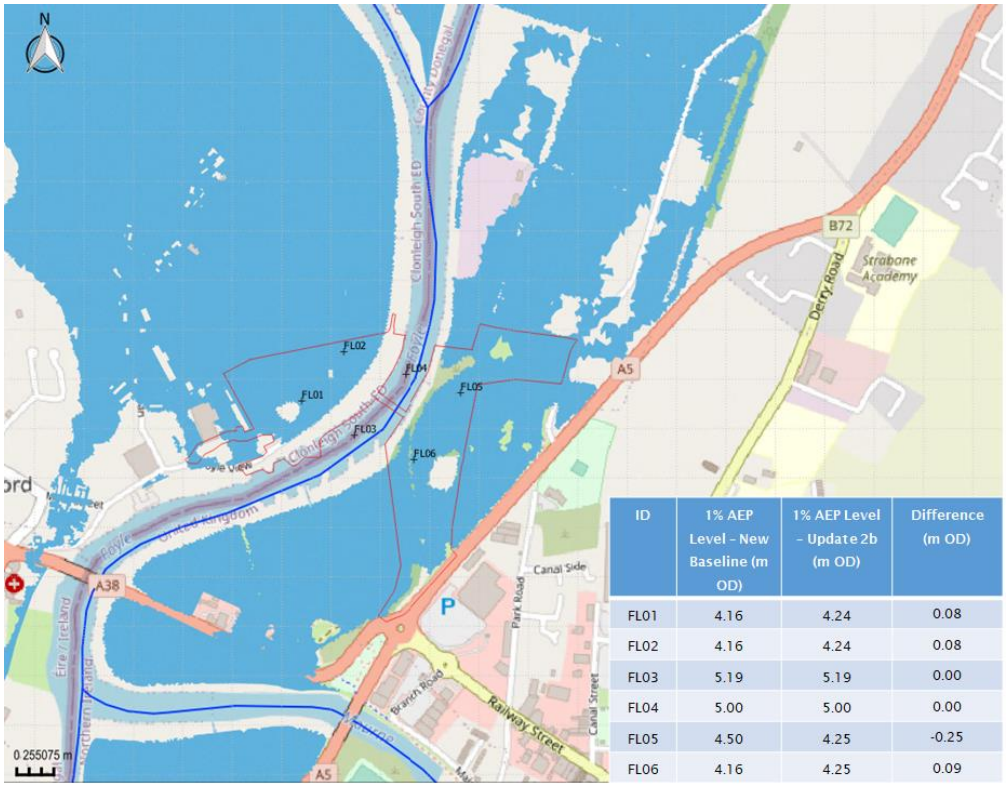

| ID | 1% AEP Level – New Baseline (m OD) | 1% AEP Level – Original Baseline (m OD) | Difference (m OD) |
|---|---|---|---|
| FL01 | 4.16 | 4.23 | 0.07 |
| FL02 | 4.16 | 4.23 | 0.07 |
| FL03 | 5.19 | 4.99 | -0.2 |
| FL04 | 5.00 | 5.19 | 0.19 |
| FL05 | 4.50 | 4.15 | -0.35 |
| FL06 | 4.16 | 4.15 | -0.01 |

**Figure C- 7 1% AEP PD - Flood extent map – New Baseline Scenario**




| ID | 1% AEP Level – New Baseline (m OD) | 1% AEP Level – Update 2 (m OD) | Difference (m OD) |
|---|---|---|---|
| FL01 | 4.16 | 4.19 | 0.03 |
| FL02 | 4.16 | 4.18 | 0.02 |
| FL03 | 5.19 | 5.20 | 0.01 |
| FL04 | 5.00 | 5.00 | 0.00 |
| FL05 | 4.50 | 4.50 | 0.00 |
| FL06 | 4.16 | 4.55 | 0.39 |

**Figure C- 8 1% AEP PD - Flood extent map – Update Scenario 2**




| ID | 1% AEP Level – New Baseline (m OD) | 1% AEP Level – Update 2b (m OD) | Difference (m OD) |
|---|---|---|---|
| FL01 | 4.16 | 4.24 | 0.08 |
| FL02 | 4.16 | 4.24 | 0.08 |
| FL03 | 5.19 | 5.19 | 0.00 |
| FL04 | 5.00 | 5.00 | 0.00 |
| FL05 | 4.50 | 4.25 | -0.25 |
| FL06 | 4.16 | 4.25 | 0.09 |

**Figure C- 9 1% AEP PD - Flood extent map – Update Scenario 2b**

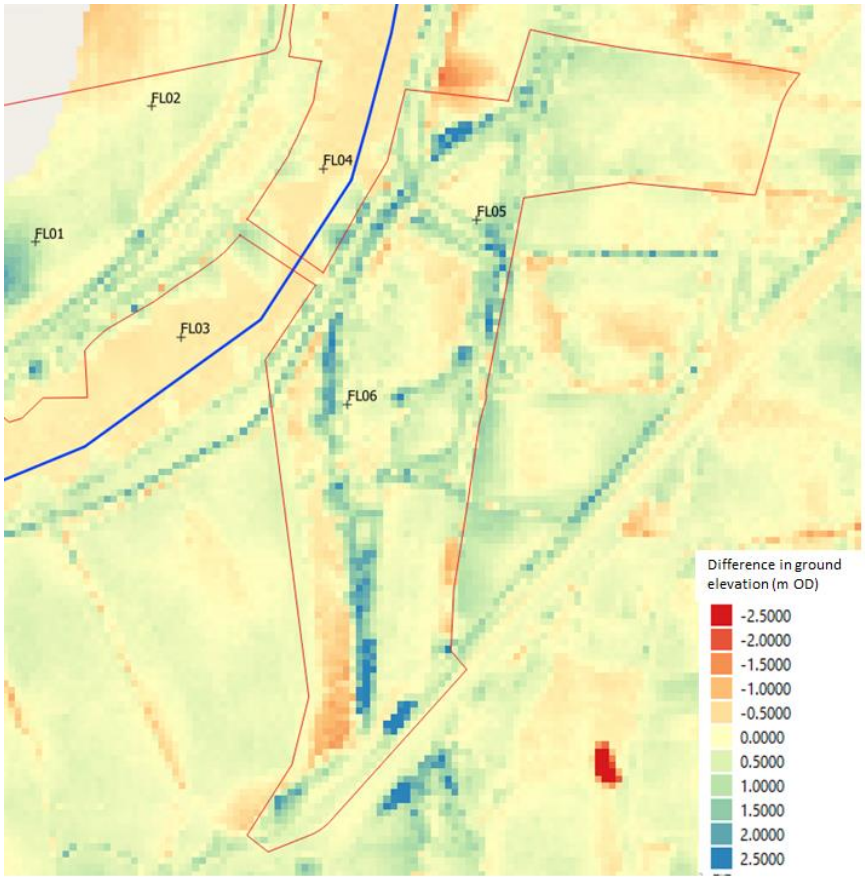



**Figure C- 10 Comparison of Strabane ground model height data (1m resolution – 2m resolution data)**

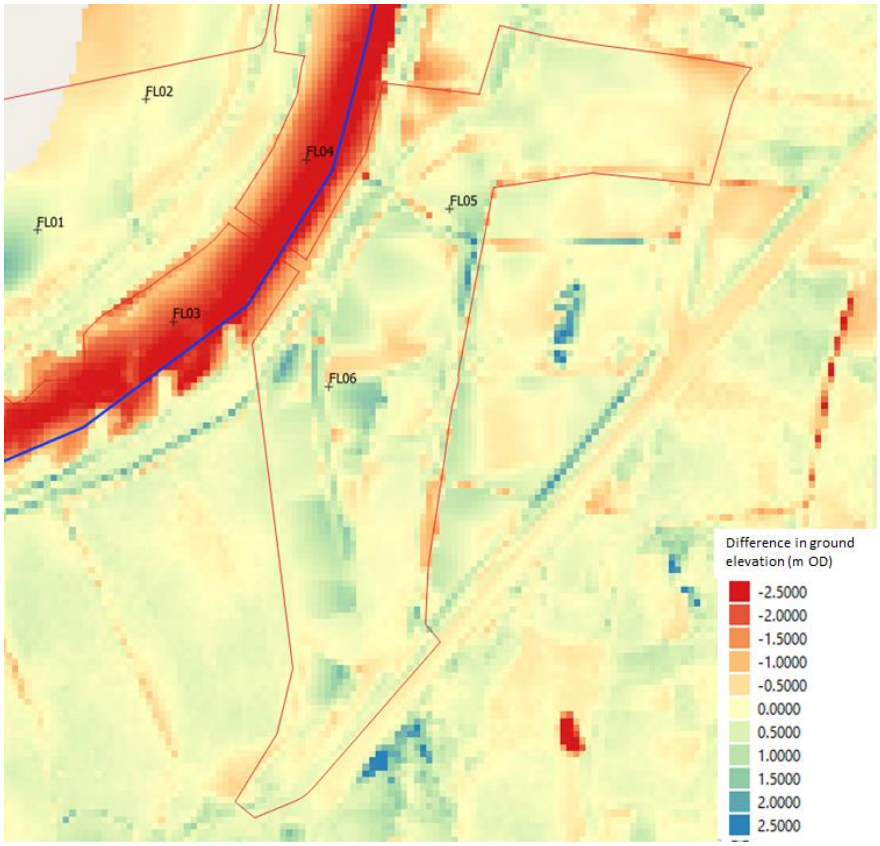



**Figure C- 11 Comparison of Strabane ground model height data (1m resolution with land survey data – 2m resolution)**

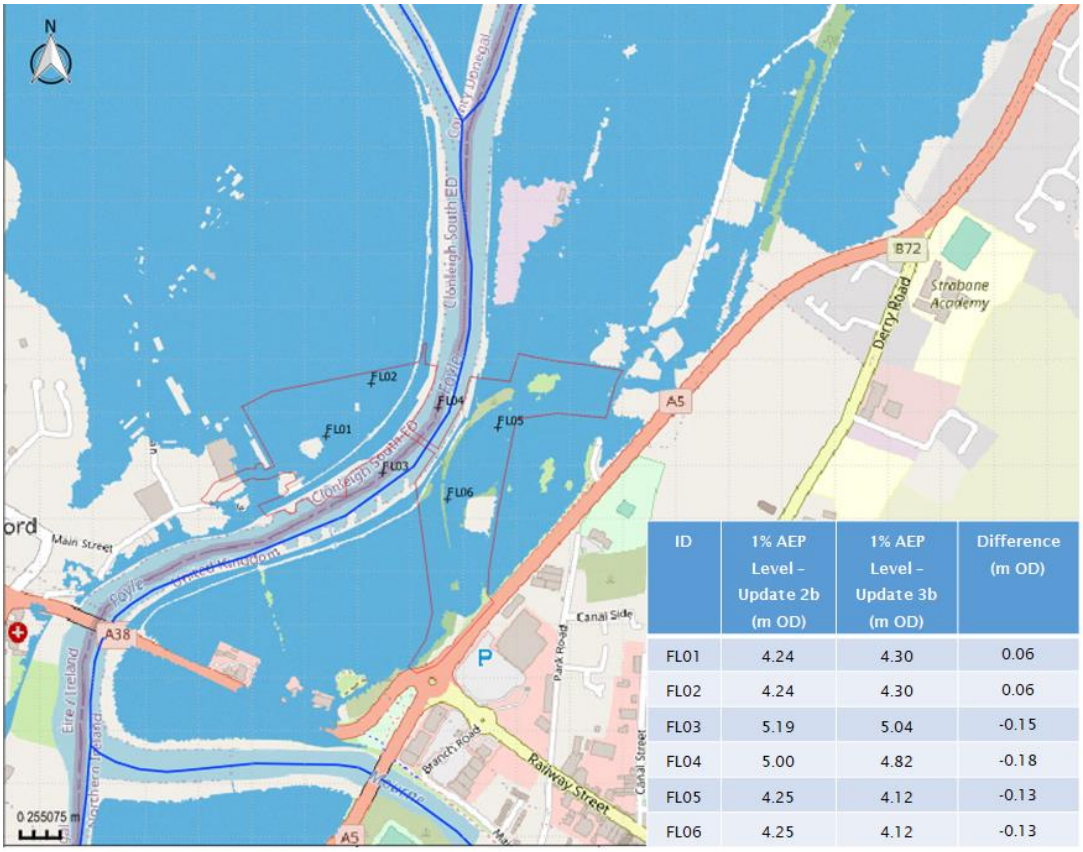
## Effect of updates to 1D/2D model extents

Embankments along the River Foyle were originally modelled within the 1D. The Lifford model was further updated to instead represent the embankments within the 2D zone. In doing so bank lines were also defined in greater detail.

The effect of this change was assessed for a 1% AEP PD event, based on Update scenario 3, in which the Strabane ground model was based on 1m resolution LiDAR and land survey data was included within the site. This update also included an update of the 2D zone. Mesh zones were added to better define the embankments and the site area.

The resulting flood extent and flood levels at location FL01-FL06 for the 1% AEP PD scenario are presented in the figure below.

Results indicate that the flood extent is largely unchanged from the baseline scenario. A reduction in flooding along the Lifford Main Street is observed. Comparison of flood levels with the Update 2b scenario (from which ground models in Update 3 are unchanged) indicates that modelling the embankments in the 2D lead to changes in flood levels within the Lifford side of the site of c 0.06m. In channel flood levels are found to be reduced by a maximum of 0.18m. A decrease in flood levels of c 0.13m is noted on the Strabane side of the site.




| ID | 1% AEP Level – Update 2b (m OD) | 1% AEP Level – Update 3b (m OD) | Difference (m OD) |
|---|---|---|---|
| FL01 | 4.24 | 4.30 | 0.06 |
| FL02 | 4.24 | 4.30 | 0.06 |
| FL03 | 5.19 | 5.04 | -0.15 |
| FL04 | 5.00 | 4.82 | -0.18 |
| FL05 | 4.25 | 4.12 | -0.13 |
| FL06 | 4.25 | 4.12 | -0.13 |

**Figure C- 12 1% AEP PD - Flood extent map – Update Scenario 3**

## Effect of the proposed development

The effect of the proposed development has been assessed based on the proposed layout, using an updated proposed development ground model. The ground model has been developed by the Civil Engineering design team to reflect all earthworks likely to cause a significant change in ground level or structure that could impede, displace or divert floodwater. A visual showing the change in ground levels between base and proposed scenario terrain models is shown on the following figure.

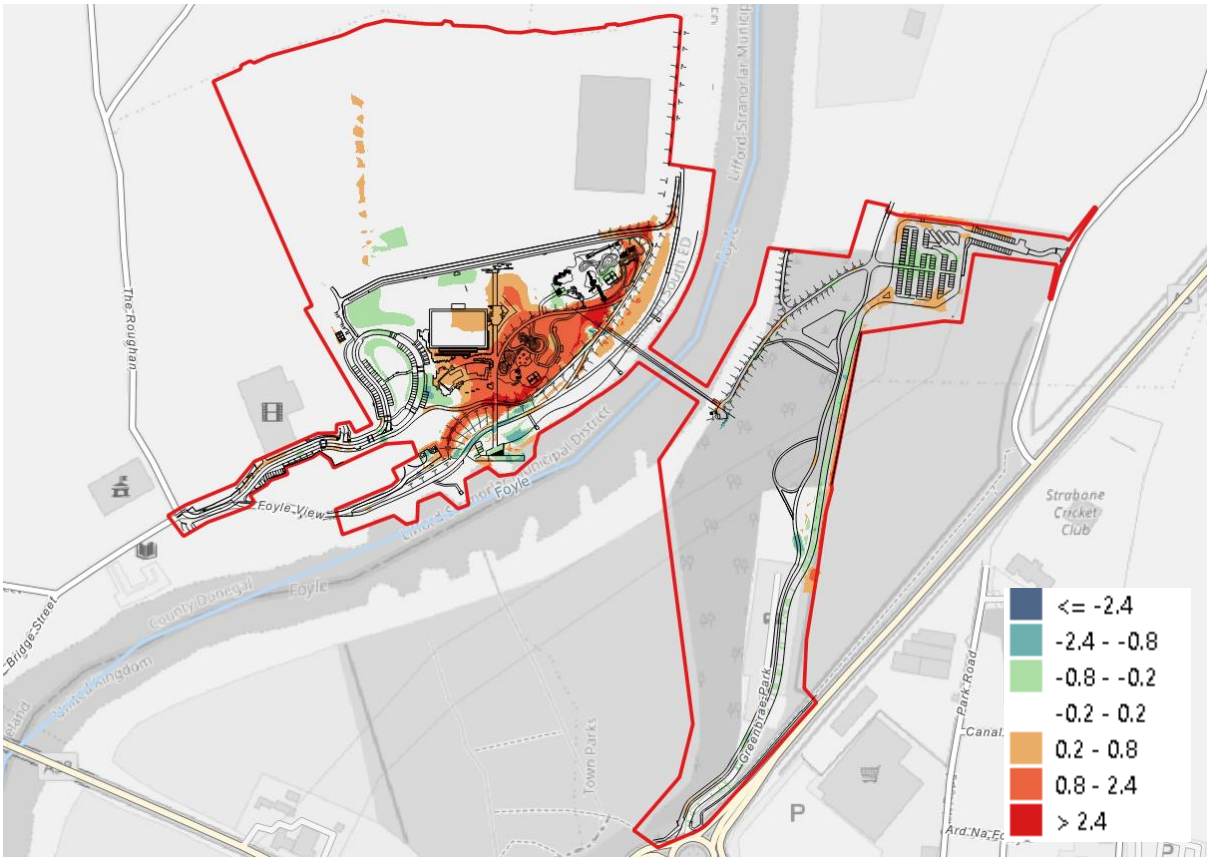



**Figure C- 13 Propsoed Changes in Ground Levels**

The proposed ground model is implemented in a model scenario by re-sampling in the model 2D zone. Pre-development mesh zone triangulation outside the site were imposed in the post-development model to ensure consistent triangulation and avoid the model reporting changed flood levels as a result of differing mesh shape. Above ground structures (buildings, proposed Foyle bridge intermediate pier) were imposed on the mesh zone as mesh elements with zero porosity and infinite height to ensure that they act as an obstruction where water reaches them.

1% AEP PD model results showed increased flood depths within the site, but no adverse effects outside of the development site.

0.1% AEP PD model results showed increased flood depths within the site and extending out of bank on the Lifford side. The impact outside of the development site occurs near the southwest side boundary, along the Foyle View Road.

The impact on flood levels is shown in Appendix D, map FL12 and FL13 (Lifford) and FL31 (Strabane).

## SUMMARY

The baseline model was simulated for a range of scenarios and resulting flood extents and depths were found to be comparable with the original CFRAMs results.

The model was found to be sensitive to terrain sensitive meshing, with changes to flood levels observed across the study area. To accurately capture the varying terrain and flood embankments within the model, employing terrain sensitive meshing is a more accurate approach and has therefore been adopted for the design model simulations.

The model terrain was updated based on higher resolution LiDAR and survey data. The model was not found to be sensitive to the refined 2m height data, however inclusion of the survey data resulted in increases in flood depth in the vicinity of the development site.

The model terrain was further updated based on 1m resolution Strabane LiDAR. 2m resolution Derry LiDAR was also incorporated into the ground model and survey data was patched onto the site. The model was found to be sensitive to the refined and additional height data, with increases in flood levels observed within the site boundary. Inclusion of the survey data also resulted in changes to flood depths, with both increased and decreases observed across the site.

The terrain update which includes the 1m resolution Strabane LiDAR and 2m resolution Derry Lidar, along with the survey data was used as the ground model for the final baseline scenarios. For the proposed scenario the ground model was further updated based on proposed levels within the site.

The final model update involved modelling the flood embankments in the 2D and refining the riverbanks. The model was found to be sensitive to this change, with increased flood depths observed on the Lifford side of the site and decreased flood levels found both in channel and within the Strabane side of the site. Modelling the embankments within the 1D is considered the most suitable approach, given the sensitivity of the model to the terrain.

The updated model is deemed to be reliable and fit for its intended purpose of determining flood risk at the site.

# Appendix D

# Flood Mapping

## Flood Map Schedule

| Reference | Flood Probability | Hydrology Scenario | Geometry Scenario | Type |
|---|---|---|---|---|
| **LIFFORD** | | | | |
| FL01 | 1% / 0.1% AEP | Present Day | Existing | Flood Zones for Planning |
| FL02 | 1% AEP | Present Day | Existing | Flood Extent by Depth |
| FL03 | 0.1% AEP | Present Day | Existing | Flood Extent by Depth |
| FL11 | 1% AEP | Present Day + Climate Change | Proposed | Flood Extent by Depth |
| FL12 | 0.1% AEP | Present Day + Climate Change | Proposed | Flood Extent by Depth |
| FL21 | 1% AEP | Present Day | Proposed | Effect of Development |
| FL22 | 0.1% AEP | Present Day | Proposed | Effect of Development |
| **STRABANE** | | | | |
| FL31 | 1% AEP | Present Day | Existing | Flood Extent by Depth |
| FL32 | 1% AEP | Present Day + Climate Change | Proposed | Flood Extent by Depth |
| FL41 | 1% AEP | Present Day | Proposed | Effect of Development |

# LIFFORD FLOOD MAPPING

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899000

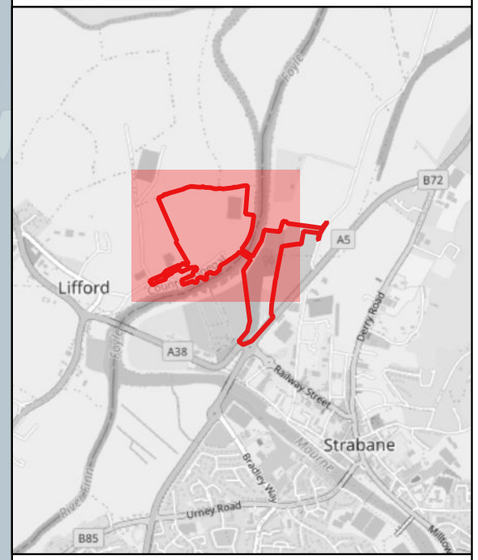
898750

898500

N

0 50 100 150 200 250 m

**MODEL OVERVIEW**




**LEGEND**

- SITE BOUNDARY
- OPEN WATERCOURSE
- FLOOD ZONE A
- FLOOD ZONE B

NOTES
1. ALL LEVELS INDICATED ARE TO ORDNANCE DATUM MALIN.

2. FLOOD EXTENTS WITHIN THE APPLICATION BOUNDARY ARE PLOTTED ON GROUND BASED TOPOGRAPHIC SURVEY.

3. FLOOD EXTENTS SHOWN OUTWITH THE RED LINE BOUNDARY ARE PLOTTED ON A COMBINATION OF GROUND BASED TOPOGRAPHIC SURVEY AND LIDAR AND AS SUCH ARE NOT SUITABLE FOR PROPERTY LEVEL ASSESSMENT.

4. ALL GRID COORDINATE INFORMATION IS TO IRISH TRANSVERSE MERCATOR.

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W: www.mccloyconsulting.ie

| | | | | |
|---|---|---|---|---|
| **PROJECT** RIVERINE, LIFFORD AND STRABANE | | **HYDROLOGY SCENARIO** PRESENT DAY | **SCALE** 1:2500 | **ORIGINAL SIZE** A3 |
| **MAP TYPE** FLOOD ZONE MAP - LIFFORD | | **GEOMETRY SCENARIO** PRESENT DAY | **DRAWN BY** DP | **APPROVED** DKS |
| **SOURCE** FLUVIAL | **FLOOD EVENT** 1%/0.1% AEP | **FIGURE NUMBER** M01959-02_FIG_FL01 | **REVISION** 1 | **DATE** 18/08/2021 |

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633500 633750 634000 634250

899000 898750 898500

N

XS103 XS102 XS101 XS100

0 50 100 150 200 250 m

| NODE ID | 1% AEP LEVEL |
|---|---|
| 1 | 4.30 |
| 2 | 4.30 |
| 3 | 4.30 |
| 4 | 4.30 |
| 5 | 4.30 |
| 6 | 4.30 |
| 7 | 4.30 |
| 8 | 4.30 |
| 9 | 4.30 |
| 10 | 4.30 |
| 11 | 4.30 |
| 12 | 4.30 |
| 13 | 4.30 |
| 14 | 4.30 |
| 15 | 4.30 |
| 16 | 4.30 |
| 17 | 4.30 |
| 18 | 4.30 |
| 19 | 4.30 |
| 20 | 4.30 |
| 21 | 4.30 |
| 22 | 4.30 |
| 23 | 4.30 |
| 24 | 4.30 |
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| 30 | 4.30 |
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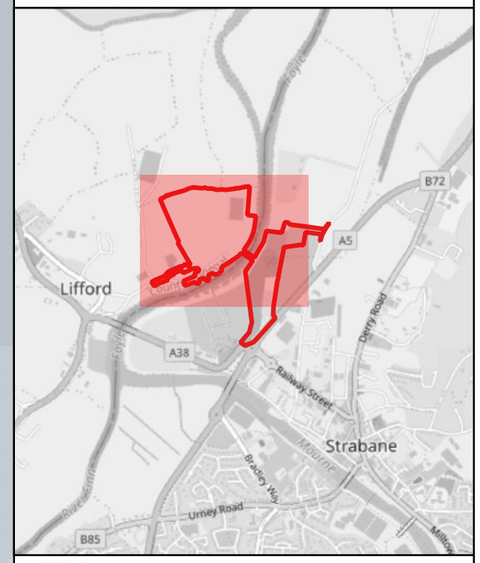
| 32 | 4.30 |
| 33 | 4.30 |
| 34 | 4.30 |
| 35 | 4.30 |
| 36 | 4.30 |
| 37 | 4.30 |
| 38 | 4.30 |
| 39 | 4.30 |
| 40 | 4.30 |
| 41 | 4.30 |
| 42 | 4.30 |
| 43 | 4.30 |
| 44 | 4.94 |
| 45 | 4.30 |
| 46 | 4.30 |
| 47 | 4.30 |
| 48 | 4.30 |
| 49 | 4.99 |
| 50 | 4.47 |
| 51 | 4.31 |
| 52 | 4.30 |
| 53 | 5.13 |

| NODE ID | 1% AEP LEVEL |
|---|---|
| XS100 | 5.04 |
| XS101 | 5.05 |
| XS102 | 4.83 |
| XS103 | 4.67 |

**MODEL OVERVIEW**




**LEGEND**

- SITE BOUNDARY
- OPEN WATERCOURSE
- FLOOD LEVEL NODE (mOD)
- FLOOD LEVEL NODE (IN CHANNEL) (mOD)

1% AEP FLOOD EXTENT BANDED BY DEPTH

- < 0.3 m
- 0.30 - 0.50 m
- 0.50 - 1.00 m
- 1.00 - 1.50 m
- > 1.5 m

NOTES

1. ALL LEVELS INDICATED ARE TO ORDNANCE DATUM MALIN.

2. FLOOD EXTENTS WITHIN THE APPLICATION BOUNDARY ARE PLOTTED ON GROUND BASED TOPOGRAPHIC SURVEY.

3. FLOOD EXTENTS SHOWN OUTWITH THE RED LINE BOUNDARY ARE PLOTTED ON A COMBINATION OF GROUND BASED TOPOGRAPHIC SURVEY AND LIDAR AND AS SUCH ARE NOT SUITABLE FOR PROPERTY LEVEL ASSESSMENT.

4. ALL GRID COORDINATE INFORMATION IS TO IRISH TRANSVERSE MERCATOR.

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E: info@mccloyconsulting.ie
W: www.mccloyconsulting.ie

| | | | |
|---|---|---|---|
| **PROJECT** RIVERINE, LIFFORD AND STRABANE | **HYDROLOGY SCENARIO** PRESENT DAY | **SCALE** 1:2500 | **ORIGINAL SIZE** A3 |
| **MAP TYPE** FLOOD DEPTH MAP - LIFFORD | **GEOMETRY SCENARIO** PRESENT DAY | **DRAWN BY** DP | **APPROVED** DKS |
| **SOURCE** FLUVIAL / **FLOOD EVENT** 1% AEP | **FIGURE NUMBER** M01959-02_FIG_FL02 | **REVISION** 1 | **DATE** 18/08/2021 |

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633500 633750 634000 634250

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1 2 3 4 5 6 7
8 9 10 11 12 13 14 15
16 17 18 19 20 21 22 23
24 25 26 27 28 29 30
31 32 33 34 35 36 37
38 39 40 41 42 43 44
45 46 47 48 49
50 51 52
53 54

XS103 XS102 XS101 XS100

0 50 100 150 200 250 m

| NODE ID | 0.1% AEP LEVEL |
|---|---|
| 1 | 4.57 |
| 2 | 4.57 |
| 3 | 4.57 |
| 4 | 4.57 |
| 5 | 4.57 |
| 6 | 4.57 |
| 7 | 4.57 |
| 8 | 4.57 |
| 9 | 4.57 |
| 10 | 4.57 |
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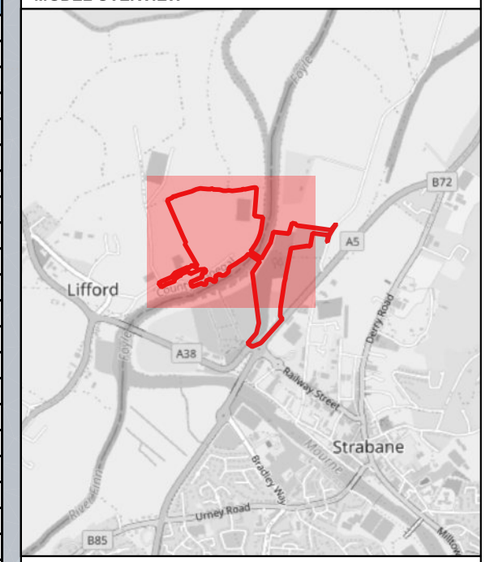
| 43 | 4.57 |
| 44 | 5.34 |
| 45 | 4.58 |
| 46 | 4.57 |
| 47 | 4.57 |
| 48 | 4.57 |
| 49 | 5.41 |
| 50 | 4.82 |
| 51 | 4.59 |
| 52 | 4.57 |
| 53 | 5.58 |
| 54 | 5.37 |

| NODE ID | 0.1% AEP LEVEL |
|---|---|
| XS100 | 5.43 |
| XS101 | 5.48 |
| XS102 | 5.19 |
| XS103 | 5.07 |

**MODEL OVERVIEW**




**LEGEND**

- SITE BOUNDARY
- OPEN WATERCOURSE
- FLOOD LEVEL NODE (mOD)
- FLOOD LEVEL NODE (IN CHANNEL) (mOD)

0.1% AEP FLOOD EXTENT BANDED BY DEPTH

- < 0.3 m
- 0.30 - 0.50 m
- 0.50 - 1.00 m
- 1.00 - 1.50 m
- > 1.5 m

NOTES
1. ALL LEVELS INDICATED ARE TO ORDNANCE DATUM MALIN.

2. FLOOD EXTENTS WITHIN THE APPLICATION BOUNDARY ARE PLOTTED ON GROUND BASED TOPOGRAPHIC SURVEY.

3. FLOOD EXTENTS SHOWN OUTWITH THE RED LINE BOUNDARY ARE PLOTTED ON A COMBINATION OF GROUND BASED TOPOGRAPHIC SURVEY AND LIDAR AND AS SUCH ARE NOT SUITABLE FOR PROPERTY LEVEL ASSESSMENT.

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| | | | |
|---|---|---|---|
| **PROJECT** RIVERINE, LIFFORD AND STRABANE | | **HYDROLOGY SCENARIO** PRESENT DAY | **SCALE** 1:2500 | **ORIGINAL SIZE** A3 |
| **MAP TYPE** FLOOD DEPTH MAP - LIFFORD | | **GEOMETRY SCENARIO** PRESENT DAY | **DRAWN BY** DP | **APPROVED** DKS |
| **SOURCE** FLUVIAL | **FLOOD EVENT** 0.1% AEP | **FIGURE NUMBER** M01959-02_FIG_FL03 | **REVISION** 1 | **DATE** 18/08/2021 |


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1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48

XS103 XS102 XS101 XS100

0 50 100 150 200 250 m

| NODE ID | 1% AEP LEVEL | 1% AEP + CC LEVEL |
|---|---|---|
| 1 | 4.30 | 4.55 |
| 2 | 4.30 | 4.55 |
| 3 | 4.30 | 4.55 |
| 4 | 4.30 | 4.55 |
| 5 | 4.30 | 4.55 |
| 6 | 4.30 | 4.55 |
| 7 | 4.30 | 4.55 |
| 8 | 4.30 | 4.55 |
| 9 | 4.30 | 4.55 |
| 10 | 4.30 | 4.55 |
| 11 | 4.30 | 4.55 |
| 12 | 4.30 | 4.55 |
| 13 | 4.30 | 4.55 |
| 14 | 4.30 | 4.55 |
| 15 | 4.30 | 4.55 |
| 16 | 4.30 | 4.55 |
| 17 | 4.30 | 4.55 |
| 18 | 4.30 | 4.55 |
| 19 | 4.30 | 4.55 |
| 20 | 4.30 | 4.55 |
| 21 | 4.30 | 4.55 |
| 22 | 4.30 | 4.55 |
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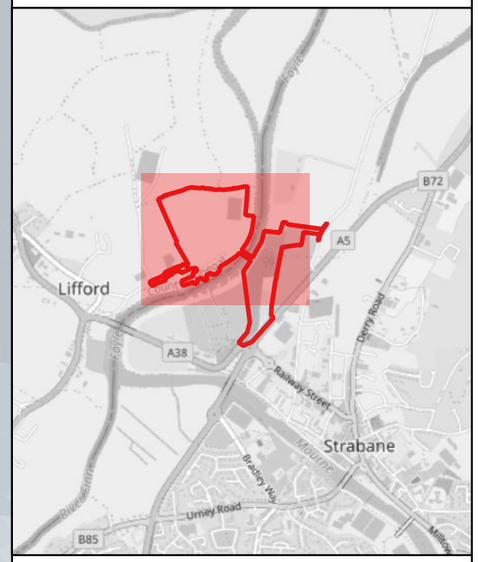
| 27 | 4.30 | 4.55 |
| 28 | 4.30 | 4.55 |
| 29 | 4.30 | 4.55 |
| 30 | 4.30 | 4.55 |
| 31 | 4.30 | 4.55 |
| 32 | 4.30 | 4.55 |
| 33 | 4.30 | 4.55 |
| 34 | 4.30 | 4.55 |
| 35 | 4.30 | 4.55 |
| 36 | 4.30 | 4.55 |
| 37 | 4.31 | 4.55 |
| 38 | 4.31 | 4.56 |
| 39 | 4.30 | 4.55 |
| 40 | 4.30 | 4.55 |
| 41 | 4.94 | 5.31 |
| 42 | 4.31 | 4.56 |
| 43 | 4.33 | 4.59 |
| 44 | 5.00 | 5.39 |
| 45 | 4.43 | 4.76 |
| 46 | 4.34 | 4.62 |
| 47 | 5.07 | 5.47 |
| 48 | 5.14 | 5.55 |

| NODE ID | 1% AEP LEVEL | 1% AEP + CC LEVEL |
|---|---|---|
| XS100 | 5.04 | 5.40 |
| XS101 | 5.05 | 5.45 |
| XS102 | 4.83 | 5.16 |
| XS103 | 4.67 | 5.04 |

**MODEL OVERVIEW**




**LEGEND**

- SITE BOUNDARY
- PROPOSED RIVERINE DEVELOPMENT
- ACCOMMODATION WORKS
- OPEN WATERCOURSE
- FLOOD LEVEL NODE (mOD)
- FLOOD LEVEL NODE (IN CHANNEL) (mOD)

1% AEP FLOOD EXTENT BANDED BY DEPTH

- < 0.3 m
- 0.30 - 0.50 m
- 0.50 - 1.00 m
- 1.00 - 1.50 m
- > 1.5 m

NOTES

1. ALL LEVELS INDICATED ARE TO ORDNANCE DATUM MALIN.

2. FLOOD EXTENTS WITHIN THE APPLICATION BOUNDARY ARE PLOTTED ON GROUND BASED TOPOGRAPHIC SURVEY.

3. FLOOD EXTENTS SHOWN OUTWITH THE RED LINE BOUNDARY ARE PLOTTED ON A COMBINATION OF GROUND BASED TOPOGRAPHIC SURVEY AND LIDAR AND AS SUCH ARE NOT SUITABLE FOR PROPERTY LEVEL ASSESSMENT.

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|---|---|---|---|
| **PROJECT** RIVERINE, LIFFORD AND STRABANE | **HYDROLOGY SCENARIO** PRESENT DAY | **SCALE** 1:2500 | **ORIGINAL SIZE** A3 |
| **MAP TYPE** FLOOD DEPTH MAP - LIFFORD | **GEOMETRY SCENARIO** PROPOSED | **DRAWN BY** DP | **APPROVED** DKS |
| **SOURCE** FLUVIAL / **FLOOD EVENT** 1% AEP | **FIGURE NUMBER** M01959-02_FIG_FL11 | **REVISION** 1 | **DATE** 18/08/2021 |

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1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49

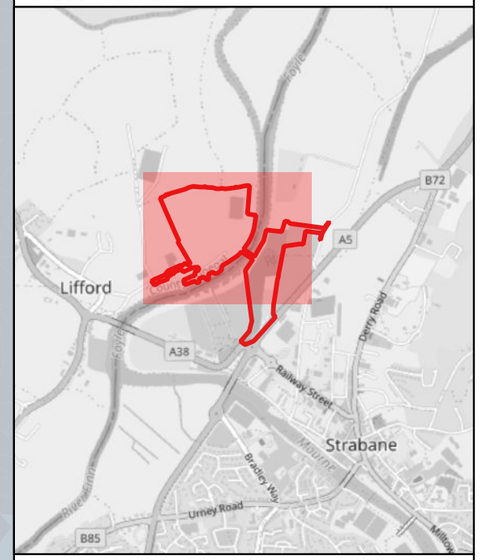
XS103 XS102 XS101 XS100

0 50 100 150 200 250 m

| NODE ID | 0.1% AEP LEVEL | 0.1% AEP + CC LEVEL |
|---|---|---|
| 1 | 4.57 | 4.95 |
| 2 | 4.57 | 4.95 |
| 3 | 4.57 | 4.95 |
| 4 | 4.57 | 4.95 |
| 5 | 4.57 | 4.95 |
| 6 | 4.57 | 4.95 |
| 7 | 4.57 | 4.95 |
| 8 | 4.58 | 4.95 |
| 9 | 4.57 | 4.95 |
| 10 | 4.57 | 4.95 |
| 11 | 4.58 | 4.95 |
| 12 | 4.57 | 4.95 |
| 13 | 4.57 | 4.95 |
| 14 | 4.57 | 4.95 |
| 15 | 4.57 | 4.95 |
| 16 | 4.58 | 4.95 |
| 17 | 4.58 | 4.95 |
| 18 | 4.58 | 4.95 |
| 19 | 4.57 | 4.95 |
| 20 | 4.57 | 4.95 |
| 21 | 4.57 | 4.95 |
| 22 | 4.57 | 4.95 |
| 23 | 4.57 | 4.95 |
| 24 | 4.58 | 4.95 |
| 25 | 4.58 | 4.95 |
| 26 | 4.58 | 4.95 |
| 27 | 4.58 | 4.95 |
| 28 | 4.57 | 4.95 |
| 29 | 4.57 | 4.95 |
| 30 | 4.57 | 4.95 |
| 31 | 4.58 | 4.95 |
| 32 | 4.58 | 4.95 |
| 33 | 4.58 | 4.95 |
| 34 | 4.58 | 4.95 |
| 35 | 4.57 | 4.95 |
| 36 | 4.57 | 4.95 |
| 37 | 4.58 | 4.95 |
| 38 | 4.58 | 4.95 |
| 39 | 4.58 | 4.95 |
| 40 | 4.57 | 4.95 |
| 41 | 5.34 | 5.66 |
| 42 | 4.59 | 4.95 |
| 43 | 4.62 | 4.99 |
| 44 | 5.42 | 5.75 |
| 45 | 4.79 | 5.15 |
| 46 | 4.64 | 5.05 |
| 47 | 5.50 | 5.82 |
| 48 | 5.58 | 5.88 |
| 49 | 5.40 | 5.61 |

| NODE ID | 0.1% AEP LEVEL | 0.1% AEP + CC LEVEL |
|---|---|---|
| XS100 | 5.43 | 5.73 |
| XS101 | 5.48 | 5.82 |
| XS102 | 5.19 | 5.48 |
| XS103 | 5.07 | 5.41 |

**MODEL OVERVIEW**




**LEGEND**

- SITE BOUNDARY
- PROPOSED REVERINE DEVELOPMENT
- ACCOMMODATION WORKS
- OPEN WATERCOURSE
- FLOOD LEVEL NODE (mOD)
- FLOOD LEVEL NODE (IN CHANNEL) (mOD)

0.1% AEP FLOOD EXTENT BANDED BY DEPTH

- < 0.3 m
- 0.30 - 0.50 m
- 0.50 - 1.00 m
- 1.00 - 1.50 m
- > 1.5 m

NOTES

1. ALL LEVELS INDICATED ARE TO ORDNANCE DATUM MALIN.

2. FLOOD EXTENTS WITHIN THE APPLICATION BOUNDARY ARE PLOTTED ON GROUND BASED TOPOGRAPHIC SURVEY.

3. FLOOD EXTENTS SHOWN OUTWITH THE RED LINE BOUNDARY ARE PLOTTED ON A COMBINATION OF GROUND BASED TOPOGRAPHIC SURVEY AND LIDAR AND AS SUCH ARE NOT SUITABLE FOR PROPERTY LEVEL ASSESSMENT.

4. ALL GRID COORDINATE INFORMATION IS TO IRISH TRANSVERSE MERCATOR.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W: www.mccloyconsulting.ie


| | | | |
|---|---|---|---|
| **PROJECT** RIVERINE, LIFFORD AND STRABANE | **HYDROLOGY SCENARIO** PRESENT DAY | **SCALE** 1:2500 | **ORIGINAL SIZE** A3 |
| **MAP TYPE** FLOOD DEPTH MAP - LIFFORD | **GEOMETRY SCENARIO** PROPOSED | **DRAWN BY** DP | **APPROVED** DKS |
| **SOURCE** FLUVIAL / **FLOOD EVENT** 0.1% AEP | **FIGURE NUMBER** M01959-02_FIG_FL12 | **REVISION** 1 | **DATE** 18/08/2021 |


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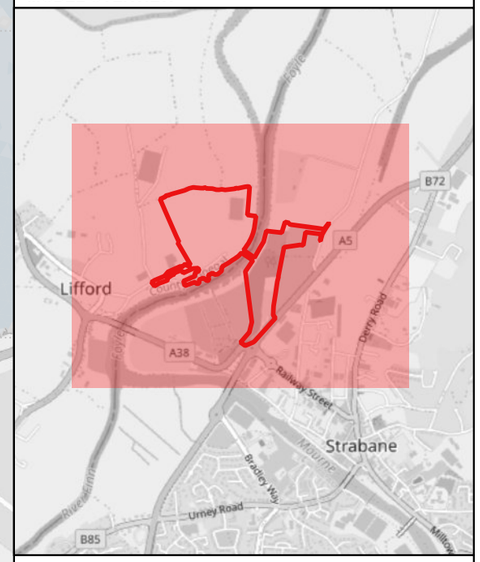
233250 233500 233750 234000 234250 234500 234750

399250 399000 398750 398500 398250

N

0 100 200 300 400 500 m

## MODEL OVERVIEW




## LEGEND

- SITE BOUNDARY
- PROPOSED RIVERINE DEVELOPMENT
- ACCOMMODATION WORKS
- OPEN WATERCOURSE

EFFECT OF DEVELOPMENT REPORT POINT

- > 0.01 m
- -0.01 - 0.01 m
- < -0.01 m

- 1% AEP EXISTING FLOOD OUTLINE

1% AEP PROPOESED FLOOD EXTENT BANDED BY DEPTH

- < 0.3 m
- 0.30 - 0.50 m
- 0.50 - 1.00 m
- 1.00 - 1.50 m
- > 1.5 m

NOTES

1. ALL LEVELS INDICATED ARE TO ORDNANCE DATUM MALIN.

2. FLOOD EXTENTS WITHIN THE APPLICATION BOUNDARY ARE PLOTTED ON GROUND BASED TOPOGRAPHIC SURVEY.

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W: www.mccloyconsulting.ie

| | | | | |
|---|---|---|---|---|
| **PROJECT** RIVERINE, LIFFORD AND STRABANE | | **HYDROLOGY SCENARIO** PRESENT DAY | **SCALE** 1:5000 | **ORIGINAL SIZE** A3 |
| **MAP TYPE** EFFECT OF DEVELOPMENT - LIFFORD | | **GEOMETRY SCENARIO** PRESENT DAY/PROPOSED | **DRAWN BY** DP | **APPROVED** DKS |
| **SOURCE** FLUVIAL | **FLOOD EVENT** 1% AEP | **FIGURE NUMBER** M01959-02_FIG_FL21 | **REVISION** 1 | **DATE** 18/08/2021 |

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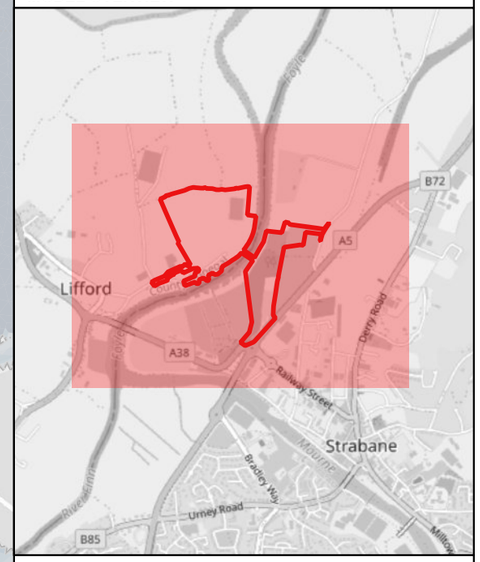
233250 233500 233750 234000 234250 234500 234750

399250 399000 398750 398500 398250

0 100 200 300 400 500 m

## MODEL OVERVIEW




## LEGEND

- SITE BOUNDARY
- PROPOSED RIVERINE DEVELOPMENT
- ACCOMMODATION WORKS
- OPEN WATERCOURSE

EFFECT OF DEVELOPMENT REPORT POINT

- > 0.01 m
- -0.01 - 0.01 m
- < -0.01 m

- 0.1% AEP EXISTING FLOOD OUTLINE

0.1% AEP PROPOESED FLOOD EXTENT BANDED BY DEPTH

- < 0.3 m
- 0.30 - 0.50 m
- 0.50 - 1.00 m
- 1.00 - 1.50 m
- > 1.5 m

NOTES

1. ALL LEVELS INDICATED ARE TO ORDNANCE DATUM MALIN.

2. FLOOD EXTENTS WITHIN THE APPLICATION BOUNDARY ARE PLOTTED ON GROUND BASED TOPOGRAPHIC SURVEY.

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W: www.mccloyconsulting.ie

| | | | | |
|---|---|---|---|---|
| **PROJECT** RIVERINE, LIFFORD AND STRABANE | | **HYDROLOGY SCENARIO** PRESENT DAY | **SCALE** 1:5000 | **ORIGINAL SIZE** A3 |
| **MAP TYPE** EFFECT OF DEVELOPMENT - LIFFORD | | **GEOMETRY SCENARIO** PRESENT DAY/PROPOSED | **DRAWN BY** DP | **APPROVED** DKS |
| **SOURCE** FLUVIAL | **FLOOD EVENT** 0.1% AEP | **FIGURE NUMBER** M01959-02_FIG_FL22 | **REVISION** 1 | **DATE** 18/08/2021 |

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# STRABANE FLOOD MAPPING

633750 634000 634250

898750 898500 898250

N

XS103 XS102 XS101 XS100

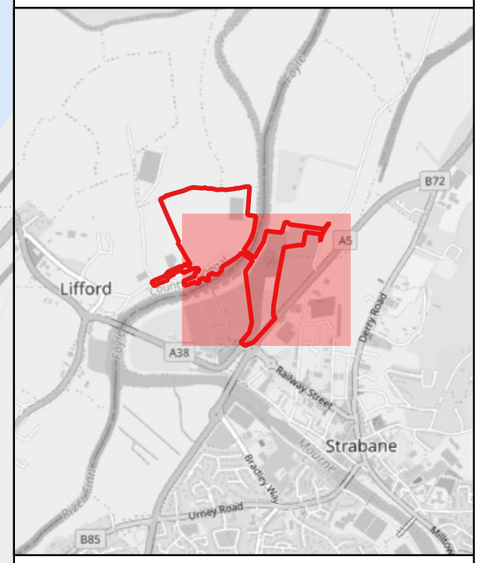
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23

0 50 100 150 200 250 m

| NODE ID | 1% AEP LEVEL | 1% AEP + CC LEVEL |
|---|---|---|
| 1 | 3.88 | 4.55 |
| 2 | 3.93 | 4.58 |
| 3 | 4.08 | 4.69 |
| 4 | 4.12 | 4.88 |
| 5 | 4.11 | 4.85 |
| 6 | 4.10 | 4.83 |
| 7 | 4.13 | 4.91 |
| 8 | 4.11 | 4.88 |
| 9 | 4.13 | 4.91 |
| 10 | 4.13 | 4.92 |
| 11 | 4.20 | 5.18 |
| 12 | 4.13 | 4.91 |
| 13 | 4.20 | 5.18 |
| 14 | 4.13 | 4.96 |
| 15 | 4.20 | 5.18 |
| 16 | 4.14 | 5.08 |
| 17 | 4.15 | 5.03 |
| 18 | 4.20 | 5.18 |
| 19 | 4.19 | 5.13 |
| 20 | 4.14 | 4.99 |
| 21 | 4.20 | 5.18 |
| 22 | 4.19 | 5.15 |
| 23 | 4.20 | 5.20 |

| NODE ID | 1% AEP LEVEL | 1% AEP + CC LEVEL |
|---|---|---|
| XS100 | 5.04 | 5.40 |
| XS101 | 5.05 | 5.44 |
| XS102 | 4.83 | 5.16 |
| XS103 | 4.67 | 5.04 |

**MODEL OVERVIEW**




**LEGEND**

- SITE BOUNDARY
- OPEN WATERCOURSE
- FLOOD LEVEL NODE (mOD)
- FLOOD LEVEL NODE (IN CHANNEL) (mOD)

1% AEP FLOOD EXTENT BANDED BY DEPTH

- < 0.3 m
- 0.30 - 0.50 m
- 0.50 - 1.00 m
- 1.00 - 1.50 m
- > 1.5 m

NOTES
1. ALL LEVELS INDICATED ARE TO ORDNANCE DATUM.

2. FLOOD EXTENTS WITHIN THE APPLICATION BOUNDARY ARE PLOTTED ON GROUND BASED TOPOGRAPHIC SURVEY.

3. FLOOD EXTENTS SHOWN OUTWITH THE RED LINE BOUNDARY ARE PLOTTED ON A COMBINATION OF GROUND BASED TOPOGRAPHIC SURVEY AND LIDAR AND AS SUCH ARE NOT SUITABLE FOR PROPERTY LEVEL ASSESSMENT.

4. ALL GRID COORDINATE INFORMATION IS TO IRISH GRID.

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W: www.mccloyconsulting.com

| | | | |
|---|---|---|---|
| **PROJECT** RIVERINE, LIFFORD AND STRABANE | **HYDROLOGY SCENARIO** PRESENT DAY | **SCALE** 1:2500 | **ORIGINAL SIZE** A3 |
| **MAP TYPE** FLOOD DEPTH MAP - STRABANE | **GEOMETRY SCENARIO** PRESENT DAY | **DRAWN BY** DP | **APPROVED** DKS |
| **SOURCE** FLUVIAL / **FLOOD EVENT** 1% AEP | **FIGURE NUMBER** M01959-02_FIG_FL31 | **REVISION** 1 | **DATE** 18/08/2021 |

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633750
634000
634250
898750
898500
898250

N

XS103
XS102
XS101
XS100

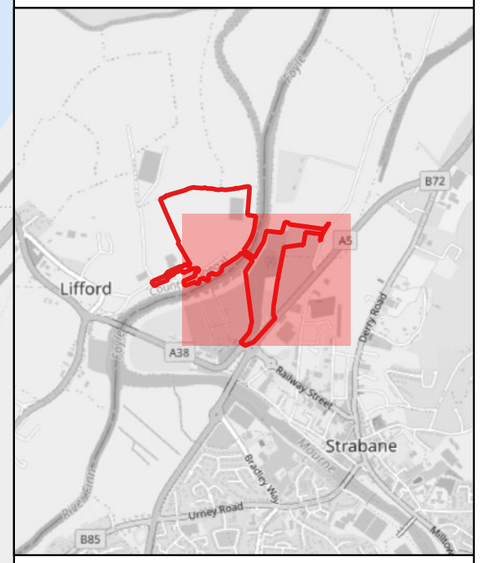
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24

0 50 100 150 200 250 m

| NODE ID | 1% AEP LEVEL | 1% AEP + CC LEVEL |
|---|---|---|
| 1 | 3.87 | 4.54 |
| 2 | 3.92 | 4.57 |
| 3 | 4.05 | 4.67 |
| 4 | 4.11 | 4.85 |
| 5 | 4.11 | 4.84 |
| 6 | 4.11 | 4.82 |
| 7 | 4.12 | 4.91 |
| 8 | 4.11 | 4.86 |
| 9 | 4.12 | 4.91 |
| 10 | 4.12 | 4.91 |
| 11 | 4.20 | 5.18 |
| 12 | 4.12 | 4.91 |
| 13 | 4.20 | 5.18 |
| 14 | 4.13 | 4.95 |
| 15 | 4.20 | 5.18 |
| 16 | 4.14 | 5.07 |
| 17 | 4.14 | 5.01 |
| 18 | 4.20 | 5.17 |
| 19 | 4.19 | 5.13 |
| 20 | 4.14 | 4.98 |
| 21 | 4.20 | 5.18 |
| 22 | 4.19 | 5.15 |
| 23 | 4.20 | 5.19 |
| 24 | 4.05 | 4.67 |

| NODE ID | 1% AEP LEVEL | 1% AEP + CC LEVEL |
|---|---|---|
| XS100 | 5.04 | 5.40 |
| XS101 | 5.05 | 5.45 |
| XS102 | 4.83 | 5.16 |
| XS103 | 4.67 | 5.04 |

**MODEL OVERVIEW**




**LEGEND**

- SITE BOUNDARY
- PROPOSED RIVERINE DEVELOPMENT
- ACCOMMODATION WORKS
- OPEN WATERCOURSE
- FLOOD LEVEL NODE (mOD)
- FLOOD LEVEL NODE (IN CHANNEL) (mOD)

1% AEP FLOOD EXTENT BANDED BY DEPTH

- < 0.3 m
- 0.30 - 0.50 m
- 0.50 - 1.00 m
- 1.00 - 1.50 m
- > 1.5 m

NOTES
1. ALL LEVELS INDICATED ARE TO ORDNANCE DATUM.

2. FLOOD EXTENTS WITHIN THE APPLICATION BOUNDARY ARE PLOTTED ON GROUND BASED TOPOGRAPHIC SURVEY.

3. FLOOD EXTENTS SHOWN OUTWITH THE RED LINE BOUNDARY ARE PLOTTED ON A COMBINATION OF GROUND BASED TOPOGRAPHIC SURVEY AND LIDAR AND AS SUCH ARE NOT SUITABLE FOR PROPERTY LEVEL ASSESSMENT.

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W: www.mccloyconsulting.com


| | | | |
|---|---|---|---|
| **PROJECT** RIVERINE, LIFFORD AND STRABANE | **HYDROLOGY SCENARIO** PRESENT DAY | **SCALE** 1:2500 | **ORIGINAL SIZE** A3 |
| **MAP TYPE** FLOOD DEPTH MAP - STRABANE | **GEOMETRY SCENARIO** PROPOSED | **DRAWN BY** DP | **APPROVED** DKS |
| **SOURCE** FLUVIAL / **FLOOD EVENT** 1% AEP | **FIGURE NUMBER** M01959-02_FIG_FL32 | **REVISION** 1 | **DATE** 18/08/2021 |


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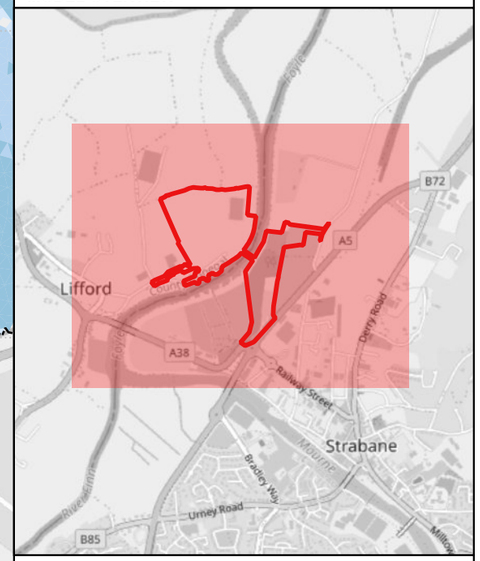
233250 233500 233750 234000 234250 234500 234750

399250 399000 398750 398500 398250

N

0 100 200 300 400 500 m

## MODEL OVERVIEW




## LEGEND

- SITE BOUNDARY
- PROPOSED RIVERINE DEVELOPMENT
- ACCOMMODATION WORKS
- OPEN WATERCOURSE

EFFECT OF DEVELOPMENT REPORT POINTS

- > 0.01 m
- -0.01 - 0.01 m
- < -0.01 m

- 1% AEP EXISTING FLOOD OUTLINE

1% AEP PROPOSED FLOOD EXTENT BANDED BY DEPTH

- < 0.3 m
- 0.30 - 0.50 m
- 0.50 - 1.00 m
- 1.00 - 1.50 m
- > 1.5 m

NOTES

1. ALL LEVELS INDICATED ARE TO ORDNANCE DATUM.

2. FLOOD EXTENTS WITHIN THE APPLICATION BOUNDARY ARE PLOTTED ON GROUND BASED TOPOGRAPHIC SURVEY.

3. FLOOD EXTENTS SHOWN OUTWITH THE RED LINE BOUNDARY ARE PLOTTED ON A COMBINATION OF GROUND BASED TOPOGRAPHIC SURVEY AND LIDAR AND AS SUCH ARE NOT SUITABLE FOR PROPERTY LEVEL ASSESSMENT.

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| | | | | |
|---|---|---|---|---|
| **PROJECT** RIVERINE, LIFFORD AND STRABANE | | **HYDROLOGY SCENARIO** PRESENT DAY | **SCALE** 1:5000 | **ORIGINAL SIZE** A3 |
| **MAP TYPE** EFFECT OF DEVELOPMENT - STRABANE | | **GEOMETRY SCENARIO** PRESENT DAY/PROPOSED | **DRAWN BY** DP | **APPROVED** DKS |
| **SOURCE** FLUVIAL | **FLOOD EVENT** 1% AEP | **FIGURE NUMBER** M01959-02_FIG_FL41 | **REVISION** 1 | **DATE** 18/08/2021 |

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# Appendix E

# Preliminary Flood Evacuation & Management Plan (Lifford)

# 1 INTRODUCTION

## 1.1 Purpose of the FEMP

This Preliminary Flood Evacuation & Management Plan (FEMP) is intended to satisfy the local planning authority that mitigation measures stated in the associated Flood Risk Assessment report have been fully considered.

This FEMP establishes flood risk at the Lifford site, identifies the roles and responsibilities of Flood Wardens and other relevant bodies and provides details of proposed flood actions. The FEMP is designed to form part of site procedures to protect site occupants during a flood event.

However, it is noted that any plans / actions may be overruled by the emergency services should they attend the site during a flood incident. The advice and instruction of emergency services should be followed at all times and will supersede any action outlined in this FEMP.

This FEMP considers Met Eireann and local government guidance and arrangements relating to key contacts, evacuation arrangements and nature of occupancy at the site. **The FEMP is designed to be a 'living' document and as such, should be reviewed periodically and updated to provide the most up-to-date information to staff and visitors regarding flood risk at the site.**

If the Lifford / Strabane Riverine Park are to be managed and controlled as a single entity, then a single Lifford / Strabane Flood Evacuation & Management Plan should be developed.

## 1.2 Site Details & Flood Risk

### 1.2.1 Site Description

The site location and extent within Lifford is as shown on the following figure.

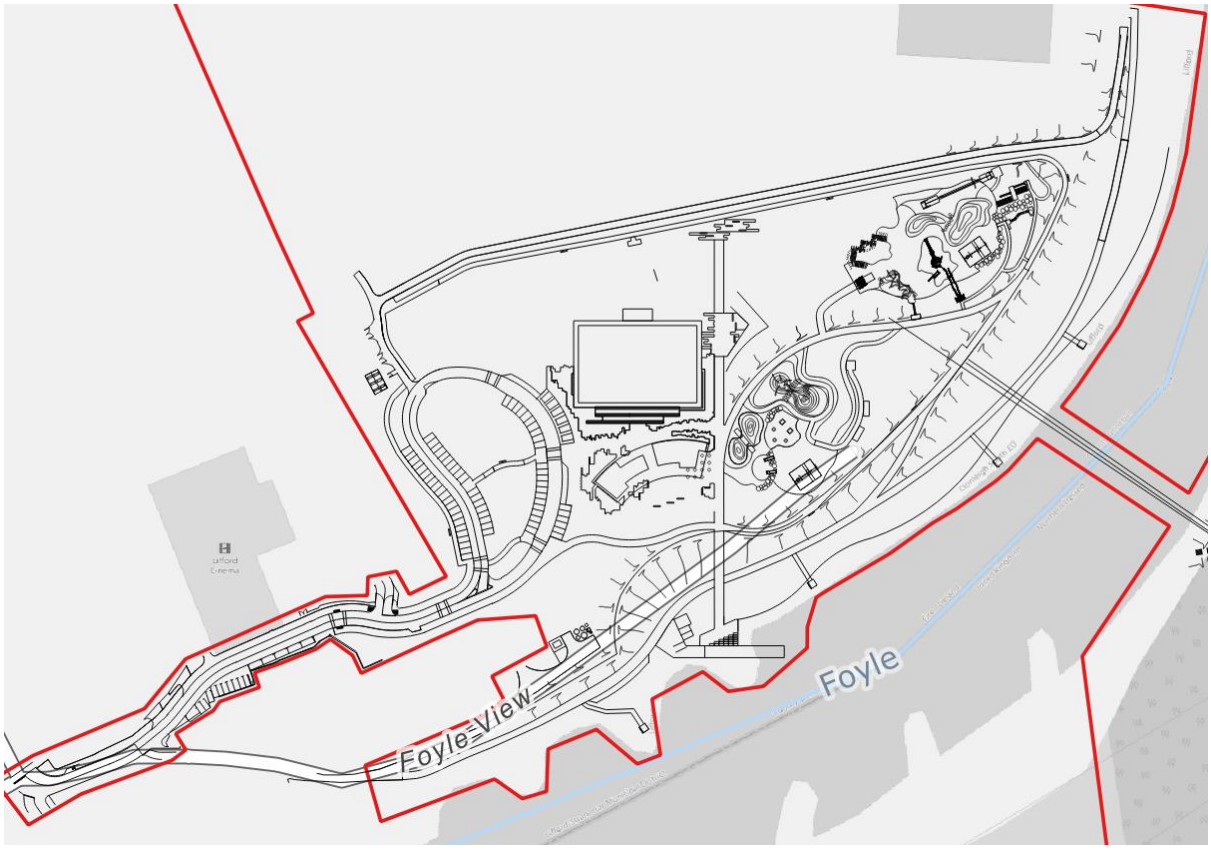



**Figure 1-1 Location Plan**

## 1.3 Flood Risk

### 1.3.1 Fluvial Flooding

The nature and level of flood risk at the site is determined by the FRA undertaken by McCloy Consulting Ltd. Key points from the FRA, relevant to the FEMP, are summarised in the following sections. The site is predicted to be at **significant risk of fluvial flooding** including for moderate and low probability flooding. For extreme flooding the whole site is expected to be inundated.

Flood extents and key flood inundation routes vs the development for a range of flood probabilities are on the following figures.

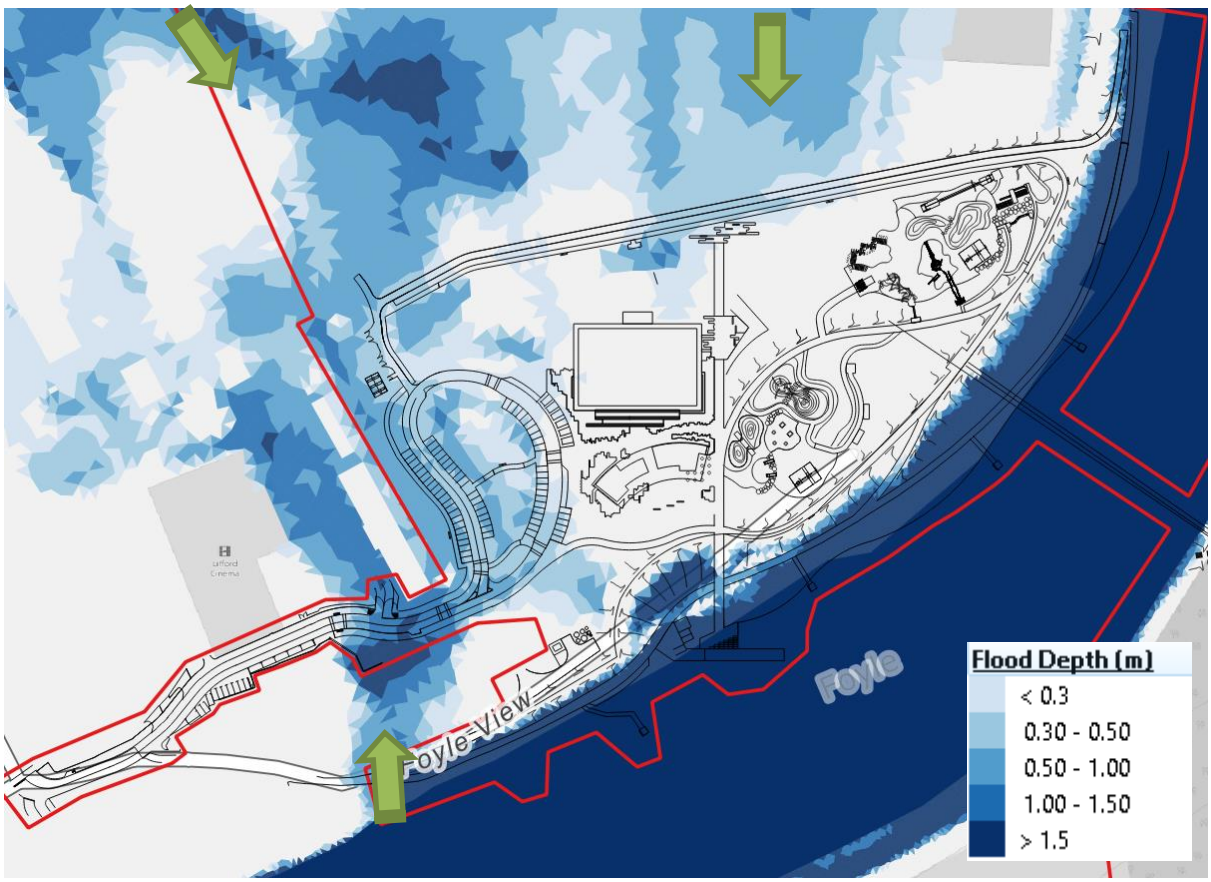



**Figure 1-2 10% AEP / 1-in-10 Year Flood**

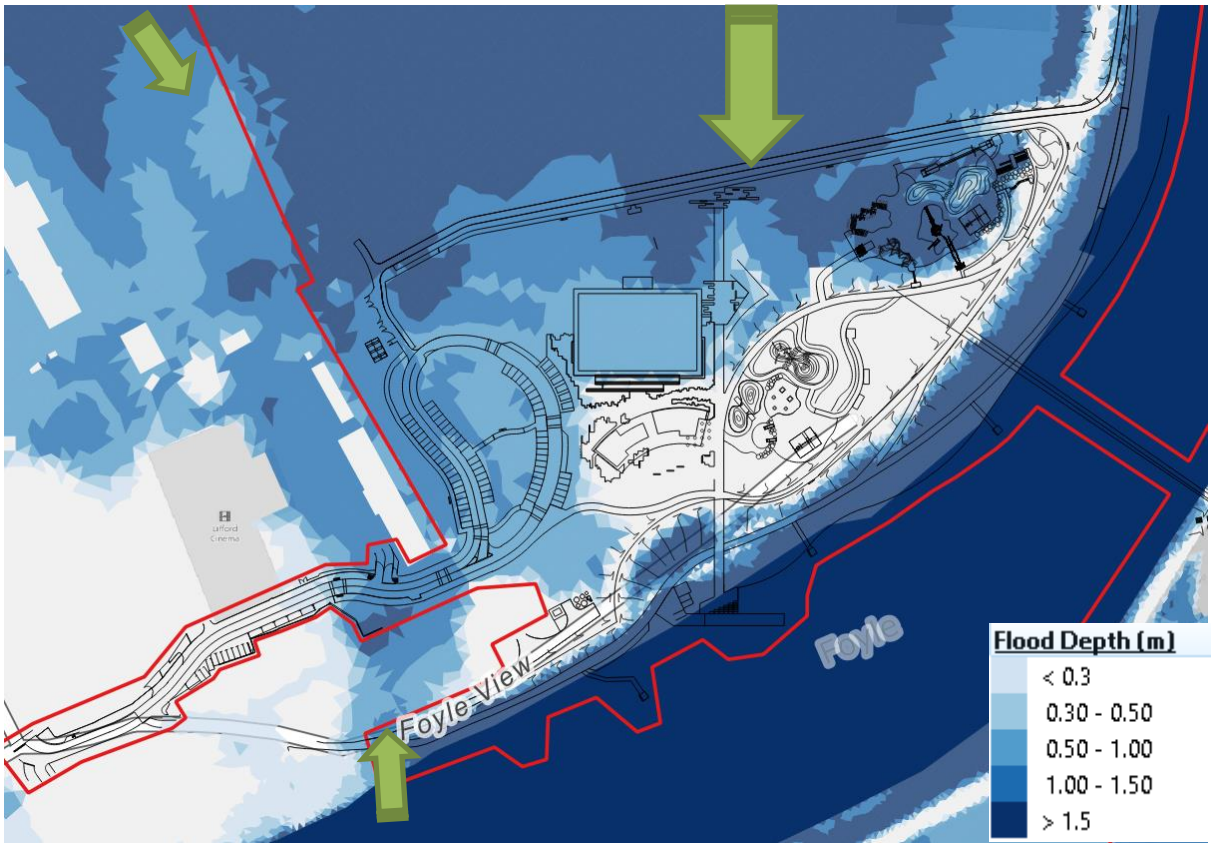



**Figure 1-3 1% AEP / 1-in-100 Year Flood**

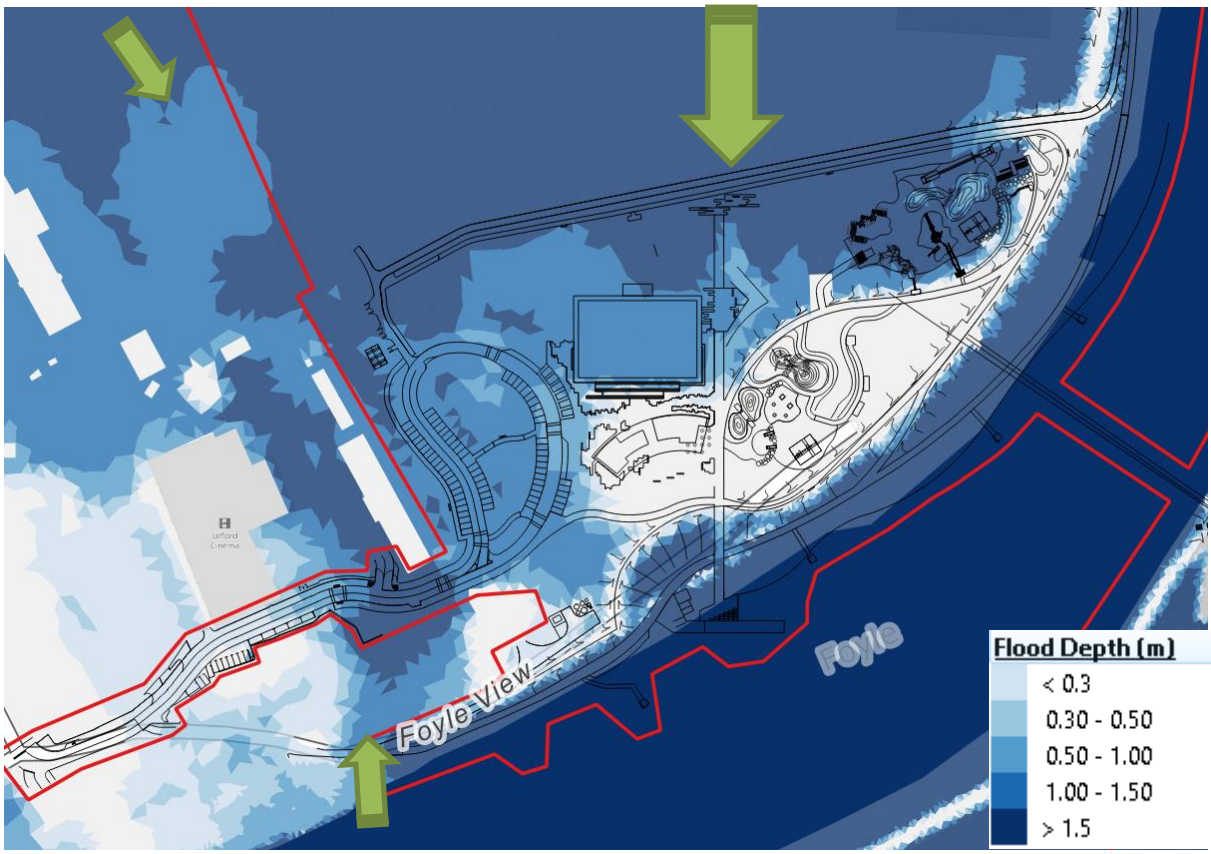



**Figure 1-4 0.1% AEP / 1-in-1000 Year Flood**

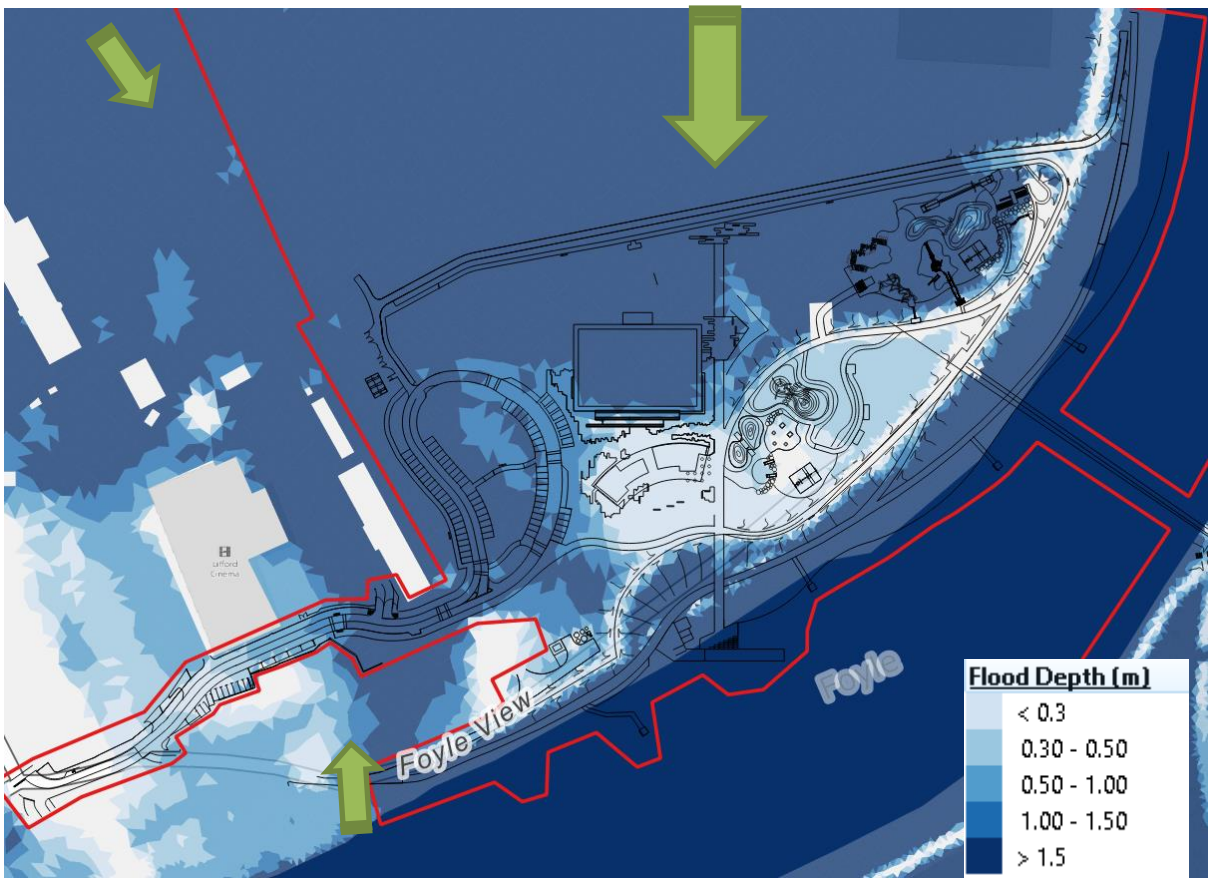



**Figure 1-5 0.1% AEP / 1-in-1000 Year Climate Change Flood**

### 1.3.2 Foyle Flood Defence Failure

The flood risk assessment has identified an additional risk of increased flooding in the event of flood defence failure. It is not possible to qualify or quantify the likelihood of such a failure.

Flood defence failure may occur when water levels are raised in the River Foyle and when there is no flooding on the site. A breach of the defence embankment on the Lifford side would result in floodwater flowing south into the site.

A breach of the defence coinciding with where the Riverine path lies on the embankment crest may result in collapse of that path and a risk to users. As such, paths on flood defence crests should be closed when there are flood conditions in the Foyle.

# 2 IDENTIFICATION OF FLOOD WARNINGS & LEVELS OF ALERT

## 2.1 Public Flood Warnings

There is no automated fluvial flood warning system in Ireland. The Met Eireann works with OPW and local authorities to forecast areas where floods are likely.

The site is transboundary with access to the Riverine Park in Lifford. Flood management at the site is to be managed in conjunction with flood management on the Lifford site and flood warnings or other local authority / Met Eireann / OPW warnings available to Lifford should similarly be acted on at the Strabane side.

## 2.2 Met Eireann Weather Warnings

Met Eireann warnings are given a colour depending the impact the conditions may have. Weather warnings apply to a range of weather including rain, wind, snow, ice and fog. **In relation to predicting fluvial flooding, the main weather warning of interest will relate to extreme rainfall.**

Weather warning bands are as follows:

| | |
|---|---|
| **Yellow** | Not unusual weather. Localised danger. |
| **Orange** | Infrequent. Dangerous/disruptive. |
| **Red** | Rare. Extremely dangerous/destructive. |

Individuals responsible for implementation of this FEMP (nominally facilities management, Flood Warden) should subscribe to the Met Eireann Weater Warning Alert Service at MY WARNINGS LOGIN - WEATHER WARNING ALERTING SERVICE - LOGIN (met.ie).

### 2.2.1 Status Yellow

Weather that does not pose a threat to the general population but is potentially dangerous on a localised scale.

**Be aware** about meteorological conditions and check if you are exposed to danger by nature of your activity or your specific location. Do not take any avoidable risks

### 2.2.2 Status Orange

Infrequent and dangerous weather conditions which may pose a threat to life and property.

**Prepare** yourself in an appropriate way depending on location and activity. All people and property in the affected areas can be significantly impacted.

**Check** your activity/event and delay or cancel as appropriate.

### 2.2.3 Status Red

Rare and very dangerous weather conditions from intense meteorological phenomena.

**Take action** to protect yourself and your property.

**Follow instructions** and advice given by the authorities under all circumstances and be prepared for exceptional measures.

## 2.3 National Emergency Coordination Group (NECG)

Local Authorities are the lead agencies for co-ordinating the response to severe weather emergencies. Where weather emergencies are judged to impact public safety at national level the National Emergency Coordination Group (NECG) is activated by the Office of Emergency Planning on request from the Department of Housing, Planning and Local Government. This is the Lead Government Department for weather emergencies.

NECG warnings are distributed by local and national media outlets.

# 3 FLOOD EVACUATION PROCEDURES

## 3.1 Flood Warnings / Alerts

Sources of Flood Alerts / Warnings are outlined in Section 2. To ensure ongoing monitoring of potential flood information, a nominated Flood Warden for the site should check with the Met Eireann Weather Warnings portal **daily** for weather warnings and in the event of a warning being in place, follow the procedures outlined in this FMP.

This point of contact designated to check and communicate flood warnings shall be specified within this plan and updated on an ongoing basis.

Local media can also be used to check Flood Warnings in place at any given time.

## 3.2 Communication

An appropriate means of communication should be established to suit the commercial nature of the building and its occupiers in order to allow communication of a flood event by the Flood Warden.

Appropriate signage should be erected on the sign to advise the public / site users on key actions in the event of flooding or instruction to evacuate the site.

The appointed Flood Warden will be responsible for communicating flood related information to site users and coordinating actions outlined in this FEMP. The Flood Warden will ensure the FEMP is regularly maintained, reviewed and kept up to date.

## 3.3 Evacuation Route

Safe evacuation **prior to onset of flooding** shall be by the main site access to lands adjacent to the County Council offices. Evacuation routes are shown on the following map.

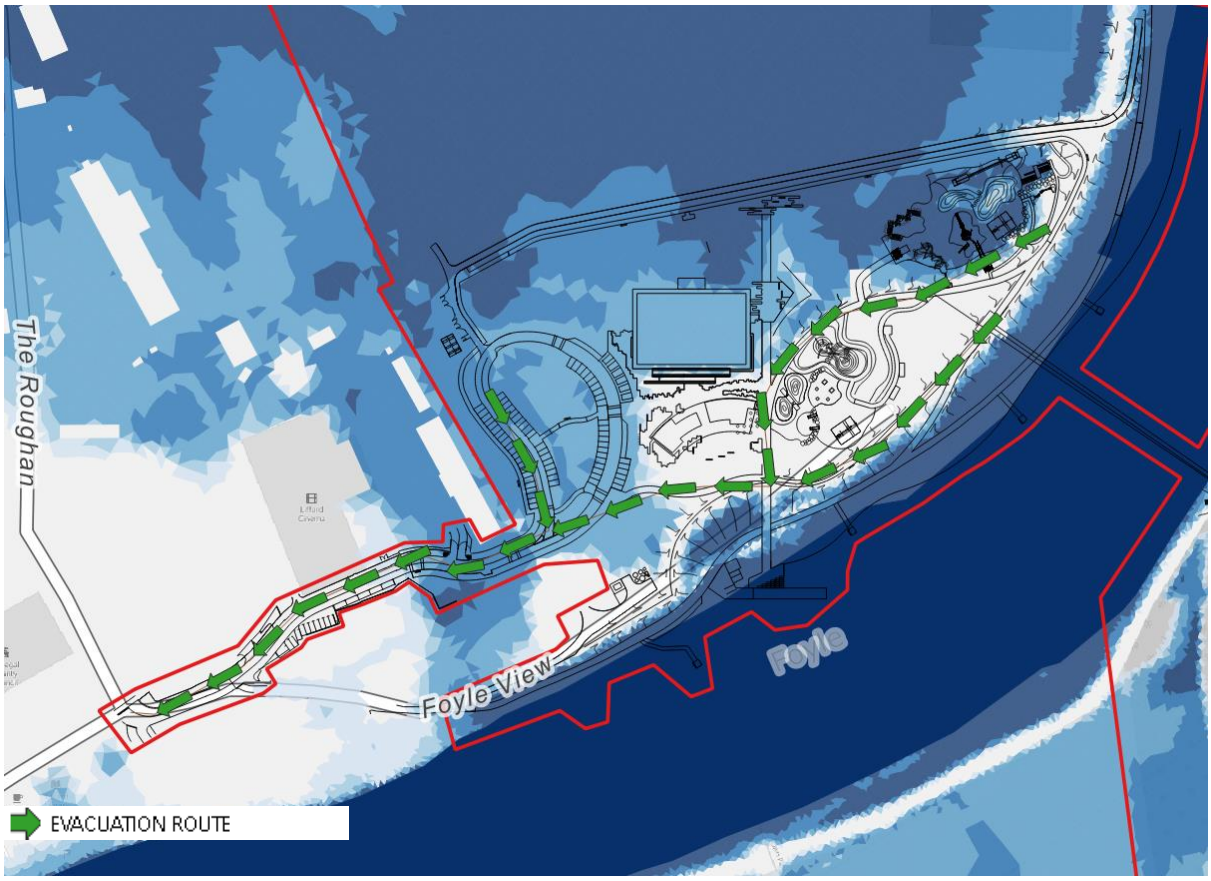



**Figure 3-1 Flood Evacuation Route**

**As noted previously, instructions from emergency services regarding evacuation routes or any other aspect of flooding at the site takes precedence over any instruction in this FEMP.**

When evacuated, occupants should follow the directions of the Emergency Services to any centralised shelter, or make arrangements to find alternative accommodation for the duration of the flood.

## 3.4 On-Site Refuge

Only where prior evacuation is not viable, then site users should seek to take sheltered refuge in the Community Hub building which is sited on high ground and is the most flood resilient area of the development.

Site users should not leave points of refuge to enter floodwater. Users should seek emergency evacuation from the upper floor by contacting the emergency services. The site is best located to the Emergency Services by any of the following methods:

| | |
|---|---|
| Postal Address: | **Riverine Park, Lifford** |
| Irish grid reference: | **233817 ,398651 (Community Hub Building)** |
| What3words reference: | **/// temper.improve.brightened (Community Hub Building)** |

## 3.5 Flood Event Actions

In the event of receipt of any Flood Alerts or Warnings, actions described in this Plan are to be undertaken by the nominated Flood Warden. The procedure required for each alert level is outlined in Table 3 1.

**Table 3-1: Flood Warning Action Plan**

| | | Site Specific Actions | | |
|---|---|---|---|---|
| **Source of Warning** | **What it means** | **Recommended Action** | **Communication** | **Responsible Persons** |
| **OPW or other inspection deems flood embankment unsafe** | Increased risk of flood defence failure | Prevent access to trails / paths / cycleways on flood defence embankments.<br>If the warning coincides with any flood warning, close the site and prevent further access. | Inform the public with appropriate signage and enforcement. | Flood Warden<br>Site Management |
| **Met Eireann Status Yellow**<br>**Be Aware** | Severe weather is possible over the next few days | Flood Warden to continue to check Met Eireann warning status and other sources of weather / flood information.<br>Plan ahead thinking about possible disruption. | Inform staff of potential requirement for further action if situation worsens | Flood Warden |
| **Met Eireann / NECG Status Orange**<br>**Be Prepared** | There is an increased likelihood of bad weather affecting you, which could potentially cause disruption and risk to life and property | Flood Warden to continue to check Met Eireann warning status and other sources of weather / flood information.<br>Flood Warden to notify and re-familiarise staff with information and plans contained within this FEMP.<br>Visual check on flooding from adjacent watercourses. Where Foyle water levels are rising, consider closing access to trails / paths / cycleways on flood defence embankments.<br>Close those aspects of the Park that attract more vulnerable users (play areas).<br>Consider limiting site access to vulnerable or less-mobile visitors | Inform staff of potential requirement for further action if situation worsens<br>Inform visitors of Alert (signage or similar) | Flood Warden |
| **Met Eireann / NECG Status Red**<br>**Take Action** | Flooding is predicted<br>Extreme weather is expected<br>Widespread damage, travel and power disruption and risk to life is likely | Restrict further access to the site.<br>**Implement a controlled evacuation of the and site** via normal means | Inform occupants of implementation of flood action procedures and requirement to evacuate<br>Check local media for information relating to severe weather / flooding | Flood Warden<br>Site Management<br>Site Visitors |

**Table 3-1: Flood Warning Action Plan**

| | | Site Specific Actions | | |
|---|---|---|---|---|
| **Source of Warning** | **What it means** | **Recommended Action** | **Communication** | **Responsible Persons** |
| **Flood Warden or other site occupant observes flooding adjacent to building** | Flooding is imminent or currently occurring | If no previous warning has been received:<br>**Follow the advice of emergency services and local authority**<br>**Evacuate the site** as per guidance and map in this FEMP. Ensure anyone with restricted mobility is assisted in evacuation and ensure visitors are guided to the muster point.<br>Follow development evacuation procedures to the muster point indicated previously. | Inform occupants of implementation of flood action procedures and requirement to evacuate.<br>Check local media for information relating to severe weather / flooding | Flood Warden<br>Site Management<br>Site Visitors |
| **Occupants are trapped on site by no-warning flood** | Flooding has occurred and evacuation is not feasible | Take refuge in the Community Hub building.<br>Do not permit occupants to return to vehicles parked in areas where flooding is predicted or ongoing.<br>Do not seek to leave the site by entering floodwater<br>**Follow the advice of emergency services and local authority.** | Contact Emergency Services<br>Await assistance. | Flood Warden<br>Site Management<br>Site Visitors |
| **Met Eireann Green Alert: No Severe Weather**<br><br>**Emergency Services give 'all-clear'** | No further flooding is currently expected in the area<br>Localised flooding of low-lying land and standing water possible | If flooding occurred:<br>• await confirmation from emergency services or suitably qualified professionals that it is safe to re-access site<br>• inspect and / or arrange for external inspection of the site before re-occupying site, including evaluation of the condition of flood defence emankments. Take care when re-entering site as there may be hidden dangers caused by flooding such as structural damage and contamination.<br>• Take care when accessing previously flooded car park areas due to potential for debris / blown manhole covers etc<br>• Contact insurance companies<br>• If no flooding has occurred, inform all occupants and re-open access to site. | Confirm that no Flood Warnings are in place<br>Arrange for suitably qualified professionals to review any suspected flood damage<br>Contact insurance company if necessary | Flood Warden<br>Site Management |

## 3.6 Other Bodies

There are a number of organisations that will play a part in the response to a major flood incident including emergency services, utility companies and voluntary agencies. The roles and responsibilities of the main bodies, and how that impacts this FEMP is summarised below.

### 3.6.1 Office of Public Works

OPW is responsible for predicting flooding from rivers and seas including the location and magnitude. OPW is likely to maintain a significant role in assisting or advising Donegal County Council in managing the condition of flood defence embankments at the site.

### 3.6.2 Emergency Services

Local police and fire and rescue will co-ordinate response during major flood events and help to save lives and property. The response may include rescuing persons in danger, establishing cordons and pumping of floodwater.

Direction or instruction from emergency services would take precedence over any guidance within this FEMP. It is also noted that emergency services should only be contacted when there is a threat to life and that evacuation of the site does not require informing police or fire and rescue.

### 3.6.3 Donegal County Council

The County Council as the Local Authority ), are the lead agency for co-ordinating the response to severe weather emergencies and will work with other agencies to plan for and help respond effectively to all emergency situations.

In the event of a major emergency, the Council can assist in a number of ways:

- Make buildings such as leisure and community centres temporarily available as shelters for people who have been displaced;
- Provide advice and guidance on cleaning up after major flooding or pollution;
- Assess structural damage to buildings;
- Provide staff/equipment to responding agencies as requested;
- Co-ordinate and lead multi-agency meetings to plan for recovery.

The Local Authority will assess each incident and decide on the level of response. In the event that flooding at the site was declared an emergency that warranted input from the council, the council's procedures and requirements would be adhered to and would take precedence over the recommendations within this site-specific FEMP.

### 3.6.4 Met Eireann

The Met Eireann issues severe weather warnings for rain and other extreme weather events. These warnings are provided to local authorities and emergency services. While no flood evacuation is required due to a Met Eireann warning, the information they provide may be useful in fully considering flood risk at the site.

### 3.6.5 Utility Companies

In the event of a flood, utility companies will strive to secure their services to ensure continuity of supply. However, in the event of damage or disruption of service, the relevant company will be responsible for re-establishing supply as soon as possible.

# 4 FLOOD RISK SUMMARY

The FRA carried out for the site demonstrates the nature and severity of flood risk at the site. This FEMP outlines that actions to be taken should it become clear that the risk is at risk imminent risk of flooding. Table 5 1 summarises flood risk at the site and details relating to potential evacuation of the site.

**Table 5 1: Flood Risk Summary**

| Flood Risk Source | Warning System in Place | Estimated Warning Time | Frequency / Probability of Flooding |
|---|---|---|---|
| **Fluvial / Rivers** | Flood Warden to check Met Eireann and local media for information. Visual check of watercourses in the vicinity. | Weather advisories up to 1 week in advance.<br>60 hours (<3 days) for Met Eireann weather warning | >10% chance of areas where development is proposed flooding in any given year. |
| **Flood Defence Breach** | Flood Warden / Site operator to monitor flood embankments (visual checks) for evidence of structural failures. | None to Hours (where cracking or slope instability is observed) | Unknown |
| **Coastal / Tidal** | N/A | N/A | Not significant |
| **Surface Water** | N/A | N/A | Not significant |
| **Groundwater** | N/A | N/A | Not significant |
| **Reservoir** | N/A | N/A | Not significant |

## 5 SPECIFIC FLOOD PLAN DETAILS

**FLOOD PLAN FOR:** Riverine Community Park, Lifford

**EMERGENCY CONTACT LIST:** Flood Warden – Name: _____

Phone:_____

Site Office – Phone: _____

Donegal County Council Emergency Number 074 91 53900

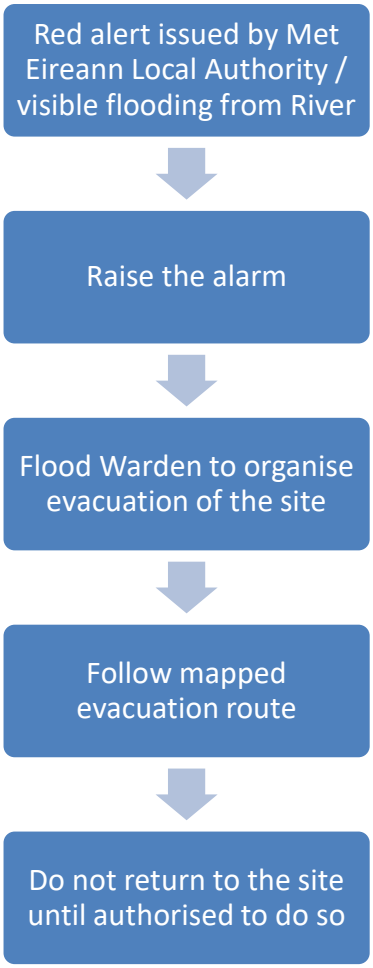
Emergency Services – 999

**UTILITIES CONTACT LIST:** ESB Networks: 1800 372 999

Irish Water: 1850 278 278

Gas Networks Ireland: 01 920 5050 / 066 971 4088

**FLOOD EVENT PROCEDURE:**



## CONTACT LIST

| Name | Address | Telephone | Emergency Contact | Emergency Contact Details |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
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| | | | | |
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## PERSONS WHO MAY REQUIRE EVACUATION ASSISTANCE

| Name | Office / Site Location | Assistance Required | Person Responsible |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

## SERVICES LOCATIONS / CONTACTS

| Service | Cut-off Location | Company Name | Telephone |
|---|---|---|---|
| **Electricity** | | | |
| **Gas** | | | |
| **Water** | | | |
| | | | |
| | | | |

## PROTECTIVE ACTIONS

Identify possessions that may need special protective measures, and describe the actions that will be taken to prevent damage in the event of a flood.

Protective Actions may include make a copy and store safely, raise above ground level, purchase flood protection measures, move items to safer locations etc.

| Valuable Item | Protective Action | New Location (if applicable) | Done? |
|---|---|---|---|
| Relocate herbicides, fertilisers, chemicals, oils. Fuels, lubricants , and other contaminants harmful to the water environment | Relocate from Maintenance building or other storage areas onsite | Offsite | |
| | | | |
| | | | |

# Appendix F

# Preliminary Flood Evacuation & Management Plan (Strabane)

# 1 INTRODUCTION

## 1.1 Purpose of the FEMP

This Preliminary Flood Evacuation & Management Plan (FEMP) is intended to satisfy the local planning authority that mitigation measures stated in the associated Flood Risk Assessment report have been fully considered.

This FEMP establishes flood risk at the Strabane site, identifies the roles and responsibilities of Flood Wardens and other relevant bodies and provides details of proposed flood actions. The FEMP is designed to form part of site procedures to protect site occupants during a flood event.

However, it is noted that any plans / actions may be overruled by the emergency services should they attend the site during a flood incident. The advice and instruction of emergency services should be followed at all times and will supersede any action outlined in this FEMP.

This FEMP considers Met Office and local government guidance and arrangements relating to key contacts, evacuation arrangements and nature of occupancy at the site. **The FEMP is designed to be a 'living' document and as such, should be reviewed periodically and updated to provide the most up-to-date information to staff and visitors regarding flood risk at the site.**

If the Lifford / Strabane Riverine Park are to be managed and controlled as a single entity, then a single Lifford / Strabane Flood Evacuation & Management Plan should be developed.

## 1.2 Site Details & Flood Risk

### 1.2.1 Site Description

The site location and extent within Strabane is as shown on the following figure.

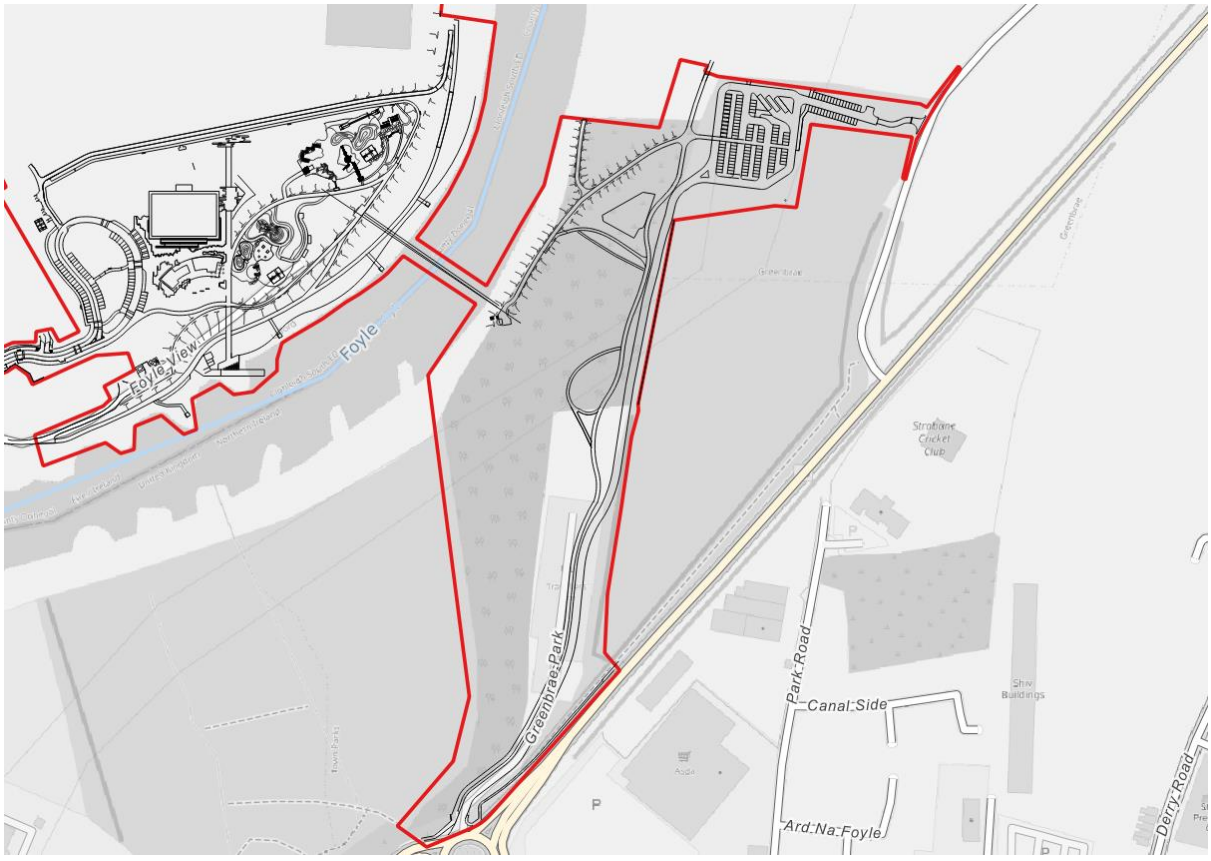



**Figure 1-1 Location Plan**

## 1.3 Flood Risk

### 1.3.1 Fluvial Flooding

The nature and level of flood risk at the site is determined by the FRA undertaken by McCloy Consulting Ltd. Key points from the FRA, relevant to the FEMP, are summarised in the following sections. The site is predicted to be at **significant risk of fluvial flooding** including for moderate and low probability flooding. For extreme flooding the whole site is expected to be inundated.

Flood extents and key flood inundation routes vs the development for a range of flood probabilities are on the following figures.

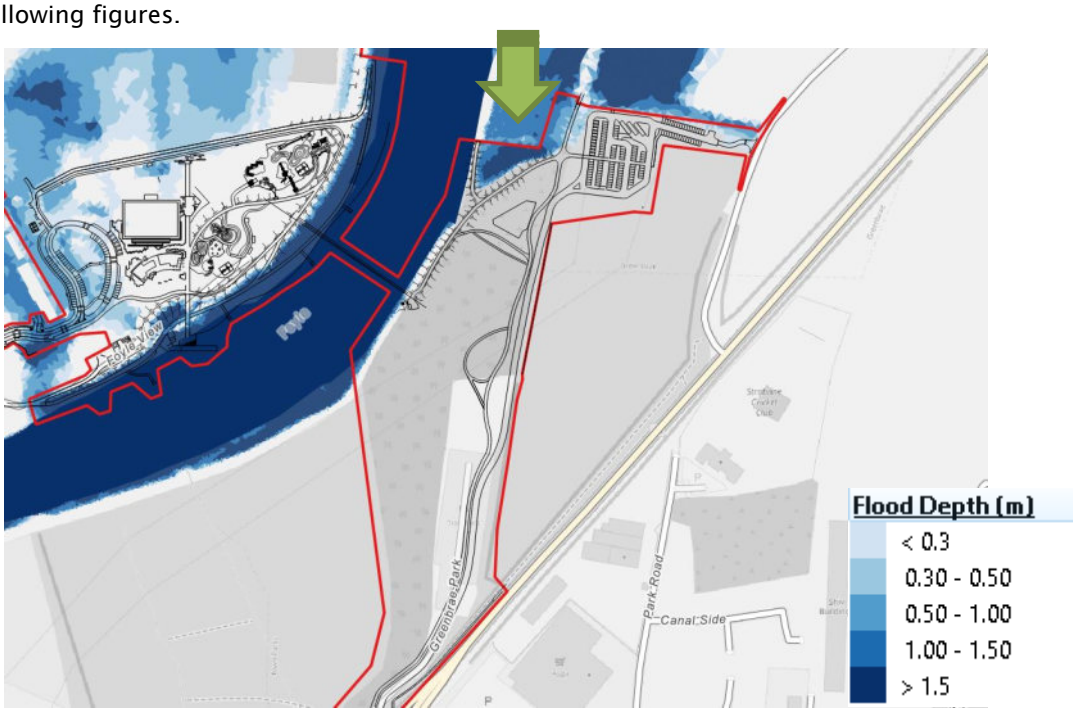



**Figure 1-2 10% AEP / 1-in-10 Year Flood**

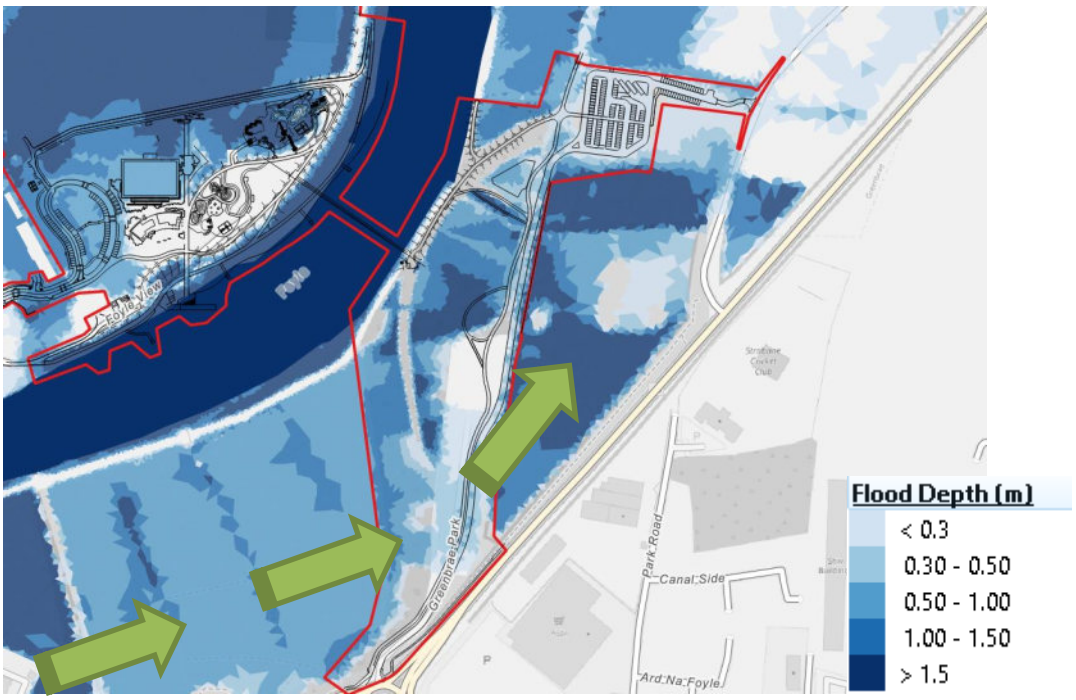



**Figure 1-3 1% AEP / 1-in-100 Year Flood**

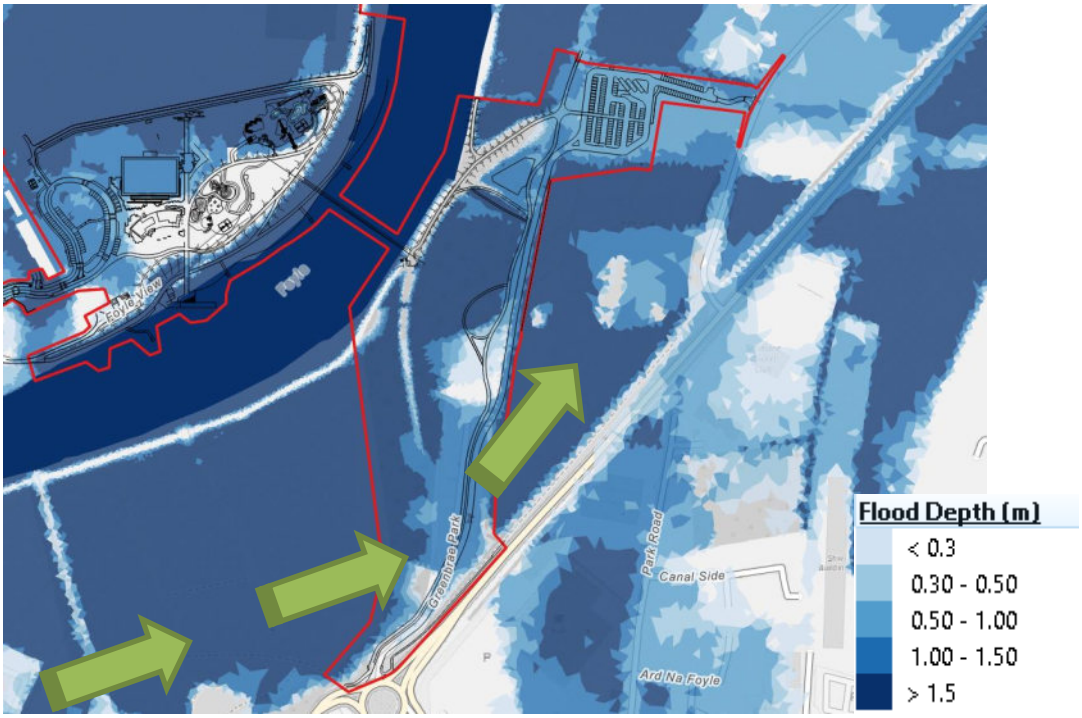



**Figure 1-4 1% AEP / 1-in-100 Year Climate Change Flood**

### 1.3.2 Foyle Flood Defence Failure

The flood risk assessment has identified an additional risk of increased flooding in the event of flood defence failure. It is not possible to qualify or quantify the likelihood of such a failure.

Flood defence failure may occur when water levels are raised in the River Foyle and when there is no flooding on the site. A breach of the defence embankment on the Strabane side would result in floodwater flowing south into the site.

A breach of the defence coinciding with where the Riverine path lies on the embankment crest may result in collapse of that path and a risk to users. As such, paths on flood defence crests should be closed when there are flood conditions in the Foyle.

# 2 IDENTIFICATION OF FLOOD WARNINGS & LEVELS OF ALERT

## 2.1 Public Flood Warnings

There is no automated flood warning system in Northern Ireland. The Met Office works with DfI Rivers, Transport NI and NI Water to forecast areas where floods are likely.

The site is transboundary with access to the Riverine park in Lifford. Flood management at the site is to be managed in conjunction with flood management on the Lifford site and flood warnings or other local authority / Met Eireann / OPW warnings available to Lifford should similarly be acted on at the Strabane side.

## 2.2 Met Office Weather Warnings

Met Office warnings are given a colour depending on a combination of both the impact the conditions may have (Table 2 1) and the likelihood of the event happening (Table 2 2).

The Met Office weather warnings apply to a range of weather including rain, wind, snow, ice and fog. In June 2018 two new warnings were introduced to include thunderstorms and lightning.

The Met Office weather warnings apply to a range of weather including rain, wind, snow, ice and fog. In June 2018 two new warnings were introduced to include thunderstorms and lightning. **In relation to predicting fluvial flooding, the main weather warning of interest will relate to extreme rainfall.** The resulting Alert Level matrix is shown in the following Table 2.3.

**Table 2-1: Met Office Impact of Flooding**

| Impact | Description |
|---|---|
| Very Low | Some flooding of low lying areas, recreational land and car parks but little or no disruption to travel. Wet road surfaces and possibility of ponding water leading to difficult driving conditions.<br>Take extra care when driving in affected areas. |
| Low | Localised flooding of low lying areas, recreational land and car parks and flooding of a small number of homes and businesses. Wet road surfaces and possibility of ponding water, especially in known trouble spots. Local disruption to travel - longer journey times.<br>Water on roads - drive according to the conditions encountered. |
| Medium | Some flooding of homes, businesses and transport links possible, disruption to travel likely and disruption to gas / electricity / water supplies and telecoms.<br>Some evacuations may be required - be prepared to protect yourself and your property. |
| High | Widespread flooding of property, severe disruption to travel, loss of gas / electricity / water supplies and significant disruption to communities.<br>Evacuation expected.<br>Significant risk to life.<br>Take action to protect yourself and follow the advice of the emergency services. |

**Table 2-2: Met Office Likelihood of Event**

| Likelihood | Description |
|---|---|
| Very Low | Be aware that there is a very small risk of an event occurring. |
| Low | There is the small chance of an event occurring. |
| Medium | We should be prepared for an event occurring. |
| High | You may need to take action as we are expecting an event to occur. |

**Table 2-3: Met Office Weather Warning Matrix**

| Likelihood | Impact | | | |
|---|---|---|---|---|
| | Very Low | Low | Medium | High |
| High | | | | |
| Medium | | | | |
| Low | | | | |
| Very Low | | | | |

### 2.2.1 Green

No severe weather warning. Note that weather assessed as having a 'very low' impact may still have some minor impacts.

### 2.2.2 Yellow: Be Aware

Severe weather is possible over the next few days and could affect you. Yellow means that you should plan ahead thinking about possible travel delays, or the disruption of your day to day activities. The Met Office is monitoring the developing weather situation and Yellow means keep an eye on the latest forecast and be aware that the weather may change or worsen, leading to disruption of your plans in the next few days.

### 2.2.3 Amber: Be Prepared

There is an increased likelihood of bad weather affecting you, which could potentially disrupt your plans and possibly cause travel delays, road and rail closures, interruption to power and the potential risk to life and property. Amber means you need to be prepared to change your plans and protect you, your family and community from the impacts of the severe weather

### 2.2.4 Red: Take Action

Extreme weather is expected. Red means you should take action now to keep yourself and others safe from the impact of the weather. Widespread damage, travel and power disruption and risk to life is likely. You must avoid dangerous areas and follow the advice of the emergency services and local authorities.

# 3 FLOOD EVACUATION PROCEDURES

## 3.1 Flood Warnings / Alerts

Sources of Flood Alerts / Warnings are outlined in Section 2. To ensure ongoing monitoring of potential flood information, a nominated Flood Warden for the site should check with the Met Office **daily** for weather warnings and in the event of a warning being in place, follow the procedures outlined in this FMP.

This point of contact designated to check and communicate flood warnings shall be specified within this plan and updated on an ongoing basis.

Local media can also be used to check Flood Warnings in place at any given time.

## 3.2 Communication

An appropriate means of communication should be established to suit the commercial nature of the building and its occupiers in order to allow communication of a flood event by the Flood Warden.

Appropriate signage should be erected on the sign to advise the public / site users on key actions in the event of flooding or instruction to evacuate the site.

The appointed Flood Warden will be responsible for communicating flood related information to site users and coordinating actions outlined in this FEMP. The Flood Warden will ensure the FEMP is regularly maintained, reviewed and kept up to date.

## 3.3 Evacuation Route

Safe evacuation prior to onset of flooding shall be by the main site access or via Park Road to the A5 / Lifford Road roundabout. Further egress south from this muster point via the A5 is unaffected by predicted flooding.

Alternative evacuation to temporary refuge in the event of sudden onset of flooding is available via the proposed Foyle Bridge to a Community Hub building in the Lifford Riverine site.

Evacuation / refuge routes are shown on the following map.

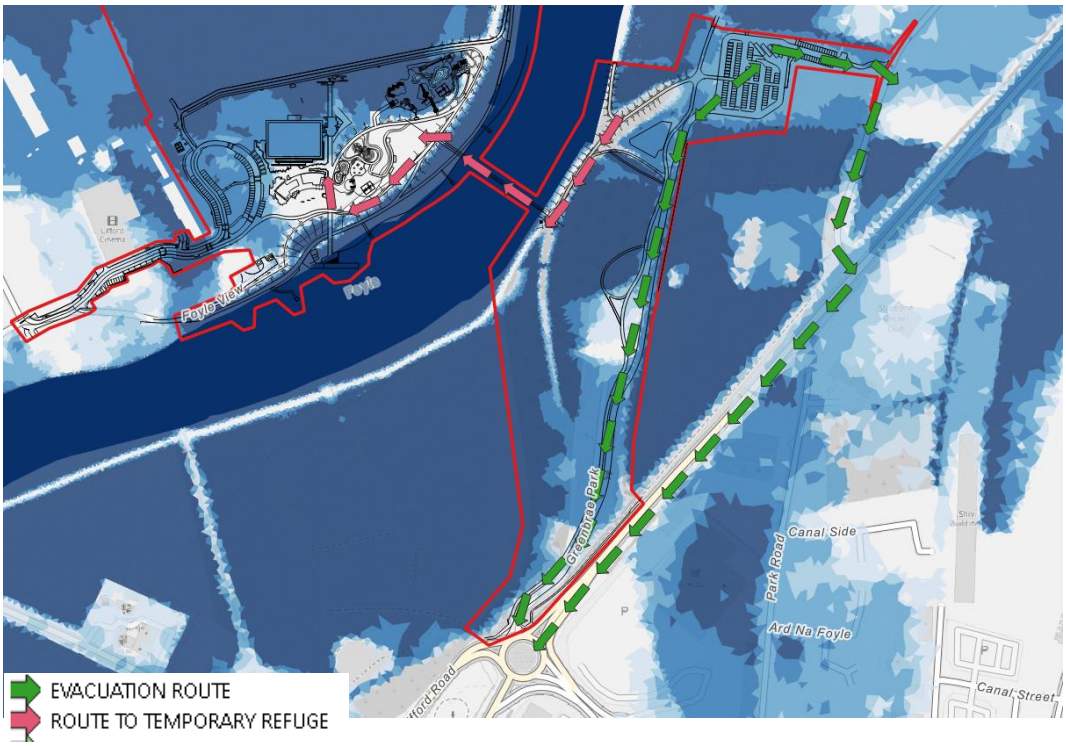



**Figure 3-1 Flood Evacuation Route**

**As noted previously, instructions from emergency services regarding evacuation routes or any other aspect of flooding at the site takes precedence over any instruction in this FEMP.**

When evacuated, occupants should follow the directions of the Emergency Services to any centralised shelter, or make arrangements to find alternative accommodation for the duration of the flood.

## 3.4 On-Site Refuge

Only where prior evacuation is not viable, then site users should seek to take refuge on high ground (flood defence embankments, or preferable to the Lifford Community Hub building as shown at Figure 3-1

Site users should not leave points of refuge to enter floodwater. Users should seek emergency evacuation from the upper floor by contacting the emergency services. The site is best located to the Emergency Services by any of the following methods:

| | |
|---|---|
| Postal Address: | **Riverine Park, Strabane** |
| Irish grid reference: | **234242 ,398747 (for Strabane Carpark area)** |
| What3words reference: | **/// /// ///journal.inspirations.straining (for Strabane Carpark)** |

## 3.5 Flood Event Actions

In the event of receipt of any Flood Alerts or Warnings, actions described in this Plan are to be undertaken by the nominated Flood Warden. The procedure required for each alert level is outlined in Table 3 1.

**Table 3-1: Flood Warning Action Plan**

| | | Site Specific Actions | | |
|---|---|---|---|---|
| **Source of Warning** | **What it means** | **Recommended Action** | **Communication** | **Responsible Persons** |
| **DfI Rivers inspection deems flood embankment unsafe** | Increased risk of flood defence failure | Prevent access to trails / paths / cycleways on flood defence embankments.<br>If the warning coincides with any flood warning, close the site and prevent further access. | Inform the public with appropriate signage and enforcement. | Flood Warden<br>Site Management |
| **Met Office Yellow Alert:**<br>**Be Aware** | Severe weather is possible over the next few days | Flood Warden to continue to check Met Office warning status and other sources of weather / flood information.<br>Plan ahead thinking about possible disruption. | Inform staff of potential requirement for further action if situation worsens | Flood Warden |
| **Met Office Amber Alert:**<br>**Be Prepared** | There is an increased likelihood of bad weather affecting you, which could potentially cause disruption and risk to life and property | Flood Warden to continue to check Met Office warning status and other sources of weather / flood information.<br>Flood Warden to notify and re-familiarise staff with information and plans contained within this FEMP.<br>Visual check on flooding from adjacent watercourses. Where Foyle water levels are rising, consider closing access to trails / paths / cycleways on flood defence embankments.<br>Consider limiting site access to vulnerable or less-mobile visitors | Inform staff of potential requirement for further action if situation worsens<br>Inform visitors of Alert (signage or similar) | Flood Warden |
| **Met Office Red Alert:**<br>**Take Action** | Flooding is predicted<br>Extreme weather is expected<br>Widespread damage, travel and power disruption and risk to life is likely | Restrict further access to the site.<br>**Implement a controlled evacuation of the and site** via normal means | Inform occupants of implementation of flood action procedures and requirement to evacuate<br>Check local media for information relating to severe weather / flooding | Flood Warden<br>Site Management<br>Site Visitors |

**Table 3-1: Flood Warning Action Plan**

| | | Site Specific Actions | | |
|---|---|---|---|---|
| **Source of Warning** | **What it means** | **Recommended Action** | **Communication** | **Responsible Persons** |
| **Flood Warden or other site occupant observes flooding adjacent to building** | Flooding is imminent or currently occurring | If no previous warning has been received:<br>**Follow the advice of emergency services and local authority**<br>**Evacuate the site** as per guidance and map in this FEMP. Ensure anyone with restricted mobility is assisted in evacuation and ensure visitors are guided to the muster point.<br>Follow development evacuation procedures to the muster point indicated previously. | Inform occupants of implementation of flood action procedures and requirement to evacuate.<br>Check local media for information relating to severe weather / flooding | Flood Warden<br>Site Management<br>Site Visitors |
| **Occupants are trapped on site by no-warning flood** | Flooding has occurred and evacuation is not feasible | Take refuge on high ground or refuge in Lifford Community Hub building where it is safe to use the .Foyle bridge.<br>Do not permit occupants to return to vehicles parked in areas where flooding is predicted or ongoing.<br>Do not seek to leave the site by entering floodwater<br>**Follow the advice of emergency services and local authority.** | Contact Emergency Services<br>Await assistance. | Flood Warden<br>Site Management<br>Site Visitors |

**Table 3-1: Flood Warning Action Plan**

| | | Site Specific Actions | | |
|---|---|---|---|---|
| **Source of Warning** | **What it means** | **Recommended Action** | **Communication** | **Responsible Persons** |
| **Met Office Green Alert: No Severe Weather**<br><br>**Emergency Services give 'all-clear'** | No further flooding is currently expected in the area<br><br>Localised flooding of low-lying land and standing water possible | If flooding occurred:<br>• await confirmation from emergency services or suitably qualified professionals that it is safe to re-access site<br>• inspect and / or arrange for external inspection of the site before re-occupying site, including evaluation of the condition of flood defence emankments. Take care when re-entering site as there may be hidden dangers caused by flooding such as structural damage and contamination.<br>• Take care when accessing previously flooded car park areas due to potential for debris / blown manhole covers etc<br>• Contact insurance companies<br>• If no flooding has occurred, inform all occupants and re-open access to site. | Confirm that no Flood Warnings are in place<br><br>Arrange for suitably qualified professionals to review any suspected flood damage<br><br>Contact insurance company if necessary | Flood Warden<br><br>Site Management |

## 3.6 Other Bodies

There are a number of organisations that will play a part in the response to a major flood incident including emergency services, utility companies and voluntary agencies. The roles and responsibilities of the main bodies, and how that impacts this FEMP is summarised below.

### 3.6.1 DfI Rivers

DfI Rivers is responsible for predicting flooding from rivers and seas including the location and magnitude. DfI Rivers is likely to maintain a significant role in managing the condition of flood defence embankments at the site.

### 3.6.2 Flooding Incident Line

Contact the flooding incident line (0300 2000 100) to report flooding. Staff will alert and coordinate the relevant bodies (DfI Rivers, Transport NI or NI Water) that deal with flooding. Note that this is a non-emergency number and if persons are in danger contact the emergency services by telephoning 999.

### 3.6.3 Emergency Services

Local police and fire and rescue will co-ordinate response during major flood events and help to save lives and property. The response may include rescuing persons in danger, establishing cordons and pumping of floodwater.

Direction or instruction from emergency services would take precedence over any guidance within this FEMP. It is also noted that emergency services should only be contacted when there is a threat to life and that evacuation of the site does not require informing police or fire and rescue.

### 3.6.4 Derry City and Strabane District Council

Derry City and Strabane District Council works with the emergency services and other agencies such as DfI Rivers and Roads, NI Water, etc to plan for and help respond effectively to all emergency situations.

In the event of a major emergency, the Council can assist in a number of ways:

- Make buildings such as leisure and community centres temporarily available as shelters for people who have been displaced;
- Provide advice and guidance on cleaning up after major flooding or pollution;
- Assess structural damage to buildings;
- Provide staff/equipment to responding agencies as requested;
- Co-ordinate and lead multi-agency meetings to plan for recovery.

The council will assess each incident and decide on the level of response. In the event that flooding at the site was declared an emergency that warranted input from the council, the council's procedures and requirements would be adhered to and would take precedence over the recommendations within this site-specific FEMP.

### 3.6.5 Met Office

The Met Office issues severe weather warnings for rain, wind, fog, ice, snow and from June 2018, thunderstorms and lightning. These warnings are provided to local authorities and emergency services. While no flood evacuation is required due to a Met Office warning, the information they provide may be useful in fully considering flood risk at the site.

### 3.6.6 Utility Companies

In the event of a flood, utility companies will strive to secure their services to ensure continuity of supply. However, in the event of damage or disruption of service, the relevant company will be responsible for re-establishing supply as soon as possible.

# 4 FLOOD RISK SUMMARY

The FRA carried out for the site demonstrates the nature and severity of flood risk at the site. This FEMP outlines that actions to be taken should it become clear that the risk is at risk imminent risk of flooding. Table 5 1 summarises flood risk at the site and details relating to potential evacuation of the site.

**Table 5 1: Flood Risk Summary**

| Flood Risk Source | Warning System in Place | Estimated Warning Time | Frequency / Probability of Flooding |
|---|---|---|---|
| **Fluvial / Rivers** | Flood Warden to check Met Office and local media for information. Visual check of watercourses in the vicinity. | 2-3 days for Met Office yellow / amber warning<br>Hours for Met Office red warning | Between 10 and 1% chance of areas where development is proposed flooding in any given year. |
| **Flood Defence Breach** | Flood Warden / Site operator to monitor flood embankments (visual checks) for evidence of structural failures. | None to Hours (where cracking or slope instability is observed) | Unknown |
| **Coastal / Tidal** | N/A | N/A | Not significant |
| **Surface Water** | N/A | N/A | Not significant |
| **Groundwater** | N/A | N/A | Not significant |
| **Reservoir** | N/A | N/A | Not significant |

## 5 SPECIFIC FLOOD PLAN DETAILS

**FLOOD PLAN FOR:** Riverine Community Park, Strabane

**EMERGENCY CONTACT LIST:** Flood Warden – Name: _____

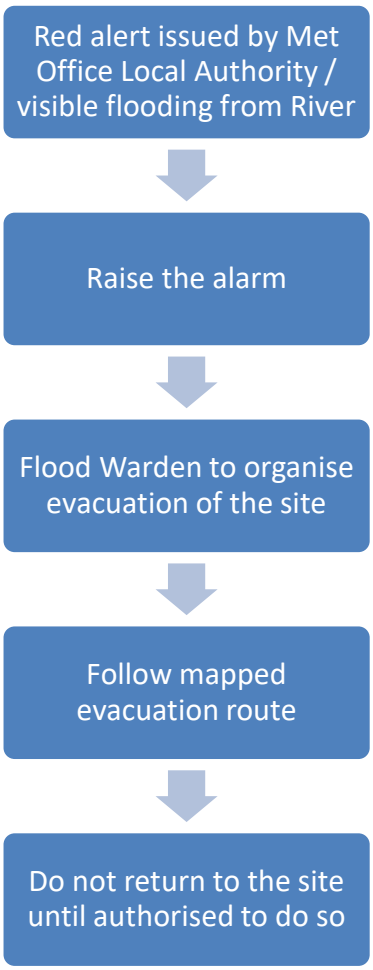
Phone: _____

Site Office – Phone: _____

Flood Incident Line – 0300 2000 100

Emergency Services – 999

**FLOOD EVENT PROCEDURE:**



## CONTACT LIST

| Name | Address | Telephone | Emergency Contact | Emergency Contact Details |
|---|---|---|---|---|
| | | | | |
| | | | | |
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## PERSONS WHO MAY REQUIRE EVACUATION ASSISTANCE

| Name | Office / Site Location | Assistance Required | Person Responsible |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

## SERVICES LOCATIONS / CONTACTS

| Service | Cut-off Location | Company Name | Telephone |
|---|---|---|---|
| **Electricity** | | | |
| **Gas** | | | |
| **Water** | | | |
| | | | |
| | | | |

## PROTECTIVE ACTIONS

Identify possessions that may need special protective measures, and describe the actions that will be taken to prevent damage in the event of a flood.

Protective Actions may include make a copy and store safely, raise above ground level, purchase flood protection measures, move items to safer locations etc.

| Valuable Item | Protective Action | New Location (if applicable) | Done? |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

## Appendix 9-2

### Drainage Assessment

McCloy Consulting

# Appendix 9-2

# Drainage Assessment

## Riverine Community Park – Strabane Site

M01959-02_DG03 | August 2021



WATER & ENVIRONMENTAL CONSULTANTS

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# CONTENTS


1 INTRODUCTION ..... 1
1.1 Terms of Reference ..... 1
1.2 Statement of Authority ..... 1
1.3 Approach to the Assessment ..... 1
1.4 Application Site ..... 2
*1.4.1 Existing Land Use ..... 2*
*1.4.2 Proposed Land Use ..... 2*
1.5 Site Characteristics ..... 3
*1.5.1 Topography ..... 3*
*1.5.2 Hydrology and Watercourses ..... 4*
*1.5.3 Geology ..... 4*
2 BACKGROUND INFORMATION REVIEW ..... 6
2.1 Internet / Media / Background Search ..... 6
2.2 Northern Ireland Water ..... 6
*2.2.1 Out of Sewer Flooding ..... 6*
*2.2.2 NI Water Assets ..... 6*
2.3 DfI Rivers ..... 7
*2.3.1 Flood Maps NI ..... 7*
3 FLOOD RISK ASSESSMENT ..... 8
3.1 Initial Assessment ..... 8
3.2 Surface Water ..... 8
*3.2.1 Effect of the Development ..... 8*
3.3 Culverts / Effect of Blockage ..... 10
4 SUMMARY OF FINDINGS AND RECOMMENDATIONS ..... 12
4.1 Summary of Findings ..... 12
4.2 Design Measures ..... 12
*4.2.1 Drainage Design ..... 12*
4.3 Maintenance Requirements ..... 13
*4.3.1 Drainage System Maintenance ..... 13*
*4.3.2 Watercourse Maintenance ..... 14*
4.4 Summary ..... 14

## LIST OF TABLES

TABLE 3-1: INITIAL ASSESSMENT – FLD3 / SURFACE WATER FLOOD MECHANISM SCREENING ..... 8
TABLE 3-2 COMPARISON OF SURFACE WATER RUNOFF RATES (PEAK [1HR] RUNOFF RATES) ..... 8
TABLE 4-1: ATTENUATION REQUIREMENTS ..... 13
**TABLE 4-2 SITE DRAINAGE MAINTENANCE SCHEDULE** ..... 13
TABLE 4-3: PPS15 FLD3 POLICY SUMMARY ..... 14

## LIST OF FIGURES

FIGURE 1-1 SITE LOCATION ..... 2
FIGURE 1-2 SUMMARY OF LAND USE CHANGE ..... 3
FIGURE 1-3 APPLICATION SITE TOPOGRAPHY (10M DTM) ..... 3
FIGURE 1-4 - WATERCOURSES ..... 4
FIGURE 1-5 UNDERLYING SITE GEOLOGY ..... 5
FIGURE 2-1 - NI WATER ASSETS ..... 7
FIGURE 2-3 EXTRACT FROM FLOOD MAPS (NI) – INDICATIVE 0.5% AEP SURFACE WATER FLOOD EXTENT ..... 7
FIGURE 2-4 HISTORICAL FLOODING ..... 8
FIGURE 3-1 INDICATIVE OVERLAND FLOW PATHS ..... 9
FIGURE 3-2 CULVERT UNDER FARM LANE ..... 10
FIGURE 3-3 CULVERT UNDER EMBANKMENT ..... 11
FIGURE 3-4 CULVERT EXIT – DISCHARGE TO RIVER FOYLE ..... 11

## APPENDICES

APPENDIX A SURVEY INFORMATION
APPENDIX B CORRESPONDENCE
APPENDIX C CALCULATIONS
APPENDIX D DRAINAGE DESIGN SUMMARY

# 1 INTRODUCTION

## 1.1 Terms of Reference

This Drainage Assessment was commissioned by McAdam Design Ltd to support a planning application for the development of the eastern portion of the new Riverine Community Park, which includes a new area of open space, access, car parking area and a new footbridge to the adjacent Western section of the proposed community park at Lifford, County Donegal.

The assessment addresses specific policy requirements in PPS15 (Revised) – Planning and Flood Risk and is limited to assessment of surface water flooding to address policy FLD3. **This document is relevant to the Strabane planning application only.**

The assessment will determine potential overland sources of flooding at the site and their associated risk to life and property. The assessment will determine the suitability of the site for development in relation to flood risk from various sources and propose design and mitigation measures where appropriate.

The assessment should be read in conjunction with Appendix 9-1 – Flood Risk Assessment, which addresses flood risk from rivers and other sources.

## 1.2 Statement of Authority

This report and assessment have been prepared and reviewed by qualified professional flood analysts specialising in the fields of hydrology, drainage and flood risk as required by DfI Rivers and SuDS studies. The key staff members involved in this project are as follows:

- Anthony McCloy BEng CEng FIEI – Director of McCloy Consulting and a Charted Civil and Environmental Engineer specialising in engineering hydrology; SuDS design and flood risk investigation and assessment.
- Vincent Bradley BEng (Hons) GMICE – Project Engineer with experience in detailed drainage design, drainage planning and infrastructure engineering.

## 1.3 Approach to the Assessment

Consideration has been given to the sources and extent of fluvial flooding at the site, as well as flooding of the site from pluvial sources, infrastructure failure, overland flow, and ponding of localised rainfall within the site.

For the purposes of this study, the following have been considered:

- Available information on historical surface water flooding in the area.
- Site level information based on OSNI 2m LiDAR data and 3rd party survey (see Appendix A).
- Assessment of potential flooding to the site from sources other than rivers and sea.
- Assessment of potential flood risk to adjacent lands caused by development at the site; and
- Determination of the availability of safe discharge of surface water from the site.

Further guidance is also provided in the CIRIA Research Project 624 "Development and Flood Risk: Guidance for the Construction Industry" and Revised PPS 15 – Planning and Flood Risk.

## 1.4 Application Site

The site is situated at the vacant lands to the Northwest of the A5 (Barnhill Road) and East of Park Road, Strabane at Irish Grid reference 234113, 398570 and has an area within its boundary of 8.3 ha.

The site context and location are shown on drawings submitted in support of the application.

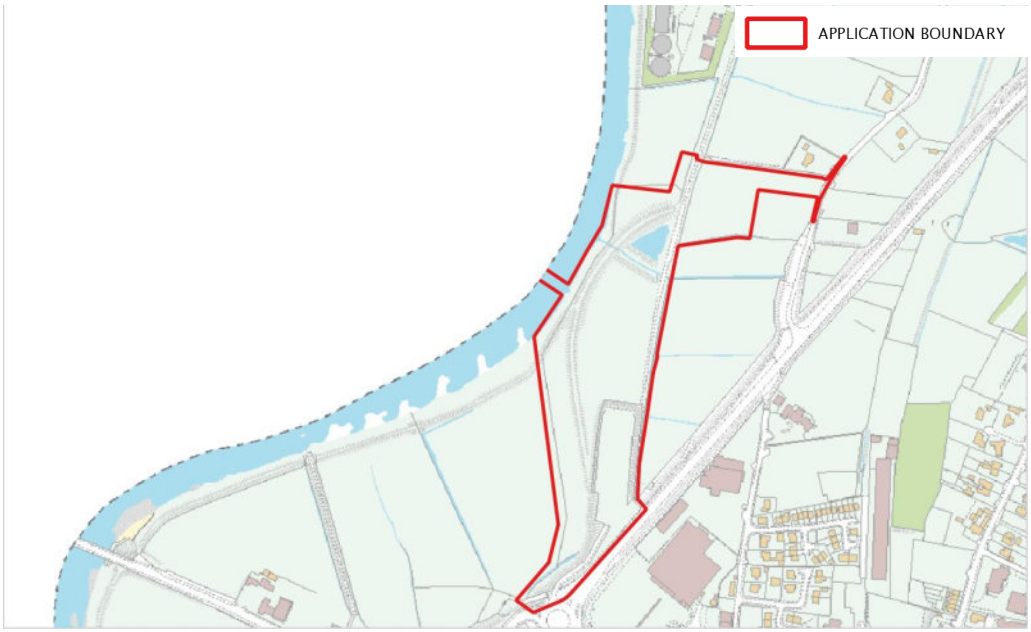



**Figure 1-1 Site Location**

### 1.4.1 Existing Land Use

The site currently comprises of undeveloped greenfield lands with an existing hardstanding ground and access located at the south of the site.

### 1.4.2 Proposed Land Use

Development proposals within the Eastern portion of the new Riverine Community Park, i.e., the area of development that falls within the Derry and Strabane District Council area; includes a new area of open space, access, car parking area and a new footbridge to the adjacent western section of the proposed community park at Lifford, County Donegal. The proposal includes the Foyle bridge which is a clear span structure spanning between flood embankments on the Strabane and Lifford sites. A schematic showing change of land use for the area subject to re-development is included on the following figure. Key proposal drawings on which this assessment is based are included in Figure 1-2 for ease of reference.

| Existing | | Proposed | |
|---|---|---|---|
| Land Use: | Disused | Land Use: | Leisure, parking facilities |
| Impermeable Area | 8.6% | Impermeable Area | 14.4% |
|  | |  | |

**Figure 1-2 Summary of Land Use Change**

## 1.5 Site Characteristics

### 1.5.1 Topography

The lands subject to development are relatively flat with lowest points positioned along the west of the site, where the river is located. Land along the banks of the stream create the highest points on the site. Ground levels within the lands subject to development are observed from a survey surface combined with 2m LiDAR data and varies between -3.2- 2.8m AOD.

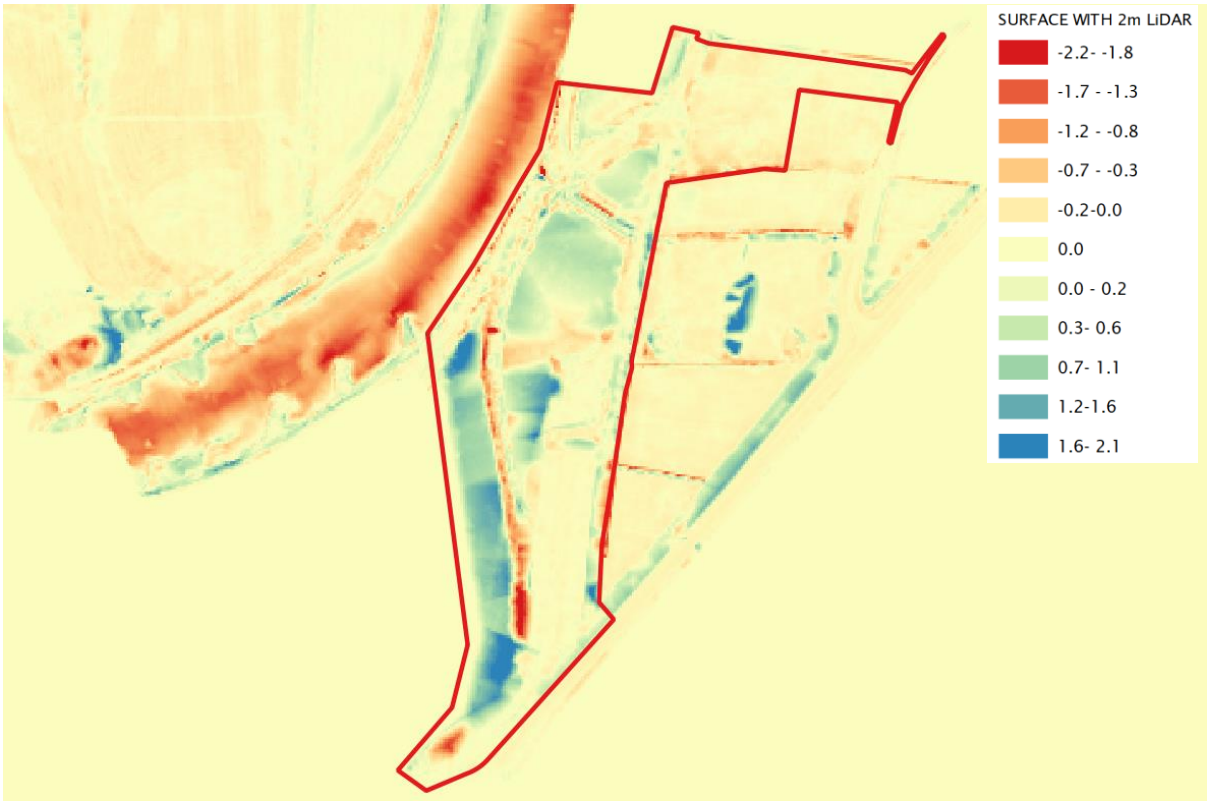



**Figure 1-3 Application Site Topography (10m DTM)**

### 1.5.2 Hydrology and Watercourses

Designated watercourse, River Foyle flows from north to south along the western boundary of the site. A review of DFI Watercourses designations has indicated that two of the Foyle's tributary's flow through the site Nancy Burn (U1202) and Park Road Drain (U1716). Designated watercourse, Tarry Drain (U1718) flows into Nancy Burn and two undesignated watercourses located at the west of the site flow into the Park Road Drain. Undesignated watercourses were identified from OSNI Mapping immediately north and south, south-west of the site boundary.

Watercourses in the area are shown in Figure 1-4.

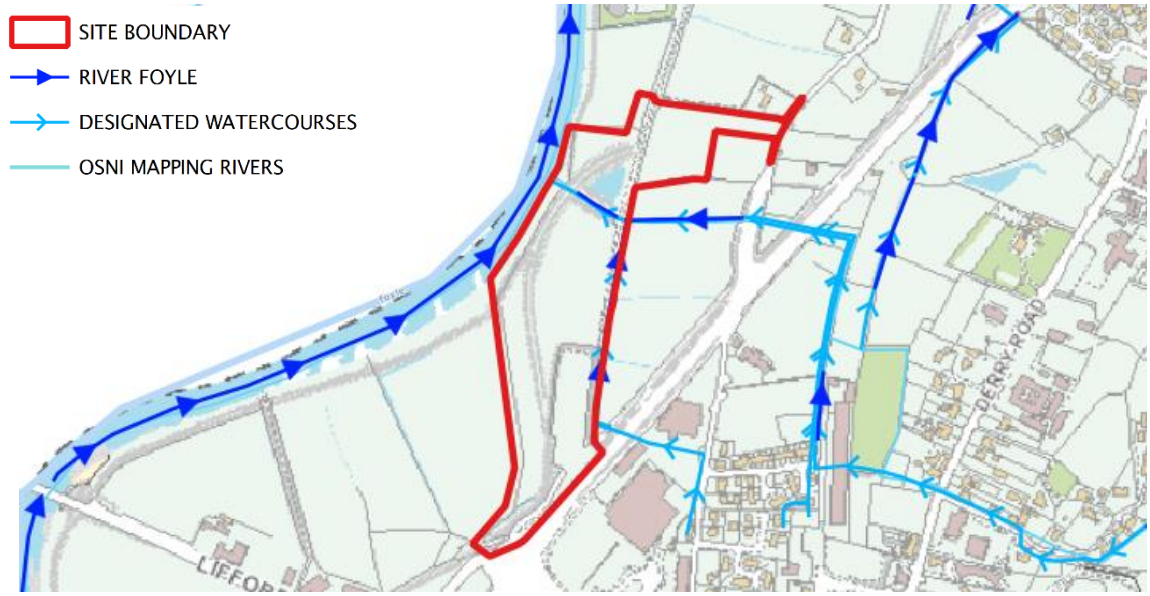



**Figure 1-4 - Watercourses**

### 1.5.3 Geology

A review of GSNI geology data has been undertaken to inform this assessment. Underlying superficial site geology based on GSNI 10k mapping within the area subject to development is indicated to be mostly tidal flat deposits of clay and sand. Sand and gravel deposits are located approximately 400m east of the site boundary. This is shown on the following figure. Permeability on sands and gravels is likely to be high.

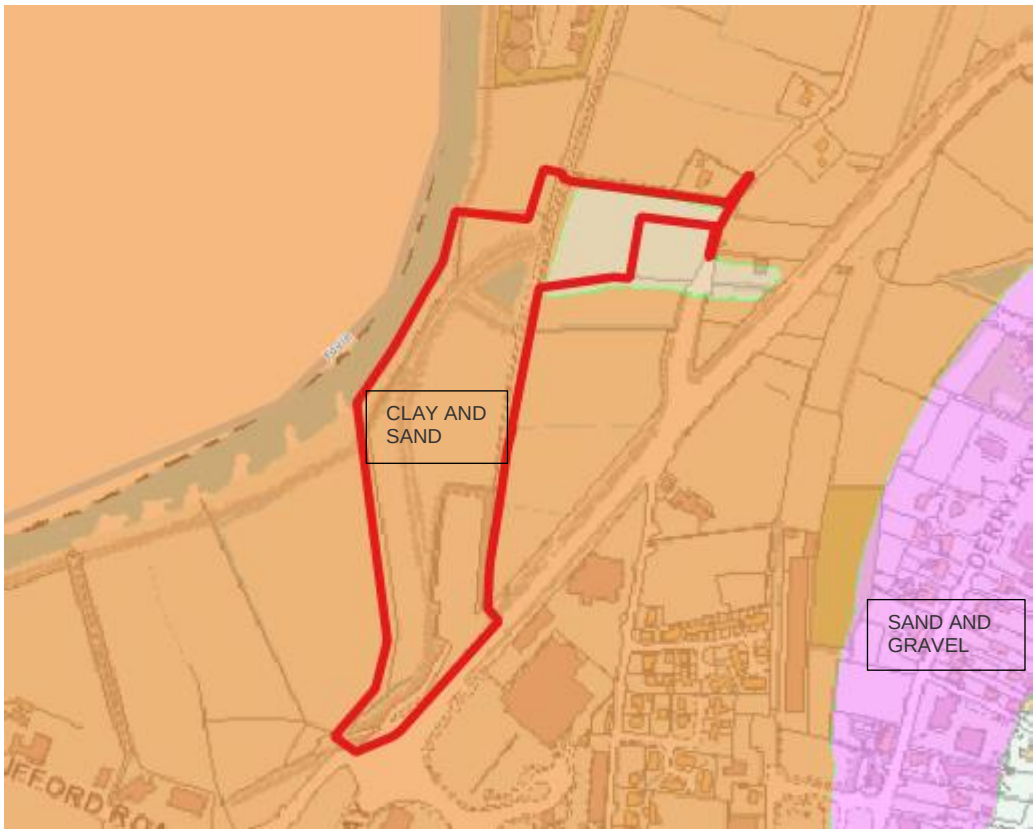



**Figure 1-5 Underlying Site Geology**

# 2 BACKGROUND INFORMATION REVIEW

As part of the study data collection phase, several available sources of information were investigated to build an understanding of the potential risk of flooding to the site.

The following review highlights the key findings of the anecdotal evidence collection exercise.

## 2.1 Internet / Media / Background Search

A brief media search returned several incidences where flooding occurred within the Strabane vicinity, these include:

- Flooding which occurred in the Lower Main Street and Railway Street areas on the 22nd of October 1987 when the River Mourne burst its banks. Resulting in water levels of four feet in Abercorn Square and the construction of a flood wall in 1989[1]. The flood wall is understood not to offer any protection to the subject site.
- Flooding occurred in August 2017, within the Burndennett area[2]. This area is approximately 5.5 miles north from the site.
- Pluvial flooding, due to a torrential downpour, has occurred within the Ballycolman estate in July 2020 and 8 weeks later, in August 2020[3]. Ballycolman Estate is located approximately 1.5 miles southeast of the site.

## 2.2 Northern Ireland Water

### 2.2.1 Out of Sewer Flooding

Northern Ireland Water is unable to provide an indication of history of flooding from its assets for reasons of data protection.

### 2.2.2 NI Water Assets

A preliminary review of NI Water asset information indicates the following:

- An unknown sewer is located at the south of the site boundary discharging in the Mourne River through Lifford Road.
- A 1000mm diameter combined sewer cuts through the north of the site, eventually discharging north into the sewage treatment works.
- 150mm diameter foul pipe runs from north to south along the eastern boundary of the site eventually discharging into the combined sewer.

[1] McLaughlin, D., 2012. *Strabane recalls devastating 1987 flood*. [online] BBC News. Available at: <https://www.bbc.co.uk/news/uk-northern-ireland-20031598> [Accessed 29 June 2021].
[2] Devlin, M., 2019. *Flood risk residents 'hung out to dry' by department - The Strabane Chronicle*. [online] The Strabane Chronicle. Available at: <https://www.strabanechronicle.com/2019/10/flood-risk-residents-hung-out-to-dry-by-department/> [Accessed 29 June 2021].
[3] News, B., 2020. *Strabane: Ballycolman residents angry as homes flooded again*. [online] BBC News. Available at: <https://www.bbc.co.uk/news/uk-northern-ireland-53859210> [Accessed 29 June 2021].

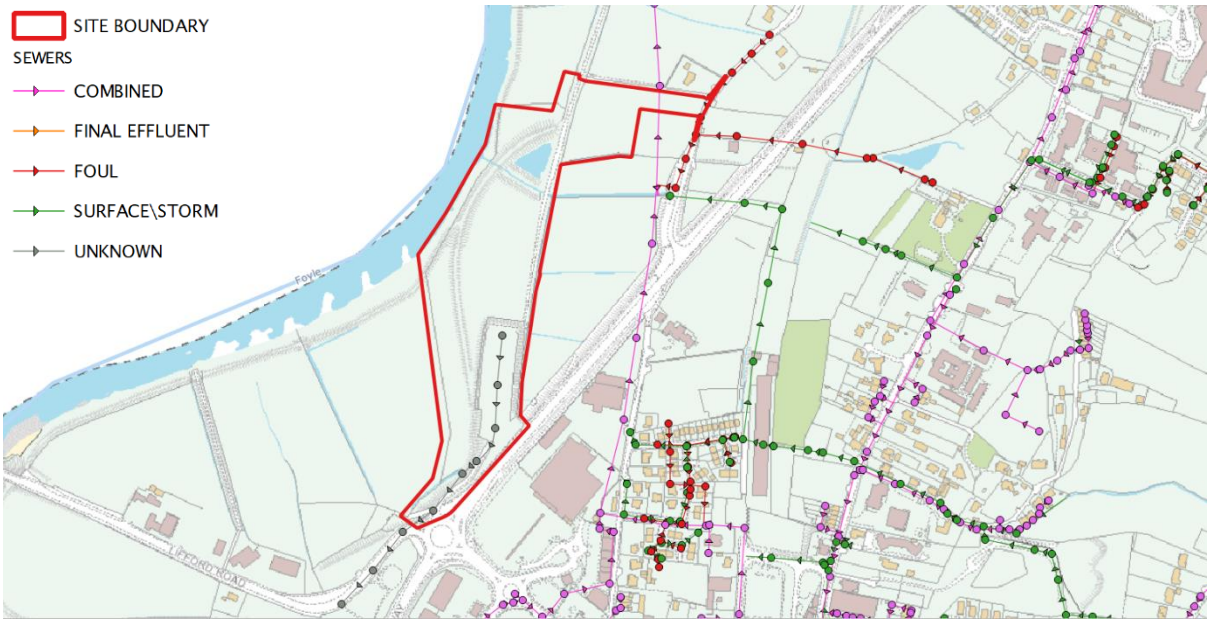



**Figure 2-1 - NI Water Assets**

## 2.3 DfI Rivers

### 2.3.1 Flood Maps NI

The extent of development was reviewed with reference to flood mapping shown on Flood Maps (NI)[4] relevant to surface water. The indicative surface water flood map indicates that lands subject to development are partially affected by the 0.5% AEP flood extents.

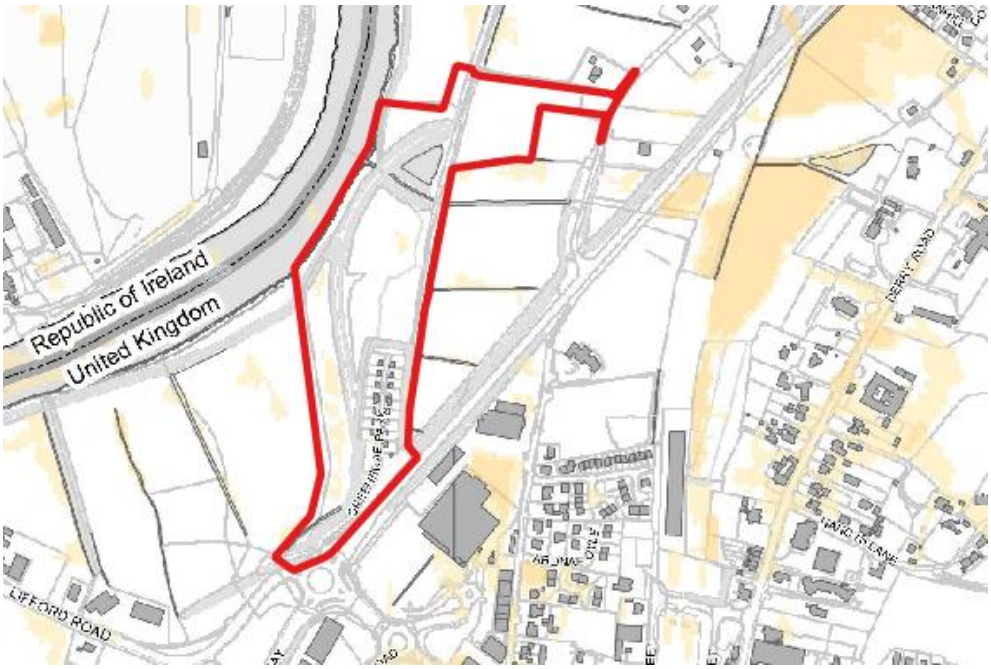



**Figure 2-2 Extract from Flood Maps (NI) – Indicative 0.5% AEP Surface Water Flood Extent**

[4] Flood Maps (NI). (2016) Flood Hazard & Flood Risk Maps for NI. Available from: http://riversagency.maps.arcgis.com/apps/webappviewer/index.html?id=fd6c0a01b07840269a50a2f596b3daf6 . [Accessed: 26 Aug. 21].

# 3 FLOOD RISK ASSESSMENT

## 3.1 Initial Assessment

This assessment addresses the following flood pathways relevant to policy FLD3 of PPS15 (Revised) Planning and Flood Risk, bearing in mind Dfl Rivers Pre-Application Discussion consultation.

**Table 3-1: Initial Assessment – FLD3 / Surface Water Flood Mechanism Screening**

| Policy | Flood Mechanism | Initial Assessment | Assess Further? | Policy Applies? |
|---|---|---|---|---|
| FLD 3 – Development and Pluvial Flood Risk Outside Flood Plains | Surface water flooding | Flood Maps (NI) indicates that land where development is proposed is unaffected by predicted surface water flooding. | No | Yes |
| | Surface water discharge | The development has potential to modify surface water runoff characteristics on site/off site. The scale and nature of the development is sufficient to require to demonstration that safe discharge of surface water is feasible. | Yes | |
| | Culvert Blockage | The Nancy Burn / Tarry Drain is culverted in part through the site and under the flood embankment which runs along the eastern boundary. | Yes | |
| | Urban Drainage / Local Drainage Failure | No indication of urban drainage flooding / sewer incapacity in initial evidence searches. | No | |
| | Groundwater | Ground conditions are not conducive to groundwater flooding. | No | |

## 3.2 Surface Water

### 3.2.1 Effect of the Development

The proposed development will cause an increase in the impermeable area of the site and is likely to result in an increase to the rate and volume of runoff from the site, when compared to the existing scenario, and prior to any mitigation.

An estimate of unmitigated post-development runoff for the site has been made as part of this assessment. Runoff estimates are based on plans submitted as part of the present planning application. A comparison of existing and proposed runoff rates in litres per second (l/s) is given in Table 3-2 relating to the area subject to development only.

**Table 3-2 Comparison of Surface Water Runoff Rates (Peak [1hr] Runoff Rates)**

| Return Period | Existing Site (lps) | Proposed Site (lps) | Increase (lps) |
|---|---|---|---|
| 1 in 2 year (1hr) | 42.5 | 54 | 11.6 |
| 1 in 30 year (1hr) | 97.3 | 133.2 | 35.8 |
| 1 in 100 year (1hr) | 126.9 | 176.9 | 50 |

#### 3.2.1.1 Potential for Overland Flooding

The site falls via shallow gradients to the western boundary. A review of the site hydrology based on a "rolling ball" hydrological analysis would suggest that run-off from the site typically drains towards the west as shown in Figure 3-1. Overland flow unmitigated would drain towards the western and northern areas of the site boundary.

Flood risk to adjacent lands will be mitigated by ensuring control of runoff from the site up to a suitable flood protection standard (100-yr rainfall event including climate change).




**Figure 3-1 Indicative overland flow paths**

#### 3.2.1.2 Effect on Drainage Networks

The development will utilise new connections to Nancy Burn watercourse at locations of open channel. There will be no new outfall to the River Foyle, and all runoff shall ultimately drain to the Foyle via the existing culvert and non-return valve arrangement on the Nancy Burn outlet.

Runoff from the site will be limited to a greenfield equivalent run-off rate for all additional hardstanding runoff and will not exceed the previous discharge rate for the site.

For purposes of demonstrating that safe and authorised discharge of surface water can be achieved (relevant to Policy FLD3), a Schedule 6 application for consent to discharge to a watercourse was made under the Drainage (Northern Ireland) Order 1973. The point of discharge is within lands under the applicant's control.

A response has not been received from DfI at the time of writing. A copy of the consent shall be submitted as supplementary information to this assessment under separate cover when received.

Where runoff is limited to no greater than the pre-existing runoff rate for all events up to the DfI flood protection standard, then there can be no significant offsite effect on flood risk from downstream drainage networks.

Requirements for the attenuation and discharge of surface water based on the proposals at the site are discussed in Section 4.2.

## 3.3 Culverts / Effect of Blockage

The topographic survey indicates that the Nancy Burn is conveyed by a large diameter pipe (approximately 1.8m dia.) exiting under the Foyle flood defence embankment, prior to discharging via a non-return valve to the Foyle.

Watercourses upstream of the Nancy Burn – Foyle outlet structure within the site flow in open channels which are typically 2.5m deep when compared to outlying ground levels, with the exception of a culverted section under an existing farm lane.

The Nancy Burn / Foyle outlet is a significant structure and is likely to be subject to regular DfI Rivers maintenance. There was no evidence of blockage on occasion of a site visit. Consequences of blockage of the outlet culvert would be to cause a potentially significant impounding effect that could cause flooding of the site.

The farm lane accommodation culvert is visibly overgrown and is likely to have a moderate to high likelihood of blockage. Consequences of blockage would be to cause flooding on lands to the east and north, with maximum flood levels and depths limited by the overtopping level / short -circuiting level on and around the lane/

Given the significant fluvial flood risk to the lands (refer to EIAR Appendix 9-1), additional flood risk due to blockage or failure of culverts is not significant. Mitigation to fluvial flood risk, in terms of selection of appropriate flood resilient materials and finishes, will be similarly effective against flooding from culvert blockage.

Culvert blockage risk can be reduced by pro-active monitoring and maintenance of culvert maintenance, described at Section 4.3.2.



**Figure 3-2 Culvert under farm lane**



**Figure 3-3 Culvert under embankment**



**Figure 3-4 Culvert exit – discharge to River Foyle**

# 4 SUMMARY OF FINDINGS AND RECOMMENDATIONS

## 4.1 Summary of Findings

An assessment to address flood risk beyond floodplains was undertaken. Mitigation of surface water flood risk to the development and surrounding areas shall be by providing an adequate drainage system, discussed below.

## 4.2 Design Measures

This section details measures which have been incorporated into the proposal submitted in support of the planning application, and to be further developed in any detailed design or variation post-determination of the planning application.

### 4.2.1 Drainage Design

A sufficiently detailed drainage design based on the following parameters has been prepared to demonstrate that safe discharge of surface water from the development is feasible and is shown in Appendix D. A summary of drainage calculations are provided in Appendix C. Reference is made to the EIA Appendix 9-3 - Sustainable Drainage Strategy (report reference M01959-02_DG04) for further detail on the drainage design.

#### *4.2.1.1 Design Standard*

Drainage will not be eligible for adoption and will be privately maintained; therefore, NIW design standards are not applicable. Drainage shall comply with the following mandatory standards:

| | |
|---|---|
| • The drainage network / site layout should ensure containment and control of the 100-year (1% AEP) return period storm within the site to ensure no offsite effect elsewhere.<br>• The drainage network should also allow for a **20%** allowance for climate change at all the above listed return periods. | To suit DfI Rivers flood protection standards. |

Other drainage shall comply with Northern Ireland Building Regulations as appropriate. Any SuDS features shall be designed in accordance with guidance as stated in CIRIA C753 SuDS manual.

#### *4.2.1.2 Discharge Rate and Location*

A Schedule 6 application has been made to DfI Rivers for application to discharge to the undesignated watercourse located south of the re-development area via new storm outfall. Surface water discharge from the site shall be limited to the greenfield equivalent rate of 10 litres per sec / Hectare for the development area, equivalent to 11.13lps.

A response has not been received from DfI at the time of writing. A copy of the consent shall be submitted as supplementary information to this assessment under separate cover when received.

#### *4.2.1.3 Attenuation Requirements*

To ensure flood protection elsewhere, proposed site drainage is intended to retain runoff from the site to that rate up to the 100-yr rainfall flood protection standard. Containment will be by surfaced based features (swales and basins). Where water is designed to accumulate or flow overland on site, it shall be in accordance with best practice guidance provided in CIRIA document C635 – Designing for Exceedance in Urban Drainage.

Please refer to Appendix C for corresponding calculations.

**Table 4-1: Attenuation Requirements**

| Adopted Greenfield Runoff Rate | Limiting Rate for Impermeable areas within the area of the site boundary subject to development | Attenuation Volume |
|---|---|---|
| 10 lps /Ha | 11.13 lps | 452 $m^3$ |

The discharge rate and attenuation volume stated are based on information presented as part of the planning application. Volumes stated are dependent on the type and efficiency of the flow control method used which may be updated as part of development to detailed design status. The final design (to be completed and agreed post-consent) must comply with the limiting discharge rate (per hectare) applied to the drained development area.

#### *4.2.1.4 Exceedance*

It has been demonstrated that flows from the site up to the flood protection design standard (1 in 100 year/1% AEP) can be safely contained within the drainage network without out of system flooding, refer to Appendix C.

Runoff in the event of other exceedance (i.e., blockage or other failure) will tend to follow flow routes tending towards the west/southwest of the re-development area as per the present-day scenario (refer to Figure 3-1.

Mitigation of such exceedance shall be by robust maintenance of the drainage and watercourse network described subsequently.

## 4.3 Maintenance Requirements

### 4.3.1 Drainage System Maintenance

Drainage assets shall be the responsibility of the site operator to maintain. The developer shall put in place drainage management procedures as part of the site management operating company.

The owner / operator is to ensure that the maintenance of onsite drainage is covered within their overall management plan. The detailed drainage layout for the site shall ensure that key features requiring maintenance are in accessible locations.

Maintenance plans for un-adopted drainage features are shown in Table 4-2.

**Table 4-2 Site Drainage Maintenance Schedule**

| Feature | Maintenance Requirements | Time |
|---|---|---|
| Flow control devices | • Checking of devices for siltation/blockages and clearing as required<br>• Checking of device outlets for damage and undertaking remediation | Annual/ after significant storm events |
| Swales and basins | • Checking for siltation/ blockages<br>• Landscape maintenance as per the landscape maintenance plan | Annual strim at the end of growing season or 5 cuts per year depending upon the type of vegetation. |
| Gullies/Drainage channels / short lengths of connection pipework | • Checking for siltation/blockage and jetting as required. | Annual/ after significant storm events |

| Feature | Maintenance Requirements | Time |
|---|---|---|
| Watercourses / culvert | • Check watercourses for build-up of vegetation / silt / debris and clearing as required<br>• Check Culvert inlets for build-up of vegetation / silt / debris and clearing as required<br>• Watercourse is noted to be designated and therefore maintenance operations are the responsibility of DfI Rivers | Annual/ after significant storm events |

### 4.3.2 Watercourse Maintenance

The site will be proactively maintained, anticipated to be by the local authority. Undesignated watercourses are to be maintained bearing in mind responsibilities defined by the Drainage Order on the site operator as riparian landowners to a watercourse.

The site operator will similarly be required to facilitate maintenance of designated watercourses by DfI Rivers.

The site operator should note additional flood risks that may arise, particularly because of blockage or failure of the Nancy Burn outlet to the River Foyle and should ensure that the culvert inlet is maintained clear of debris. Significant blockages should be reported to DfI Rivers local area office.

## 4.4 Summary

The following table summarises the findings, mitigation, and policy context of those flood mechanisms and policies deemed to be required to be investigated further by the initial assessment.

**Table 4-3: PPS15 FLD3 Policy Summary**

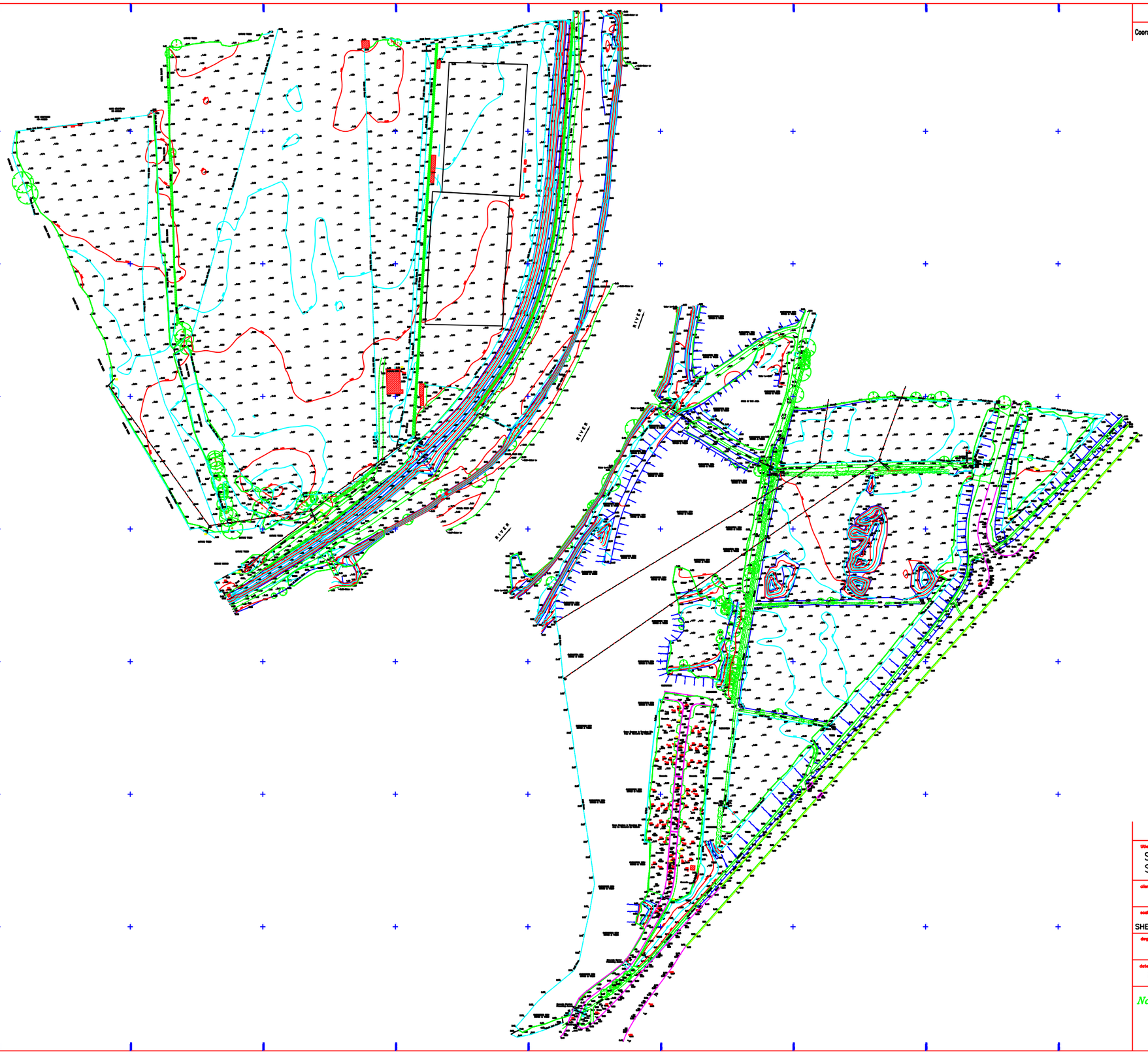
| Planning Policy | Assessment / Mitigation |
|---|---|
| FLD 3 – Development and Pluvial Flood Risk Outside Flood Plains | Site drainage design shall ensure the site is drained and flood resilient. Drainage design shall be as per the requirements of DfI in relation to flood protection standards on the site and elsewhere.<br>It is anticipated that surface water can be safely disposed of to the Nancy Burn subject to Schedule 6 authorisation.<br>Runoff shall be limited to equivalent redevelopment rate and shall not affect flooding elsewhere.<br>The proposal complies with FLD3. |

# Appendix A

# Survey Information

## Notes

Coordinates to Irish Grid, levels to Ordnance Datum.

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title
SITE SURVEY OF LANDS AT STRABANE & LIFFORD.

client
DERRY CITY & STRABANE DISTRICT COUNCIL.

| scale | surveyed by |
|---|---|
| 1:500 SHEET=1:1000@A0 | IT |
| dwg no. 1171602 | drawn by IT |
| date 19 OCT 2016 | checked by IT |

*North West Land Survey*

Unit 3, The Vale Centre
Greysteel, BT47 3QE
Tel: 028 7181 2060
Email: ian@northwestlandsurvey.co.uk

# Appendix B

# Correspondence

Department for Infrastructure
An Roinn Bonneagair
www.infrastructure-ni.gov.uk

**Dfl Rivers Planning Advisory Unit**

44 Seagoe Industrial Estate
CRAIGAVON
Co. Armagh
BT63 5QE
Tel: 028 3839 9118

FAO Sarah Barrett
Derry City and Strabane District Council
Planning Department
98 Strand Road,
Derry
BT48 7NN

Your Ref: LA11/2020/0446/PAD
Our Ref: IN1-20-10413

Date: 12/08/2020

Dear Madam,

**Re: Riverine Community Park at Park Road, Strabane.**

Thank you for your consultation dated 22nd July 2020 regarding the above proposal. Dfl Rivers have assessed the application and our comments are as follows:-

**PPS15 Policy FLD 1 Development in Fluvial (River) and Coastal Flood Plains**
Flood Map (NI) indicates that the site lies within the 1 in 100 year fluvial flood plain which has a level of 4.83.

PPS 15, FLD 1, states that the Planning Authority will not permit development within flood plains unless it meets the 'Exceptions Test'. If the Planning Authority deems this to be an exception under FLD 1 Dfl Rivers would request that the applicant carries out a Flood Risk Assessment to demonstrate that all sources of flood risk to and from the proposed development have been identified; and there are adequate measures to manage and mitigate any increase in flood risk arising from the development. The Planning Authority should refer to PPS 15, Annex D, paragraph D7.

The planning authority should be aware that the Department for Infrastructure updated its Technical Flood Risk Guidance in relation to allowances for climate change in Northern Ireland on 25th February 2020.

The Flood Hazard Map (NI) shows the predicted 1 in 100 year climate change flood level to be 5.41.

INVESTORS IN PEOPLE

The Guidance and associated documentation can be accessed or downloaded via the Department for Infrastructure's web page as follows:- https://www.infrastructure-ni.gov.uk/publications/technical-flood-risk-guidance-relation-allowances-climate-change-northern-ireland

**PPS15 Policy FLD 2 Protection of Flood Defence and Drainage Infrastructure**
The site contains a number watercourses designated under the terms of the Drainage Order Northern Ireland 1973.

1. The River Foyle flows adjacent to the western boundary.
2. The Nancy Burn traverses the site at its northern section.
3. The Park Road Drain flows adjacent to the eastern boundary.

Under 6.32 of the policy a maintenance strip is required. The applicant should contact the local Dfl Rivers area staff to establish their needs. The maintenance strip should be level, marked up on all layout drawings and be protected from impediments (including tree planting permanent fencing and sheds), land raising or future unapproved development by way of a planning condition. Clear access and egress should be provided at all times

The site may be affected by undesignated watercourses of which we have no record, in the event of an undesignated watercourse being discovered, Policy FLD 2 will apply.

**PPS15 Policy FLD 3 Development and Surface Water (Pluvial) Flood Risk Outside Flood Plains**
PPS 15 FLD3 states that a drainage assessment will be required for all development proposals that exceed the following thresholds:

1. Residential development comprising 10 dwelling units or more.
2. A Development site in excess of 1 hectare.
3. New hard-surfacing exceeding 1000m$^2$.

As this application exceeds **point 2** of these thresholds, Dfl Rivers would require the submission of a drainage assessment as part of a new consultation for our consideration. The drainage assessment should be appropriate to the scale and nature of the proposed development and the risks involved.

**In carrying out the drainage assessment the applicant should acquire from the relevant authority evidence that the proposed storm water run-off from the site can be safely discharged. If the proposal is to discharge into a watercourse then an application should be made to the local Dfl Rivers office for consent to discharge storm water under Schedule 6 of the Drainage (NI) Order 1973.**

If it is proposed to discharge storm water into an NI Water system then a Pre-Development Enquiry should be made and if a simple solution cannot be identified then a Network Capacity Check should be carried out.

Correspondence with both authorities should be included in the drainage assessment regardless of the outcome.

Detailed guidance on the aims and content of a Drainage Assessment can be found in Planning Policy Statement (Planning and Flood Risk) – Annex D.

**PPS15 Policy FLD 4 Artificial Modification of Watercourses**
This policy may be applicable to this site. Under FLD 4 of Planning Policy Statement 15, artificial modification of a watercourse is normally not permitted unless it is necessary to provide access to a development site or for engineering reasons. This is a matter for the Planning Authority.

Any culverting approved by the Planning Authority will also be subject to approval from Dfl Rivers under Schedule 6 of the Drainage Order 1973. These two approvals do not go hand in hand.

**PPS15 Policy FLD 5 Development in Proximity to Reservoirs**
Not applicable based on the information provided.

**Under the terms of Schedule 6 of the Drainage (Northern Ireland) Order 1973 the applicant must submit to Dfl Rivers, for its consent for any proposal to carry out works which might affect a watercourse such as culverting, bridging, diversion, building adjacent to or discharge of storm water etc. Failure to obtain such consent prior to carrying out such proposals is an offence under the aforementioned Order which may lead to prosecution or statutory action as provided for.**

I trust you find the foregoing to be helpful but should you require any further information or clarification please contact me at the above address.

Please quote our reference number above on any future correspondence.

Yours faithfully,

**Trevor Mills**
**Planning Advisory and Modelling Unit**

**Infrastructure Planning**
Westland House
Old Westland Road
Belfast
BT41 6TE

Tel: 028 90354813 Ext 20646
www.niwater.com

Derry and Strabane
Local Plannning Office
Orchard House
40 Foyle Street
Londonderry
BT48 6AT

Your Ref:
LA11/2020/0446/PAD

Our Ref:

Date: 4 August 2020

Dear Sir / Madam.

**PLANNING CONSULTATION REFERENCE – LA11/2020/0446/PAD**

NI Water would advise as follows –

This proposed development would not have a significant impact on existing NI Water infrastructure. Consultation with NIW is required at an early design stage by means of a Pre-development Enquiry to determine how this proposal may be served.

Yours faithfully

**Alan Moore**
Infrastructure Planning

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# Appendix C

# Calculations

| | |
|---|---|
| **Project** | Riverine |
| **Ref** | M01959-02 |
| **Date** | 29/06/2021 |

**Purpose**

To estimate the indicative (1-hr) change in runoff rate on a site caused by the proposed development. Note that proposed / indicative runoff rates are outline only and rely on the routing equation within the Modified Rational and Wallingford methods; actual runoff rates may differ significantly dependant on the nature of the surface water drainage network proposed and should be determined using hydraulic modelling.

| **Existing Site** | A1 | A2 | A3 | A4 | **TOTAL** | |
|---|---|---|---|---|---|---|
| Roof | 0 | | | | 0 | $m^2$ |
| Bitmac / Paved / Hardstanding | 6676 | | | | 6676 | $m^2$ |
| | | | | | **6676** | $m^2$ |

| **Proposed Site** | A1 | A2 | A3 | A4 | **TOTAL** | |
|---|---|---|---|---|---|---|
| Roof | 0 | | | | 0 | $m^2$ |
| Bitmac / Paved / Hardstanding | 15869 | | | | 11127 | $m^2$ |
| | | | | | **11127** | $m^2$ |

**Site Details**

| | | | |
|---|---|---|---|
| **Total Site Area** | 7.80 | **Ha** | |
| **SAAR** | 987 | **mm** | From FEH3 |
| **SAAR4170** | 1193 | **mm** | From FEH3 |
| **UCWI** | 108 | **mm** | |
| **IOH124 region** | I | | from map -> |
| **SOIL** | 2 | | From WRAP maps |
| **SOIL** | 0.30 | | |
| **DEEPSTOR** | 0.77 | | |




**Modified Rational Method (MRM):**

| | ***Existing*** | | ***Proposed*** | | |
|---|---|---|---|---|---|
| **Length (m)** | 633 | **m** | 633 | **m** | From Site Maps |
| **Impermeable Area (ha)** | 0.668 | **Ha** | 1.113 | **Ha** | |
| **Max Height** | 3.1 | **mAOD** | 3.1 | **mAOD** | From Survey |
| **Min Height** | -2.2 | **mAOD** | -2.2 | **mAOD** | From Survey |
| **DeltaH** | 5.300 | | 5.300 | | |
| **Slope (%)** | 0.84 | | 0.84 | | |
| **Te (mins)** | 18.42 | | 18.42 | | |
| **ARF** | 0.990 | | 0.988 | | |

| | Existing Site | | Proposed Site | |
|---|---|---|---|---|
| **PIMP** | 100.000 | **%** | 100.000 | **%** |
| **Percentage Runoff PR** | 78.16 | **%** | 78.16 | **%** |
| **Cv** | 0.78 | | 0.78 | |
| **Cr** | 1.3 | | 1.3 | |

**Institute of Hydrology Report 124 (IoH 124) "Flood Estimation on Small Catchments" method**

| | ***Existing*** | | ***Proposed*** | |
|---|---|---|---|---|
| Remaining Greenfield Area | 7.13 | **Ha** | 6.69 | **Ha** |
| % Greenfield | 91.44 | **%** | 85.73 | **%** |

**Existing Site - Peak (1-hr) Runoff Rates**

| Return Period | Permeable Runoff (IOH124) (lps) | Impermeable Runoff (MRM) (lps) | Total Runoff (lps) |
|---|---|---|---|
| 1 in 2 year (1hr) | 23.0 | 19.5 | 42.5 |
| 1 in 30 year (1hr) | 39.9 | 57.5 | 97.3 |
| 1 in 100 year (1hr) | 47.4 | 79.4 | 126.9 |

**Proposed Site - Peak (1-hr) Runoff Rates**

| Return Period | Permeable Runoff (IOH124) (lps) | Impermeable Runoff (MRM) (lps) | Total Runoff (lps) |
|---|---|---|---|
| 1 in 2 year (1hr) | 21.6 | 32.5 | 54.0 |
| 1 in 30 year (1hr) | 37.4 | 95.8 | 133.2 |
| 1 in 100 year (1hr) | 44.5 | 132.4 | 176.9 |

**Summary - Peak (1-hr) Runoff Rates**

| Return Period | Existing Site (lps) | Proposed Site (lps) | *Increase (lps)* | Increase (%) |
|---|---|---|---|---|
| 1 in 2 year (1hr) | 42.5 | 54.0 | *11.6* | *27%* |
| 1 in 30 year (1hr) | 97.3 | 133.2 | *35.8* | *37%* |
| 1 in 100 year (1hr) | 126.9 | 176.9 | *50.0* | *39%* |

| By | Checked | Revision | Reason for Change | Date |
|---|---|---|---|---|
| TM | SK | 1 | | 29/06/2021 |
| VB | AMC | 2 | Revised layout from client | 25/08/2021 |
| | | | | |
| | | | | |

**CRM Stormflow** Stormwater Management Software

| | |
|---|---|
| **Client:** | |
| **Project:** | |
| **Location:** | Strabane |
| **Catchment:** | Strabane |

**Catchment Details:**

| | | | |
|---|---|---|---|
| Buildings | 0 | $m^2$ | x 95 % |
| Dense surfacing | 11127 | $m^2$ | x 90 % |
| Effective Area | 10014.3 | $m^2$ | |

**Storage Details:**

| | | |
|---|---|---|
| Length | 452 | m |
| Width | 1 | m |
| Depth | 1 | m |
| Porosity | 100 | % |
| Area Increase | 0 | % |

**Rainfall Details - FSR Method:**

| | | |
|---|---|---|
| Return Period | 100 | years |
| Climate Change Factor | 20 | % |
| r value | 0.3 | |
| M5-60 | 17 | mm |

| | mm | mm/h | storage ($m^3$) |
|---|---|---|---|
| 5 min | 10.1 | 146.0 | 118.527 |
| 10 min | 15.5 | 111.6 | 179.636 |
| 15 min | 19.2 | 92.0 | 220.286 |
| 30 min | 26.1 | 62.7 | 293.706 |
| 45 min | 30.2 | 48.4 | 333.178 |
| 60 min | 33.3 | 40.0 | 360.456 |
| 2 hours | 41.5 | 24.9 | 418.666 |
| 6 hours | 57.1 | 11.4 | 445.318 |
| 24 hours | 83.5 | 4.2 | 41.843 |

**Outflow Details:**

| | | |
|---|---|---|
| Infiltration rate | 0 | m/hr |
| Attenuation Control | Fixed Outflow | |
| Control Diameter | - | mm |
| Discharge rate | 11.13 | l/s |

**Results:**

| | |
|---|---|
| Outcome: | Pass |
| Critical Storm Duration | 4.5 hrs |
| Hmax | 1 m |
| Time to half empty | 5.6 hrs |

## Design Settings

| | | | |
|---|---|---|---|
| Rainfall Methodology | FSR | Maximum Time of Concentration (mins) | 30.00 |
| Return Period (years) | 2 | Maximum Rainfall (mm/hr) | 50.0 |
| Additional Flow (%) | 0 | Minimum Velocity (m/s) | 1.00 |
| FSR Region | Scotland and Ireland | Connection Type | Level Soffits |
| M5-60 (mm) | 17.000 | Minimum Backdrop Height (m) | 0.200 |
| Ratio-R | 0.300 | Preferred Cover Depth (m) | 1.200 |
| CV | 0.750 | Include Intermediate Ground | ✓ |
| Time of Entry (mins) | 5.00 | Enforce best practice design rules | ✓ |

## Links (Input)

| Name | US Node | DS Node | Length (m) | ks (mm) / n | US IL (m) | DS IL (m) | Fall (m) | Slope (1:X) | Dia (mm) | T of C (mins) | Rain (mm/hr) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 1 | 2 | 280.000 | 0.032 | 5.400 | 3.000 | 2.400 | 116.7 | 1000 | 8.60 | 42.5 |
| 1.001 | 2 | 3 | 20.926 | 0.032 | 3.000 | 2.940 | 0.060 | 348.8 | 375 | 9.61 | 40.3 |
| 1.002 | 3 | 4 | 135.140 | 0.032 | 2.940 | 2.490 | 0.450 | 300.3 | 1000 | 12.39 | 35.4 |
| 1.003 | 4 | 5 | 26.700 | 0.032 | 2.490 | 2.400 | 0.090 | 296.7 | 375 | 13.58 | 33.8 |

## Simulation Settings

| | | | |
|---|---|---|---|
| Rainfall Methodology | FSR | Drain Down Time (mins) | 240 |
| FSR Region | Scotland and Ireland | Additional Storage (m³/ha) | 20.0 |
| M5-60 (mm) | 17.000 | Check Discharge Rate(s) | ✓ |
| Ratio-R | 0.300 | 1 year (l/s) | 4.0 |
| Summer CV | 0.750 | 30 year (l/s) | 4.0 |
| Winter CV | 0.840 | 100 year (l/s) | 4.0 |
| Analysis Speed | Normal | Check Discharge Volume | x |
| Skip Steady State | ✓ | | |

### Storm Durations

| 15 | 30 | 60 | 120 | 180 | 240 | 360 | 480 | 600 | 720 | 960 | 1440 |
|---|---|---|---|---|---|---|---|---|---|---|---|

| Return Period (years) | Climate Change (CC %) | Additional Area (A %) | Additional Flow (Q %) |
|---|---|---|---|
| 1 | 20 | 10 | 0 |
| 30 | 20 | 10 | 0 |
| 100 | 20 | 10 | 0 |

## Pre-development Discharge Rate

| | | | |
|---|---|---|---|
| Site Makeup | Greenfield | Growth Factor 30 years | 1.95 |
| Greenfield Method | IH124 | Growth Factor 100 years | 2.48 |
| Positively Drained Area (ha) | 1.440 | Betterment (%) | 0 |
| SAAR (mm) | 1193 | QBar | 4.9 |
| Soil Index | 2 | Q 1 year (l/s) | 4.2 |
| SPR | 0.30 | Q 30 year (l/s) | 9.6 |
| Region | 1 | Q 100 year (l/s) | 12.1 |
| Growth Factor 1 year | 0.85 | | |

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## Node 5 Online Hydro-Brake® Control

| | | | |
|---|---|---|---|
| Flap Valve | x | Objective | (HE) Minimise upstream storage |
| Replaces Downstream Link | ✓ | Sump Available | ✓ |
| Invert Level (m) | 2.400 | Product Number | CTL-SHE-0084-4200-2000-4200 |
| Design Depth (m) | 2.000 | Min Outlet Diameter (m) | 0.100 |
| Design Flow (l/s) | 4.2 | Min Node Diameter (mm) | 1200 |

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**Results for 1 year +20% CC +10% A Critical Storm Duration. Lowest mass balance: 98.15%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | 1 | 1 | 5.400 | 0.000 | 0.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 1.000:50% | 13 | 4.266 | 0.066 | 39.9 | 0.0000 | 0.0000 | OK |
| 60 minute winter | 2 | 48 | 3.167 | 0.167 | 19.9 | 0.0000 | 0.0000 | OK |
| 60 minute winter | 3 | 51 | 2.984 | 0.044 | 10.5 | 0.0000 | 0.0000 | OK |
| 360 minute winter | 1.002:50% | 304 | 2.884 | 0.169 | 11.0 | 0.0000 | 0.0000 | OK |
| 360 minute winter | 4 | 304 | 2.884 | 0.394 | 10.1 | 0.0000 | 0.0000 | SURCHARGED |
| 360 minute winter | 5 | 304 | 2.883 | 0.483 | 3.8 | 0.6918 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | 1 | 1.000 | 1.000:50% | 0.0 | 0.000 | 0.000 | 5.2778 | |
| 15 minute summer | 1 | 1.000 | 2 | 27.8 | 0.397 | 0.017 | 13.1868 | |
| 60 minute winter | 2 | 1.001 | 3 | 10.5 | 0.415 | 0.275 | 0.5702 | |
| 60 minute winter | 3 | 1.002 | 1.002:50% | 10.4 | 0.188 | 0.010 | 5.2094 | |
| 60 minute winter | 3 | 1.002 | 4 | 15.5 | 0.142 | 0.015 | 25.7641 | |
| 360 minute winter | 4 | 1.003 | 5 | 3.8 | 0.155 | 0.091 | 2.9449 | |
| 360 minute winter | 5 | Hydro-Brake® | | 3.3 | | | | 98.0 |

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**Results for 30 year +20% CC +10% A Critical Storm Duration. Lowest mass balance: 98.15%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | 1 | 1 | 5.400 | 0.000 | 0.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 1.000:50% | 12 | 4.307 | 0.107 | 88.5 | 0.0000 | 0.0000 | OK |
| 60 minute winter | 2 | 44 | 3.257 | 0.257 | 44.6 | 0.0000 | 0.0000 | OK |
| 480 minute winter | 3 | 464 | 3.137 | 0.197 | 12.8 | 0.0000 | 0.0000 | OK |
| 480 minute winter | 1.002:50% | 464 | 3.137 | 0.422 | 19.1 | 0.0000 | 0.0000 | OK |
| 480 minute winter | 4 | 464 | 3.137 | 0.647 | 10.6 | 0.0000 | 0.0000 | SURCHARGED |
| 480 minute winter | 5 | 464 | 3.136 | 0.736 | 3.8 | 1.0538 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | 1 | 1.000 | 1.000:50% | 0.0 | 0.000 | 0.000 | 9.5502 | |
| 15 minute summer | 1 | 1.000 | 2 | 69.8 | 0.538 | 0.043 | 27.8620 | |
| 60 minute winter | 2 | 1.001 | 3 | 29.8 | 0.623 | 0.783 | 1.0215 | |
| 480 minute winter | 3 | 1.002 | 1.002:50% | 11.3 | 0.134 | 0.011 | 42.8634 | |
| 480 minute winter | 3 | 1.002 | 4 | 10.6 | 0.085 | 0.011 | 96.5501 | |
| 480 minute winter | 4 | 1.003 | 5 | 3.8 | 0.153 | 0.091 | 2.9449 | |
| 480 minute winter | 5 | Hydro-Brake® | | 3.3 | | | | 112.8 |

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**Results for 100 year +20% CC +10% A Critical Storm Duration. Lowest mass balance: 98.15%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | 1 | 1 | 5.400 | 0.000 | 0.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 1.000:50% | 11 | 4.322 | 0.122 | 115.0 | 0.0000 | 0.0000 | OK |
| 60 minute winter | 2 | 43 | 3.296 | 0.296 | 58.5 | 0.0000 | 0.0000 | OK |
| 480 minute winter | 3 | 472 | 3.225 | 0.285 | 16.8 | 0.0000 | 0.0000 | OK |
| 480 minute winter | 1.002:50% | 472 | 3.225 | 0.510 | 23.4 | 0.0000 | 0.0000 | SURCHARGED |
| 480 minute winter | 4 | 472 | 3.225 | 0.735 | 11.5 | 0.0000 | 0.0000 | SURCHARGED |
| 480 minute winter | 5 | 472 | 3.224 | 0.824 | 3.7 | 1.1796 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | 1 | 1.000 | 1.000:50% | 0.0 | 0.000 | 0.000 | 11.3671 | |
| 15 minute summer | 1 | 1.000 | 2 | 96.2 | 0.569 | 0.059 | 34.6185 | |
| 60 minute winter | 2 | 1.001 | 3 | 40.4 | 0.695 | 1.058 | 1.2071 | |
| 480 minute winter | 3 | 1.002 | 1.002:50% | 13.2 | 0.133 | 0.013 | 61.4104 | |
| 480 minute winter | 3 | 1.002 | 4 | 11.5 | 0.097 | 0.011 | 123.1225 | |
| 480 minute winter | 4 | 1.003 | 5 | 3.7 | 0.153 | 0.090 | 2.9449 | |
| 480 minute winter | 5 | Hydro-Brake® | | 3.3 | | | | 113.0 |

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## Design Settings

| | | | |
|---|---|---|---|
| Rainfall Methodology | FSR | Maximum Time of Concentration (mins) | 30.00 |
| Return Period (years) | 2 | Maximum Rainfall (mm/hr) | 50.0 |
| Additional Flow (%) | 0 | Minimum Velocity (m/s) | 1.00 |
| FSR Region | Scotland and Ireland | Connection Type | Level Soffits |
| M5-60 (mm) | 17.000 | Minimum Backdrop Height (m) | 0.200 |
| Ratio-R | 0.300 | Preferred Cover Depth (m) | 1.200 |
| CV | 0.750 | Include Intermediate Ground | ✓ |
| Time of Entry (mins) | 5.00 | Enforce best practice design rules | ✓ |

## Links (Input)

| Name | US Node | DS Node | Length (m) | ks (mm) / n | US IL (m) | DS IL (m) | Fall (m) | Slope (1:X) | Dia (mm) | T of C (mins) | Rain (mm/hr) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 1 | 2 | 128.835 | 0.032 | 3.000 | 2.570 | 0.430 | 299.6 | 1000 | 7.65 | 44.8 |
| 1.001 | 2 | 3 | 21.354 | 0.032 | 2.570 | 2.500 | 0.070 | 305.1 | 1000 | 8.10 | 43.6 |
| 1.002 | 3 | 4 | 19.525 | 0.032 | 2.500 | 2.430 | 0.070 | 278.9 | 1000 | 8.48 | 42.7 |
| 1.003 | 4 | 5 | 50.000 | 0.032 | 2.430 | 2.260 | 0.170 | 294.1 | 1000 | 9.50 | 40.5 |
| 2.000 | 6 | 7 | 30.975 | 0.032 | 3.200 | 3.090 | 0.110 | 281.6 | 1000 | 5.62 | 50.0 |
| 2.001 | 7 | 8 | 3.000 | 0.032 | 3.090 | 3.080 | 0.010 | 300.0 | 300 | 5.77 | 50.0 |
| 2.002 | 8 | 9 | 19.205 | 0.032 | 3.080 | 3.000 | 0.080 | 240.1 | 1000 | 6.13 | 49.3 |
| 2.003 | 9 | 2 | 9.938 | 0.032 | 2.700 | 2.570 | 0.130 | 76.4 | 300 | 6.39 | 48.4 |
| 3.000 | 10 | 11 | 26.910 | 0.032 | 3.200 | 3.100 | 0.100 | 269.1 | 1000 | 5.52 | 50.0 |
| 3.001 | 11 | 3 | 7.500 | 0.032 | 2.700 | 2.500 | 0.200 | 37.5 | 225 | 5.69 | 50.0 |
| 4.000 | 12 | 13 | 36.599 | 0.032 | 3.100 | 2.980 | 0.120 | 305.0 | 1000 | 5.76 | 50.0 |
| 4.001 | 13 | 14 | 3.141 | 0.032 | 2.980 | 2.970 | 0.010 | 314.1 | 300 | 5.93 | 50.0 |
| 4.002 | 14 | 15 | 26.910 | 0.032 | 2.970 | 2.880 | 0.090 | 299.0 | 1000 | 6.48 | 48.2 |
| 4.003 | 15 | 4 | 6.933 | 0.032 | 2.500 | 2.430 | 0.070 | 99.0 | 300 | 6.69 | 47.5 |
| 5.000 | 17 | 18 | 42.440 | 0.032 | 2.900 | 2.760 | 0.140 | 303.1 | 1000 | 5.88 | 50.0 |
| 5.001 | 18 | 19 | 10.600 | 0.032 | 2.760 | 2.720 | 0.040 | 265.0 | 150 | 6.70 | 47.5 |
| 5.002 | 19 | 20 | 29.876 | 0.032 | 2.720 | 2.620 | 0.100 | 298.8 | 1000 | 7.31 | 45.7 |
| 5.003 | 20 | 16 | 9.000 | 0.032 | 2.620 | 2.488 | 0.132 | 68.2 | 150 | 7.67 | 44.7 |
| 1.004 | 5 | 22 | 10.163 | 0.032 | 2.260 | 2.220 | 0.040 | 254.1 | 450 | 9.87 | 39.7 |
| 1.005 | 22 | 23 | 29.550 | 0.032 | 2.220 | 2.120 | 0.100 | 295.5 | 1000 | 10.48 | 38.6 |
| 1.006 | 23 | 24 | 12.143 | 0.032 | 2.120 | 2.070 | 0.050 | 242.9 | 450 | 10.91 | 37.8 |

## Simulation Settings

| | | | |
|---|---|---|---|
| Rainfall Methodology | FSR | Analysis Speed | Normal |
| FSR Region | Scotland and Ireland | Skip Steady State | ✓ |
| M5-60 (mm) | 17.000 | Drain Down Time (mins) | 240 |
| Ratio-R | 0.300 | Additional Storage (m³/ha) | 20.0 |
| Summer CV | 0.750 | Check Discharge Rate(s) | x |
| Winter CV | 0.840 | Check Discharge Volume | x |

### Storm Durations

| 15 | 30 | 60 | 120 | 180 | 240 | 360 | 480 | 600 | 720 | 960 | 1440 |
|---|---|---|---|---|---|---|---|---|---|---|---|

| Return Period (years) | Climate Change (CC %) | Additional Area (A %) | Additional Flow (Q %) |
|---|---|---|---|
| 1 | 20 | 10 | 0 |
| 30 | 20 | 10 | 0 |
| 100 | 20 | 10 | 0 |

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## Node 5 Online Hydro-Brake® Control

| | | | |
|---|---|---|---|
| Flap Valve | ✓ | Objective | (HE) Minimise upstream storage |
| Replaces Downstream Link | ✓ | Sump Available | ✓ |
| Invert Level (m) | 2.260 | Product Number | CTL-SHE-0123-6900-1000-6900 |
| Design Depth (m) | 1.000 | Min Outlet Diameter (m) | 0.150 |
| Design Flow (l/s) | 6.9 | Min Node Diameter (mm) | 1200 |

## Node 24 Online Hydro-Brake® Control

| | | | |
|---|---|---|---|
| Flap Valve | x | Objective | (HE) Minimise upstream storage |
| Replaces Downstream Link | ✓ | Sump Available | ✓ |
| Invert Level (m) | 2.070 | Product Number | CTL-SHE-0123-6900-1000-6900 |
| Design Depth (m) | 1.000 | Min Outlet Diameter (m) | 0.150 |
| Design Flow (l/s) | 6.9 | Min Node Diameter (mm) | 1200 |

## Node 5 Depth/Area Storage Structure

| | | | | | |
|---|---|---|---|---|---|
| Base Inf Coefficient (m/hr) | 0.00000 | Safety Factor | 2.0 | Invert Level (m) | 2.260 |
| Side Inf Coefficient (m/hr) | 0.00000 | Porosity | 1.00 | Time to half empty (mins) | 0 |

| Depth (m) | Area (m²) | Inf Area (m²) | Depth (m) | Area (m²) | Inf Area (m²) |
|---|---|---|---|---|---|
| 0.000 | 756.0 | 0.0 | 0.500 | 983.0 | 0.0 |

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**Results for 1 year +20% CC +10% A Critical Storm Duration. Lowest mass balance: 99.85%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | 1 | 1 | 3.000 | 0.000 | 0.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 1.000:50% | 13 | 2.822 | 0.037 | 12.1 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 2 | 14 | 2.654 | 0.084 | 34.5 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 1.001:50% | 14 | 2.623 | 0.088 | 32.2 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 3 | 14 | 2.598 | 0.098 | 43.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 1.002:50% | 14 | 2.570 | 0.105 | 43.4 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 4 | 14 | 2.550 | 0.120 | 60.8 | 0.0000 | 0.0000 | OK |
| 30 minute winter | 1.003:50% | 24 | 2.486 | 0.141 | 62.0 | 0.0000 | 0.0000 | OK |
| 480 minute winter | 5 | 352 | 2.384 | 0.124 | 14.3 | 96.9678 | 0.0000 | OK |
| 15 minute winter | 6 | 12 | 3.223 | 0.023 | 1.8 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 2.000:50% | 12 | 3.223 | 0.078 | 22.3 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 7 | 12 | 3.215 | 0.125 | 18.9 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 8 | 12 | 3.139 | 0.059 | 18.4 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 2.002:50% | 12 | 3.120 | 0.080 | 27.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 9 | 12 | 2.862 | 0.162 | 26.7 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 10 | 11 | 3.212 | 0.012 | 0.9 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 3.000:50% | 11 | 3.212 | 0.062 | 15.1 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 11 | 11 | 2.808 | 0.108 | 13.6 | 0.0000 | 0.0000 | OK |
| 15 minute summer | 12 | 1 | 3.100 | 0.000 | 0.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 4.000:50% | 12 | 3.095 | 0.055 | 14.9 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 13 | 12 | 3.086 | 0.106 | 13.1 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 14 | 12 | 3.019 | 0.049 | 12.4 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 4.002:50% | 12 | 3.000 | 0.075 | 20.6 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 15 | 12 | 2.650 | 0.150 | 19.4 | 0.0000 | 0.0000 | OK |
| 120 minute winter | 16 | 92 | 2.507 | 0.019 | 0.5 | 0.0000 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | 1 | 1.000 | 1.000:50% | 0.0 | 0.000 | 0.000 | 1.2678 | |
| 15 minute summer | 1 | 1.000 | 2 | 7.2 | 0.132 | 0.007 | 4.4082 | |
| 15 minute winter | 2 | 1.001 | 1.001:50% | 31.0 | 0.289 | 0.031 | 1.1502 | |
| 15 minute winter | 2 | 1.001 | 3 | 32.3 | 0.272 | 0.032 | 1.2701 | |
| 15 minute winter | 3 | 1.002 | 1.002:50% | 42.4 | 0.325 | 0.040 | 1.2914 | |
| 15 minute winter | 3 | 1.002 | 4 | 43.3 | 0.289 | 0.041 | 1.4651 | |
| 15 minute winter | 4 | 1.003 | 1.003:50% | 60.5 | 0.373 | 0.059 | 4.1497 | |
| 15 minute winter | 4 | 1.003 | 5 | 63.8 | 0.829 | 0.062 | 2.7711 | |
| 480 minute winter | 5 | Hydro-Brake® | 22 | 5.6 | | | | |
| 15 minute winter | 6 | 2.000 | 2.000:50% | -1.8 | -0.045 | -0.002 | 0.9326 | |
| 15 minute winter | 6 | 2.000 | 7 | 18.9 | 0.154 | 0.018 | 2.0768 | |
| 15 minute winter | 7 | 2.001 | 8 | 18.4 | 1.002 | 0.812 | 0.0565 | |
| 15 minute winter | 8 | 2.002 | 2.002:50% | 18.4 | 0.219 | 0.016 | 0.8132 | |
| 15 minute winter | 8 | 2.002 | 9 | 26.7 | 0.376 | 0.024 | 0.6935 | |
| 15 minute winter | 9 | 2.003 | 2 | 26.8 | 1.083 | 0.596 | 0.2644 | |
| 15 minute winter | 10 | 3.000 | 3.000:50% | -0.9 | -0.030 | -0.001 | 0.5749 | |
| 15 minute winter | 10 | 3.000 | 11 | 13.6 | 0.274 | 0.013 | 0.6795 | |
| 15 minute winter | 11 | 3.001 | 3 | 13.5 | 0.945 | 0.454 | 0.1262 | |
| 15 minute summer | 12 | 4.000 | 4.000:50% | 0.0 | 0.000 | 0.000 | 0.5645 | |
| 15 minute summer | 12 | 4.000 | 13 | 12.7 | 0.147 | 0.013 | 1.8147 | |
| 15 minute winter | 13 | 4.001 | 14 | 12.4 | 0.862 | 0.561 | 0.0468 | |
| 15 minute winter | 14 | 4.002 | 4.002:50% | 12.3 | 0.168 | 0.012 | 0.9942 | |
| 15 minute winter | 14 | 4.002 | 15 | 19.4 | 0.310 | 0.019 | 0.8593 | |
| 15 minute winter | 15 | 4.003 | 4 | 19.2 | 0.695 | 0.486 | 0.2084 | |

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**Results for 1 year +20% CC +10% A Critical Storm Duration. Lowest mass balance: 99.85%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | 17 | 1 | 2.900 | 0.000 | 0.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 5.000:50% | 11 | 2.847 | 0.017 | 2.1 | 0.0000 | 0.0000 | OK |
| 60 minute winter | 18 | 44 | 2.821 | 0.061 | 1.1 | 0.0000 | 0.0000 | OK |
| 30 minute winter | 19 | 28 | 2.730 | 0.010 | 0.6 | 0.0000 | 0.0000 | OK |
| 120 minute winter | 20 | 92 | 2.650 | 0.030 | 0.6 | 0.0000 | 0.0000 | OK |
| 480 minute winter | 22 | 352 | 2.251 | 0.031 | 5.6 | 0.0000 | 0.0000 | OK |
| 480 minute winter | 1.005:50% | 336 | 2.220 | 0.050 | 6.0 | 0.0000 | 0.0000 | OK |
| 480 minute winter | 23 | 336 | 2.218 | 0.098 | 6.0 | 0.0000 | 0.0000 | OK |
| 480 minute winter | 24 | 336 | 2.203 | 0.133 | 6.0 | 0.1905 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | 17 | 5.000 | 5.000:50% | 0.0 | 0.000 | 0.000 | 0.1797 | |
| 15 minute summer | 17 | 5.000 | 18 | 1.8 | 0.107 | 0.002 | 0.6286 | |
| 60 minute winter | 18 | 5.001 | 19 | 0.7 | 0.209 | 0.172 | 0.0381 | |
| 30 minute winter | 19 | 5.002 | 20 | 0.7 | 0.076 | 0.001 | 0.4878 | |
| 120 minute winter | 20 | 5.003 | 16 | 0.5 | 0.255 | 0.064 | 0.0172 | 1.9 |
| 480 minute winter | 22 | 1.005 | 1.005:50% | 5.6 | 0.144 | 0.005 | 0.6722 | |
| 480 minute winter | 22 | 1.005 | 23 | 6.0 | 0.075 | 0.006 | 1.3612 | |
| 480 minute winter | 23 | 1.006 | 24 | 6.0 | 0.204 | 0.081 | 0.3916 | |
| 480 minute winter | 24 | Hydro-Brake® | | 6.0 | | | | 132.9 |

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**Results for 30 year +20% CC +10% A Critical Storm Duration. Lowest mass balance: 99.85%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | 1 | 1 | 3.000 | 0.000 | 0.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 1.000:50% | 12 | 2.849 | 0.064 | 26.8 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 2 | 13 | 2.711 | 0.141 | 80.9 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 1.001:50% | 13 | 2.686 | 0.151 | 78.5 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 3 | 13 | 2.666 | 0.166 | 103.9 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 1.002:50% | 13 | 2.641 | 0.176 | 106.9 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 4 | 13 | 2.623 | 0.193 | 147.9 | 0.0000 | 0.0000 | OK |
| 30 minute winter | 1.003:50% | 23 | 2.541 | 0.196 | 144.1 | 0.0000 | 0.0000 | OK |
| 480 minute winter | 5 | 384 | 2.512 | 0.252 | 27.9 | 205.0621 | 0.0000 | OK |
| 15 minute winter | 6 | 12 | 3.281 | 0.081 | 4.6 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 2.000:50% | 12 | 3.281 | 0.136 | 49.6 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 7 | 12 | 3.275 | 0.185 | 42.6 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 8 | 12 | 3.177 | 0.097 | 41.5 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 2.002:50% | 12 | 3.156 | 0.116 | 61.5 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 9 | 12 | 3.031 | 0.331 | 60.5 | 0.0000 | 0.0000 | SURCHARGED |
| 15 minute winter | 10 | 11 | 3.244 | 0.044 | 2.3 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 3.000:50% | 11 | 3.244 | 0.094 | 33.7 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 11 | 11 | 2.899 | 0.199 | 31.5 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 12 | 12 | 3.140 | 0.040 | 3.2 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 4.000:50% | 12 | 3.140 | 0.100 | 33.1 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 13 | 12 | 3.131 | 0.151 | 27.3 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 14 | 12 | 3.053 | 0.083 | 26.5 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 4.002:50% | 12 | 3.036 | 0.111 | 44.7 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 15 | 12 | 2.745 | 0.245 | 43.8 | 0.0000 | 0.0000 | OK |
| 60 minute winter | 16 | 52 | 2.521 | 0.033 | 1.3 | 0.0000 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | 1 | 1.000 | 1.000:50% | 0.0 | 0.000 | 0.000 | 2.3554 | |
| 15 minute summer | 1 | 1.000 | 2 | 18.5 | 0.154 | 0.018 | 8.4144 | |
| 15 minute winter | 2 | 1.001 | 1.001:50% | 74.8 | 0.356 | 0.075 | 2.2442 | |
| 15 minute winter | 2 | 1.001 | 3 | 78.0 | 0.337 | 0.078 | 2.4951 | |
| 15 minute winter | 3 | 1.002 | 1.002:50% | 103.6 | 0.400 | 0.099 | 2.5288 | |
| 15 minute winter | 3 | 1.002 | 4 | 106.2 | 0.370 | 0.101 | 2.8025 | |
| 15 minute winter | 4 | 1.003 | 1.003:50% | 146.2 | 0.504 | 0.143 | 7.2543 | |
| 15 minute winter | 4 | 1.003 | 5 | 152.7 | 1.073 | 0.149 | 4.6561 | |
| 480 minute winter | 5 | Hydro-Brake® | 22 | 6.5 | | | | |
| 15 minute winter | 6 | 2.000 | 2.000:50% | -4.6 | -0.066 | -0.004 | 2.2715 | |
| 15 minute winter | 6 | 2.000 | 7 | 42.6 | 0.186 | 0.041 | 3.7091 | |
| 15 minute winter | 7 | 2.001 | 8 | 41.5 | 1.278 | 1.832 | 0.0979 | |
| 15 minute winter | 8 | 2.002 | 2.002:50% | 41.7 | 0.297 | 0.037 | 1.3517 | |
| 15 minute winter | 8 | 2.002 | 9 | 60.5 | 0.520 | 0.054 | 1.1349 | |
| 15 minute winter | 9 | 2.003 | 2 | 61.0 | 1.241 | 1.357 | 0.5120 | |
| 15 minute winter | 10 | 3.000 | 3.000:50% | -2.3 | -0.050 | -0.002 | 1.1438 | |
| 15 minute winter | 10 | 3.000 | 11 | 31.5 | 0.377 | 0.030 | 1.1484 | |
| 15 minute winter | 11 | 3.001 | 3 | 31.3 | 1.054 | 1.051 | 0.2478 | |
| 15 minute winter | 12 | 4.000 | 4.000:50% | -3.2 | -0.061 | -0.003 | 1.6010 | |
| 15 minute winter | 12 | 4.000 | 13 | 27.3 | 0.172 | 0.027 | 3.1998 | |
| 15 minute winter | 13 | 4.001 | 14 | 26.5 | 1.038 | 1.194 | 0.0809 | |
| 15 minute winter | 14 | 4.002 | 4.002:50% | 26.4 | 0.215 | 0.026 | 1.6948 | |
| 15 minute winter | 14 | 4.002 | 15 | 43.8 | 0.423 | 0.043 | 1.4258 | |
| 15 minute winter | 15 | 4.003 | 4 | 43.8 | 0.836 | 1.109 | 0.3740 | |

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**Results for 30 year +20% CC +10% A Critical Storm Duration. Lowest mass balance: 99.85%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | 17 | 1 | 2.900 | 0.000 | 0.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 5.000:50% | 11 | 2.856 | 0.026 | 4.6 | 0.0000 | 0.0000 | OK |
| 30 minute winter | 18 | 23 | 2.853 | 0.093 | 3.5 | 0.0000 | 0.0000 | OK |
| 30 minute winter | 19 | 23 | 2.737 | 0.017 | 1.7 | 0.0000 | 0.0000 | OK |
| 60 minute winter | 20 | 52 | 2.669 | 0.049 | 1.6 | 0.0000 | 0.0000 | OK |
| 480 minute winter | 22 | 368 | 2.356 | 0.136 | 6.5 | 0.0000 | 0.0000 | OK |
| 480 minute winter | 1.005:50% | 368 | 2.356 | 0.186 | 8.0 | 0.0000 | 0.0000 | OK |
| 480 minute winter | 23 | 368 | 2.356 | 0.236 | 7.3 | 0.0000 | 0.0000 | OK |
| 480 minute winter | 24 | 368 | 2.355 | 0.285 | 6.9 | 0.4081 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | 17 | 5.000 | 5.000:50% | 0.0 | 0.000 | 0.000 | 0.2886 | |
| 15 minute summer | 17 | 5.000 | 18 | 4.0 | 0.130 | 0.004 | 1.2791 | |
| 30 minute winter | 18 | 5.001 | 19 | 1.7 | 0.293 | 0.452 | 0.0666 | |
| 30 minute winter | 19 | 5.002 | 20 | 2.0 | 0.112 | 0.002 | 0.9679 | |
| 60 minute winter | 20 | 5.003 | 16 | 1.3 | 0.348 | 0.179 | 0.0350 | 3.5 |
| 480 minute winter | 22 | 1.005 | 1.005:50% | 6.5 | 0.118 | 0.006 | 3.5657 | |
| 480 minute winter | 22 | 1.005 | 23 | 7.3 | 0.076 | 0.007 | 5.1270 | |
| 480 minute winter | 23 | 1.006 | 24 | 6.9 | 0.205 | 0.093 | 1.1546 | |
| 480 minute winter | 24 | Hydro-Brake® | | 6.9 | | | | 225.4 |

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**Results for 100 year +20% CC +10% A Critical Storm Duration. Lowest mass balance: 99.85%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | 1 | 1 | 3.000 | 0.000 | 0.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 1.000:50% | 12 | 2.861 | 0.076 | 34.9 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 2 | 14 | 2.735 | 0.165 | 100.8 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 1.001:50% | 13 | 2.711 | 0.176 | 101.1 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 3 | 13 | 2.692 | 0.192 | 134.1 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 1.002:50% | 13 | 2.669 | 0.204 | 138.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 4 | 13 | 2.651 | 0.221 | 191.6 | 0.0000 | 0.0000 | OK |
| 600 minute winter | 1.003:50% | 495 | 2.582 | 0.237 | 30.4 | 0.0000 | 0.0000 | OK |
| 600 minute winter | 5 | 495 | 2.582 | 0.322 | 29.3 | 266.8007 | 0.0000 | OK |
| 15 minute winter | 6 | 12 | 3.308 | 0.108 | 5.3 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 2.000:50% | 12 | 3.308 | 0.163 | 64.4 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 7 | 12 | 3.302 | 0.212 | 55.4 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 8 | 12 | 3.197 | 0.117 | 53.6 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 2.002:50% | 12 | 3.180 | 0.140 | 79.7 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 9 | 12 | 3.160 | 0.460 | 76.6 | 0.0000 | 0.0000 | SURCHARGED |
| 15 minute winter | 10 | 11 | 3.256 | 0.056 | 2.6 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 3.000:50% | 11 | 3.256 | 0.106 | 43.7 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 11 | 11 | 3.037 | 0.337 | 41.7 | 0.0000 | 0.0000 | SURCHARGED |
| 15 minute winter | 12 | 12 | 3.161 | 0.061 | 4.5 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 4.000:50% | 12 | 3.160 | 0.120 | 43.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 13 | 12 | 3.152 | 0.172 | 35.3 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 14 | 12 | 3.068 | 0.098 | 34.5 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 4.002:50% | 12 | 3.050 | 0.125 | 58.5 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 15 | 12 | 2.803 | 0.303 | 57.4 | 0.0000 | 0.0000 | SURCHARGED |
| 60 minute winter | 16 | 50 | 2.525 | 0.037 | 1.8 | 0.0000 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | 1 | 1.000 | 1.000:50% | 0.0 | 0.000 | 0.000 | 2.8768 | |
| 15 minute summer | 1 | 1.000 | 2 | 25.0 | 0.170 | 0.025 | 10.3577 | |
| 15 minute winter | 2 | 1.001 | 1.001:50% | 97.7 | 0.381 | 0.097 | 2.7479 | |
| 15 minute winter | 2 | 1.001 | 3 | 102.4 | 0.365 | 0.102 | 3.0521 | |
| 15 minute winter | 3 | 1.002 | 1.002:50% | 133.8 | 0.424 | 0.128 | 3.0843 | |
| 15 minute winter | 3 | 1.002 | 4 | 137.5 | 0.396 | 0.131 | 3.3972 | |
| 15 minute winter | 4 | 1.003 | 1.003:50% | 190.9 | 0.550 | 0.187 | 8.6828 | |
| 15 minute winter | 4 | 1.003 | 5 | 199.6 | 1.180 | 0.195 | 5.7288 | |
| 600 minute winter | 5 | Hydro-Brake® | 22 | 6.4 | | | | |
| 15 minute winter | 6 | 2.000 | 2.000:50% | -5.3 | -0.075 | -0.005 | 2.9931 | |
| 15 minute winter | 6 | 2.000 | 7 | 55.4 | 0.200 | 0.053 | 4.5721 | |
| 15 minute winter | 7 | 2.001 | 8 | 53.6 | 1.373 | 2.362 | 0.1180 | |
| 15 minute winter | 8 | 2.002 | 2.002:50% | 53.2 | 0.310 | 0.047 | 1.7104 | |
| 15 minute winter | 8 | 2.002 | 9 | 76.6 | 0.539 | 0.068 | 2.0926 | |
| 15 minute winter | 9 | 2.003 | 2 | 74.1 | 1.278 | 1.649 | 0.5467 | |
| 15 minute winter | 10 | 3.000 | 3.000:50% | -2.6 | -0.055 | -0.002 | 1.3849 | |
| 15 minute winter | 10 | 3.000 | 11 | 41.7 | 0.422 | 0.039 | 1.3572 | |
| 15 minute winter | 11 | 3.001 | 3 | 41.4 | 1.089 | 1.388 | 0.2844 | |
| 15 minute winter | 12 | 4.000 | 4.000:50% | -4.5 | -0.068 | -0.005 | 2.1563 | |
| 15 minute winter | 12 | 4.000 | 13 | 35.3 | 0.189 | 0.035 | 3.8902 | |
| 15 minute winter | 13 | 4.001 | 14 | 34.5 | 1.122 | 1.555 | 0.0969 | |
| 15 minute winter | 14 | 4.002 | 4.002:50% | 34.5 | 0.238 | 0.034 | 2.0024 | |
| 15 minute winter | 14 | 4.002 | 15 | 57.4 | 0.471 | 0.057 | 1.6754 | |
| 15 minute winter | 15 | 4.003 | 4 | 57.5 | 0.899 | 1.456 | 0.4348 | |

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**Results for 100 year +20% CC +10% A Critical Storm Duration. Lowest mass balance: 99.85%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | 17 | 1 | 2.900 | 0.000 | 0.0 | 0.0000 | 0.0000 | OK |
| 30 minute winter | 5.000:50% | 23 | 2.865 | 0.035 | 4.8 | 0.0000 | 0.0000 | OK |
| 30 minute winter | 18 | 23 | 2.864 | 0.104 | 4.5 | 0.0000 | 0.0000 | OK |
| 30 minute winter | 19 | 22 | 2.739 | 0.019 | 2.2 | 0.0000 | 0.0000 | OK |
| 60 minute winter | 20 | 50 | 2.676 | 0.056 | 2.0 | 0.0000 | 0.0000 | OK |
| 600 minute winter | 22 | 480 | 2.424 | 0.204 | 6.4 | 0.0000 | 0.0000 | OK |
| 600 minute winter | 1.005:50% | 480 | 2.424 | 0.254 | 8.2 | 0.0000 | 0.0000 | OK |
| 600 minute winter | 23 | 480 | 2.424 | 0.304 | 7.5 | 0.0000 | 0.0000 | OK |
| 600 minute winter | 24 | 480 | 2.424 | 0.354 | 7.0 | 0.5064 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | 17 | 5.000 | 5.000:50% | 0.0 | 0.000 | 0.000 | 0.3399 | |
| 15 minute summer | 17 | 5.000 | 18 | 5.2 | 0.145 | 0.005 | 1.5769 | |
| 30 minute winter | 18 | 5.001 | 19 | 2.2 | 0.321 | 0.571 | 0.0758 | |
| 30 minute winter | 19 | 5.002 | 20 | 2.4 | 0.120 | 0.002 | 1.1559 | |
| 60 minute winter | 20 | 5.003 | 16 | 1.8 | 0.378 | 0.235 | 0.0422 | 4.6 |
| 600 minute winter | 22 | 1.005 | 1.005:50% | 6.5 | 0.121 | 0.006 | 5.7519 | |
| 600 minute winter | 22 | 1.005 | 23 | 7.5 | 0.075 | 0.007 | 7.6175 | |
| 600 minute winter | 23 | 1.006 | 24 | 7.0 | 0.204 | 0.094 | 1.5048 | |
| 600 minute winter | 24 | Hydro-Brake® | | 6.9 | | | | 266.9 |

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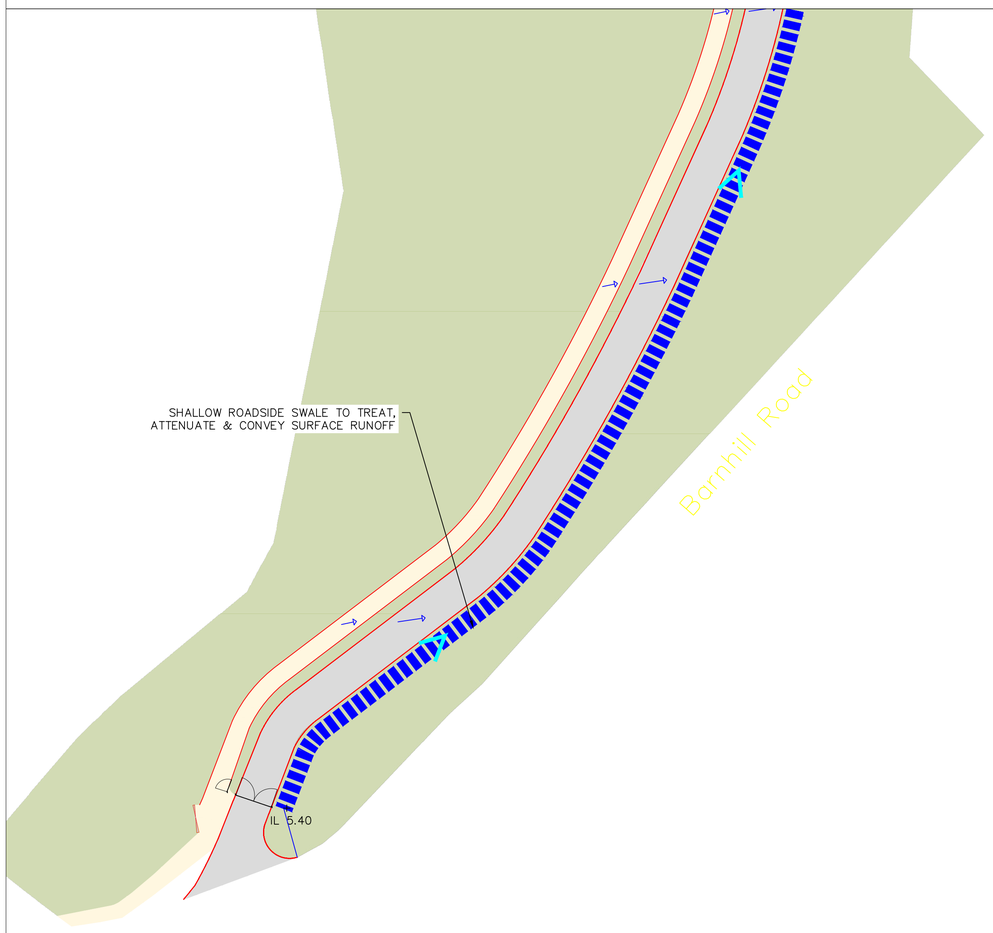
# Appendix D

# Drainage Design Summary

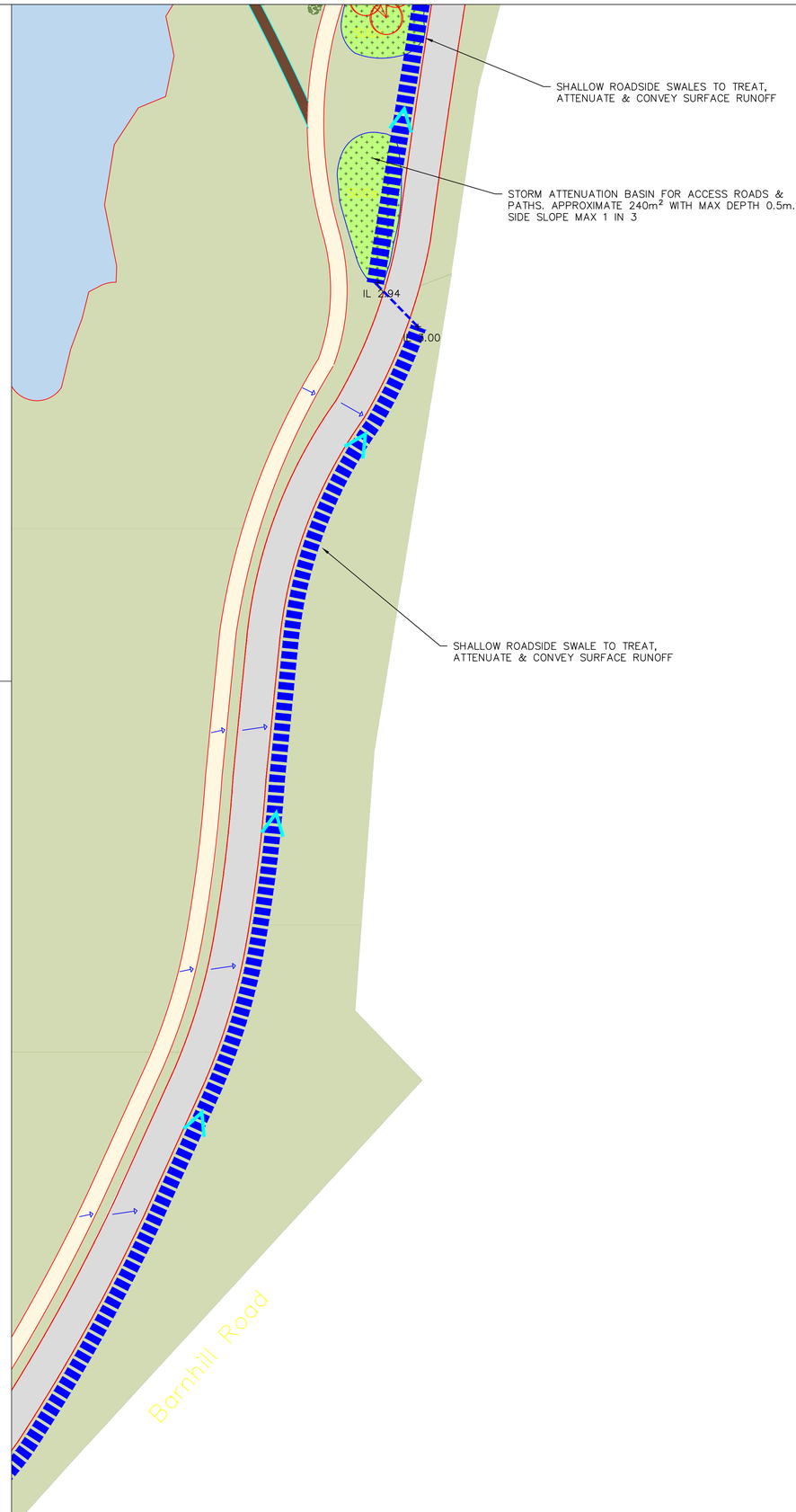
R:_Projects\M01959 McAdam Design Ltd\02 Riverine\07 Drawings\Working Drawings\M01959-02 100 SuDS Rev4.dwg 27-Aug-21 DWFx EPlot (XPS Compatible).pc3




KEY PLAN
SCALE 1:2500




PROPOSED SuDS LAYOUT PLAN – 1 OF 3
SCALE 1:500




PROPOSED SuDS LAYOUT PLAN – 2 OF 3
SCALE 1:500

## NOTES

1. ALL DIMENSIONS IN MILLIMETRES (UNLESS SHOWN OTHERWISE) AND ALL LEVELS IN METRES TO ORDNACE SURVEY BENCH MARK.
2. DRAWINGS TO BE READ IN CONJUNCTION WITH CIVIL SPECIFICATION AND IN ACCORDANCE WITH THE SPECIFICATION FOR HIGHWAY WORKS
3. THE CONTRACTOR IS TO CONFIRM THE ACCURACY OF EXISTING SURVEY AND LINES AND LEVELS OF EXISTING SERVICES INDICATED ON THE CONTRACT DRAWINGS.
4. THE CONTRACTOR IS TO LIAISE WITH ALL STATUTORY UNDERTAKERS IN REGARD TO LOCATING ALL EXISTING SERVICES WITHIN AND ADJACENT TO THE SITE OF THE WORKS. NO EXCAVATION IS TO COMMENCE UNTIL ALL EXISTING SERVICES HAVE BEEN LOCATED, MARKED ON SITE AND PROTECTED TO THE SATISFACTION OF THE RELEVANT AUTHORITY.
5. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER DRAWINGS PERTAINING TO THE WORKS.

## LEGEND

- PROPOSED SWALE
- PROPOSED PIPE
- PROPOSED HYDROBRAKE MANHOLE
- + IL 2.07 — PROPOSED INVERT LEVEL
- SURFACE FLOW DIRECTION
- PROPOSED ROAD
- PROPOSED FOOTPATH
- PROPOSED GRASS
- PROPOSED REINFORCED GRASS
- PROPOSED SuDS BASIN

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| ISSUE | DRN | APP | DATE | NOTES / DESCRIPTION |
|---|---|---|---|---|
| 1 | VB | AMC | 26/08/2021 | SuDS LAYOUT PLAN FOR PLANNING |

STATUS: PLANNING

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PROJECT: RIVERINE COMMUNITY PARK

CLIENT: Comhairle Contae Dhún na nGall / Donegal County Council; Derry City & Strabane District Council

DRAWING TITLE: STRABANE PROPOSED SuDS LAYOUT PLAN SHEET 1 OF 2

| SCALE | ORIGINAL SIZE |
|---|---|
| AS SHOWN @ A1 | A1 |

| DRAWN | CHECKED | DATE |
|---|---|---|
| VB | AMC | 26/08/2021 |

| PROJECT No. | DRAWING No. | ISSUE NO. |
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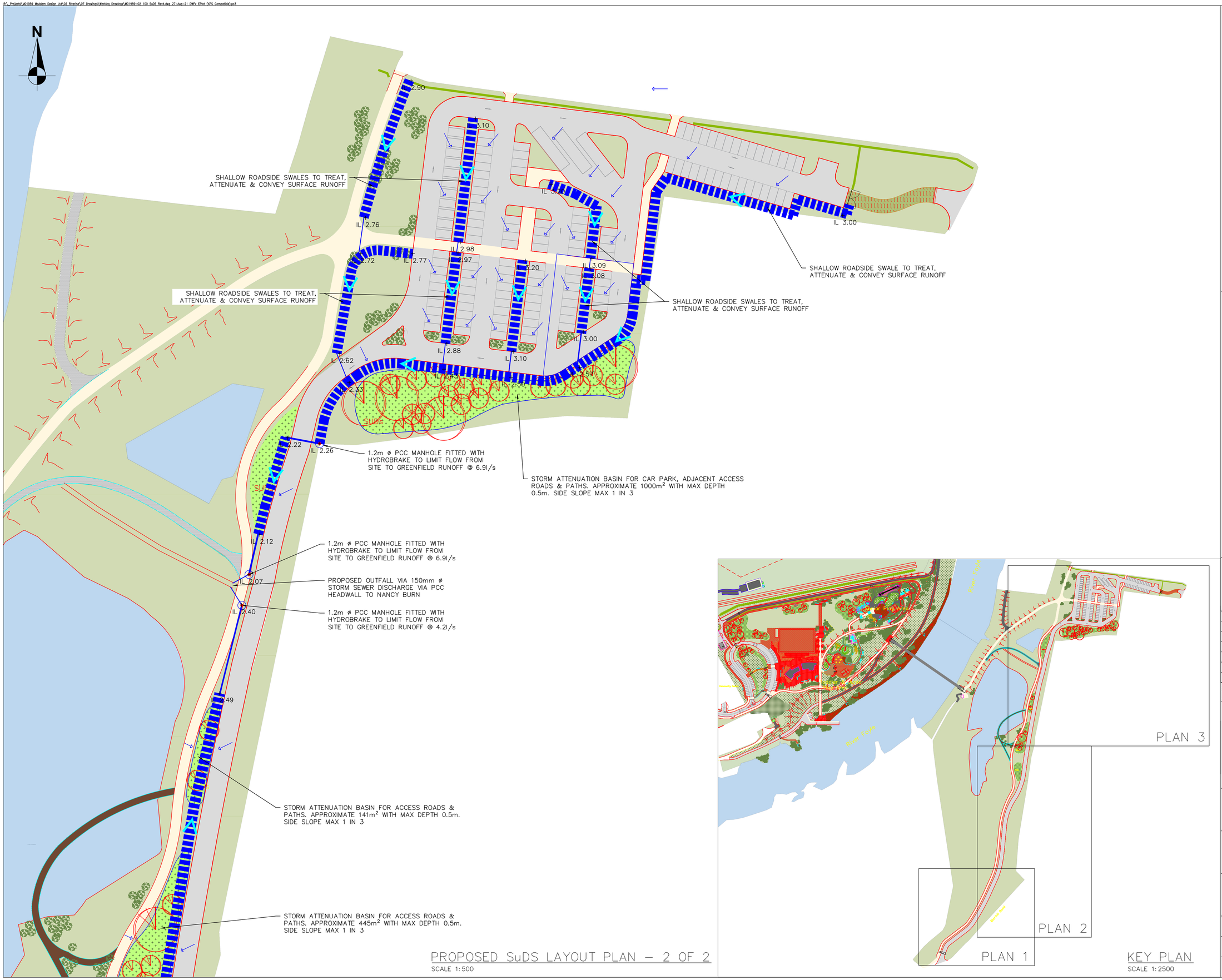


PROPOSED SuDS LAYOUT PLAN – 2 OF 2

SCALE 1:500




KEY PLAN

SCALE 1:2500

## NOTES

1. ALL DIMENSIONS IN MILLIMETRES (UNLESS SHOWN OTHERWISE) AND ALL LEVELS IN METRES TO ORDNACE SURVEY BENCH MARK.
2. DRAWINGS TO BE READ IN CONJUNCTION WITH CIVIL SPECIFICATION AND IN ACCORDANCE WITH THE SPECIFICATION FOR HIGHWAY WORKS
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5. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER DRAWINGS PERTAINING TO THE WORKS.

## LEGEND

- PROPOSED SWALE
- PROPOSED PIPE
- PROPOSED HYDROBRAKE MANHOLE
- + IL 2.07 — PROPOSED INVERT LEVEL
- SURFACE FLOW DIRECTION
- PROPOSED ROAD
- PROPOSED FOOTPATH
- PROPOSED GRASS
- PROPOSED REINFORCED GRASS
- PROPOSED SuDS BASIN

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|---|---|---|---|---|
| 1 | VB | AMC | 27/08/2021 | SuDS LAYOUT PLAN FOR PLANNING |

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PROJECT
RIVERINE COMMUNITY PARK

CLIENT
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Donegal County Council
Derry City & Strabane District Council
Comhairle Chathair Dhoire & Cheantar an tSratha Bàin
Derry Cittie & Strabane Destrick Council

DRAWING TITLE
STRABANE
PROPOSED SuDS LAYOUT PLAN
SHEET 2 OF 2

| SCALE | ORIGINAL SIZE | |
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| AS SHOWN @ A1 | A1 | |
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| M01959-02 | DWG_102 | 1 |

## Appendix 9-3

### Sustainable Drainage Strategy

McCloy Consulting

# Appendix 9-3
# Sustainable Drainage Strategy
## Riverine Community Park

M01959-02_DG04 | August 2021



WATER & ENVIRONMENTAL CONSULTANTS

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# CONTENTS


1 INTRODUCTION ..... 1
1.1 Terms of Reference ..... 1
1.2 Introduction ..... 1
2 SITE SETTING ..... 2
2.1 Application Site ..... 2
2.2 Existing Land Use ..... 2
*2.2.1 Lifford site ..... 2*
*2.2.2 Strabane site ..... 2*
2.3 Proposed Development ..... 2
3 RELEVANT PLANNING POLICIES ..... 1
*3.1.1 Lifford site ..... 1*
*3.1.2 Strabane site ..... 1*
4 SUDS CONSTRAINTS AND OPPORTUNITIES ..... 2
4.1 Site Characteristics ..... 2
4.2 Site Constraints / Opportunities ..... 2
5 SUSTAINABLE DRAINAGE STRATEGY ..... 4
5.1 Drainage Hierarchy ..... 4
5.2 SuDS Components ..... 4
5.3 Proposed SuDS Strategy ..... 8
*5.3.1 Lifford site ..... 8*
*5.3.2 Strabane Site ..... 8*
5.4 Water Quantity ..... 8
*5.4.1 Lifford site ..... 8*
*5.4.2 Strabane site ..... 8*
*5.4.3 Climate Change ..... 9*
*5.4.4 Lifford Site ..... 9*
*5.4.5 Strabane Site ..... 9*
*5.4.6 Runoff Rates - Lifford ..... 9*
*5.4.7 Storage of Runoff & Discharge Location - Lifford ..... 10*
*5.4.8 Runoff Rates – Strabane site ..... 10*
*5.4.9 Storage of Runoff & Discharge Location – Strabane site ..... 10*
*5.4.10 Designing for Exceedance ..... 11*
5.5 Water Quality Management ..... 11
5.6 Amenity ..... 11
5.7 Biodiversity ..... 12
*5.7.1 Lifford site ..... 12*
*5.7.2 Strabane site ..... 12*
6 MAINTENANCE REQUIREMENTS ..... 13
6.1 Maintenance responsibility ..... 13
*6.1.1 Lifford site ..... 13*
*6.1.2 Strabane site ..... 13*
6.2 Maintenance schedule ..... 13


# LIST OF TABLES


Table 4-1 SuDS Constraints / Opportunities ..... 2
Table 9-1 Attenuation Flow Rates – Lifford site ..... 9
Table 9-2 Indicative Attenuation Storage Volumes – Lifford site ..... 10
Table 9-3 Attenuation Flow Rates – Strabane site ..... 10
Table 9-4 Indicative Attenuation Storage Volumes – Strabane site ..... 10
Table 9-5 SuDS Mitigation Index and Pollution Hazard Indices for the site ..... 11
Table 10-1 Maintenance Schedule of SuDS Features ..... 13


# APPENDICES


Appendix A SuDS Drawings
Appendix B Hydraulic calculations

# 1 INTRODUCTION

## 1.1 Terms of Reference

This Sustainable Drainage Strategy (SDS) was commissioned by Donegal County Council and Derry & Strabane District Council (hereafter the Client) to support a planning application for Riverine Community Park, hereafter referred to as the Site.

**This report is relevant to planning applications in both jurisdictions.** To cater for differences between Northern Ireland and Republic of Ireland legislative jurisdictions, reference will be made to Strabane site and Lifford site respectively as appropriate under each section of the report.

The SDS will outline the proposed design approach adopted, design criteria used to and how the design delivers against respective Planning Policies.

## 1.2 Introduction

Sustainable Drainage Systems or SuDS is a way of managing rainfall that minimises the negative impacts on the quantity and quality of runoff whilst maximising the benefits of amenity and biodiversity for people and the environment as defined in The SuDS Manual C753 (2015)[1] published by CIRIA.

SuDS, if designed correctly, has the ability to deliver multiple benefits. The layout of SuDS will consider the inter-relationships with other aspects such as:

- Biodiversity
- Water quality
- Parks, Open Space and Recreation
- Sustainable Water Management
- Landscape design (function and amenity use)

The SDS outlines the proposed approach for the management of rainfall runoff within the development to ensure no increase in flood risk elsewhere and that the development is suitably protected from flood, with delivery of wider water quality, amenity and biodiversity benefits.

[1] CIRIA (2015). The SuDS Manual C753. [online] Available at: https://www.ciria.org/Resources/Free_publications/SuDS_manual_C753.aspx [Accessed 20 May 2019]

# 2 SITE SETTING

The following section establishes the site setting relevant to the consideration of the SuDS design.

## 2.1 Application Site

The proposed development is transboundary and includes land in the Republic of Ireland (RoI) (Co. Donegal) and Northern Ireland (NI) (Co. Tyrone). The dominant hydrological feature is the River Foyle which forms the jurisdiction boundary.

The site is located on lands in Lifford and Strabane and include a span over the River Foyle. Context and location are shown on drawing plans submitted in support of the application (SuDS drawings are included in Appendix A for ease of reference). The combined application site has an area within its boundary of 22.6 Ha.

## 2.2 Existing Land Use

A summary of existing land use is as follows.

### 2.2.1 Lifford site

The Lifford site comprises undeveloped agricultural land with main access via Foyle View and the existing Three Rivers complex.

### 2.2.2 Strabane site

The Strabane site comprises undeveloped land (agricultural land, woods and wetlands) with the exception of a Traveller halting site at Greenbrae Park.

## 2.3 Proposed Development

The development will comprise the creation of a new community park infrastructure with multi-purpose community facilities and amenities. Aspects of the development relevant to the assessment of flood risk will include:

- Construction of a pedestrian and cycle bridge between Lifford and Strabane.
- Construction of a single storey community resource building for use as community space including office and café use.
- Provision of a multi-functional outdoor space and external stage area.
- Creation of play areas, a river walk and river access.
- Construction of an access road, car parking, walkways and cycleways.
- Associated landscaping and ancillary development, accommodation works and site services

# 3 RELEVANT PLANNING POLICIES

The purpose of the SDS is to set out a framework for the delivery of a drainage system which will integrate multi-functional SuDS components within the Site Area to manage water at or near the surface, providing high quality blue / green infrastructure which enhances and improves biodiversity and brings significant community benefits within developed areas.

### 3.1.1 Lifford site

The SDS seeks to demonstrate that the objectives set out in Donegal County Development Plan (2018 – 2024) and requirements set out in GDSDS (Volume 2 and 3) SuDS Requirements can be satisfied.

The Development Plan sets out the following objectives which relate directly to the delivery of SuDS or where delivery of the objective can be (in part) facilitated through the provision of suitably designed and constructed SuDS.

- F-P-1, F-P-2, F-P-5, F-P-7
- NH-P-1

The SDS is in line with the requirements and criteria set out in the Greater Dublin Strategic Drainage Study (GDSDS) (2005).

The GDSDS provides the following definitions:

- SuDS involve a change in our way of managing urban run-off from solely looking at volume control to an integrated multi-disciplinary approach which addresses water quality, water quantity, amenity and habitat (Vol 3 p.132)
- SuDS minimise the impacts of urban runoff by capturing runoff as close to source as possible and then releasing it slowly (Vol 3 p.133)

Requirements for climate change allowances are as per OPW 'General Map User Guidance Notes' found through floodinfo.ie[2].

### 3.1.2 Strabane site

Regional Development Strategy (RDS) and Planning Policy Statement 15 are applicable to SuDS in the Planning Context.

Of particular relevance from the RDS are;

- RG7: Support urban and rural renaissance
- RG9: Reduce our carbon footprint and facilitate mitigation and adaptation to climate change whilst improving air quality
- RG11: Conserve, protect and, where possible, enhance our built heritage and our natural environment
- RG12: Promote a more sustainable approach to the provision of water and sewerage services and flood risk management

[2] OPW (2019) General Map User Guidance Notes (2019) Available at: https://www.floodinfo.ie/map/general_map_user_guidance_notes/ [Accessed 18 June 2019]

# 4 SUDS CONSTRAINTS AND OPPORTUNITIES

## 4.1 Site Characteristics

Site characteristics relevant to drainage and flooding are established in the Flood Risk Assessment (report reference M01959-02_FR01, EIAR Appendix 3-1), which this Strategy is intended to be read in conjunction with.

## 4.2 Site Constraints / Opportunities

The following table summarises the constraints / parameters which will inform the development of the SDS.

**Table 4-1 SuDS Constraints / Opportunities**

| Attribute | Description | Comment / Influence on SuDS design |
|---|---|---|
| Site characteristics | Lifford site – mixture of hard and soft landscape<br>Strabane site – mixture of hard and soft landscape | Availability of open green space will lend itself to integration of nature based SUDS components. |
| Flooding | Flood risk at the site is assessed in the FRA for the Strabane and Lifford site. | Hydraulic model results will be considered at for the design for placement of attenuation storage. |
| Existing Drainage Infrastructure | Existing drainage infrastructure is established by the DA (Strabane site).<br>No indication of formalised drainage infrastructure in the areas of the Lifford site proposed for development. | Consideration given to alignment and depth of existing drainage infrastructure. |
| Utilities | Utilities confirmed by Site Investigation –further locations may be unknown. | Existing utility information to inform SuDS design. CAT scan / trial pit required prior to construction. |
| Topography | Lifford site – site will drain to the north and connect to existing land drainage ditches.<br>Strabane site – site runoff will connect to the Nancy Burn which discharges through the embankment to the River Foyle. | The topography will influence the existing and modified flow routes / management train. |

| Attribute | Description | Comment / Influence on SuDS design |
|---|---|---|
| Infiltration potential | Lifford site - Soakaway testing found favour infiltration conditions at 1 out of 4 trial pits tested. This demonstrates that ground conditions are variable across the site and that infiltration cannot be relied upon.<br>Strabane site- Soakaway testing found favour infiltration conditions at 1 out of 3 trial pits tested. This demonstrates that ground conditions are variable across the site and that infiltration cannot be relied upon. | Calculations will be based upon zero infiltration. Should SuDS features coincide with an area of favourable infiltration rates, detailed design calculations can be updated to reflect the respective local rates (or alternatively the design will be conservative in terms of the volumes provided with no account taken for loss of flow through infiltration) |
| Groundwater | Lifford site - The site investigation indicates that there was no groundwater strikes at shallow depths (<2mbgl) that would influence the SuDS design or storage provision.<br>Strabane site - - The site investigation indicates that there was no groundwater strikes at shallow depths (<2mbgl) that would influence the SuDS design or storage provision. | No further consideration required. |
| Local Authority requirements | Lifford site - Donegal CC has identified that it does not currently take in charge permeable pavement.<br>Strabane site – Client has confirmed that the site drainage / highway will not be offered for adoption with DfI Roads and therefore is not subject to adoption requirements. | Lifford site - Where SuDS infrastructure is not taken in charge, SuDS / drainage assets would have to be managed by a maintenance company.<br>Strabane site - Where SuDS infrastructure is not taken in charge, SuDS / drainage assets would have to be managed by a maintenance company. |

# 5 SUSTAINABLE DRAINAGE STRATEGY

The SDS outlines the proposed approach for the management of rainfall runoff within the development to ensure no increase in flood risk to any development within the Site or elsewhere with delivery of wider water quality, amenity and biodiversity benefits.

The approach to the SDS is as per the guidance from the CIRIA SuDS Manual which is summarised as follows:

- Identify suitable mechanism of discharge for site drainage.
- Allocate a management train and appropriate number of subcatchments to provide the collection, treatment, storage, conveyance of runoff across the Plan Area.
- Identify SuDS components which are in keeping with the proposed landscape character and other objectives for the site.

## 5.1 Drainage Hierarchy

The way that runoff is disposed from the Plan Area should adhere to the following hierarchy of discharge:

- Re-Use – There are no opportunities for reuse within the proposals.
- Infiltration – Infiltration has been discounted within the assessment of constraints due to the locations for favourable infiltration soil conditions being isolated across the Lifford and Strabane sites.
- Watercourse – A realigned ditch will provide means of discharge for the Lifford site. The Nancy Burn will provide means of discharge for the Strabane site.
- Surface Water Sewer – Not applicable
- Combined Sewer – Not applicable

## 5.2 SuDS Components

The following table summarises a review of potential SuDS components relative to development characteristics.

| SuDS Component | Description | Suitable? | Rationale |
|---|---|---|---|
| Green roofs | Green roofs are areas of living vegetation, installed on the top of buildings. | No | Lifford site - Proposed roof have potential for green / blue roof solutions. The architect has confirmed that the main building will have multiple levels and that green roof is not being considered.<br>Strabane site – no buildings part of the development proposals. |
| Infiltration systems | Infiltration systems allow surface water runoff to infiltrate and filter through to the sublayer layer before returning to the water table. | No | Infiltration tests undertaken site indicate that a number of locations across the site are not suitable due to the low permeability.<br>Where ground conditions are favourable for infiltration, the SuDS component will act as a 'leaky', but functioning will not rely solely upon infiltration.<br>Hydraulic calculations will assume zero infiltration for the purposes of the planning application.. |
| Filter strips | The hard edge from a pavement to a filter strip is generally defined by a kerb. | Yes | There is potential to incorporate filter strips into the development to collect and provide treatment surface water runoff. |
| Filter drains | Filter drains, also known as a French drain, is an open stone filled trench. | Yes | Potential for location alongside roads and pathways. |
| Swales | Swales are shallow, flat bottomed vegetated channels which can collect, treat, convey and store runoff. | Yes | Swales could be suitable to convey flows between other SuDS features and connect green-space areas. |
| Bioretention systems / rain planters | Bioretention systems are shallow landscaped depressions used to reduce runoff rates, volumes and treat pollution through the use of engineered soils and vegetation. | Possible | There is potential to incorporate bioretention systems into the development to collect runoff. There is unlikely to be significant levels of pollution generated in development runoff to warrant the use of bioretention for treatment purposes solely. |
| Tree pits | Trees pits can attenuate surface water runoff underneath by utilising the void within each tree's rooting zone. | Yes | Trees will be planted across the site therefore there is potential to incorporate tree pits within the SuDS design. Trees may also be incorporated into other SuDS features such as basins without the necessity for a dedicated tree pit. |

| SuDS Component | Description | Suitable? | Rationale |
|---|---|---|---|
| Permeable pavements / Permeable surfaces | Permeable pavements / permeable surfaces allow rainwater to infiltrate through the surface and into the underlying structural layers where it is temporarily stored before infiltrating or discharged downstream to a receiving drainage feature. | Possible | New roads and hardstanding areas will be provided as part of the development therefore there is scope to include permeable paving / surfaces within the development<br>There is ample landscape areas across the Lifford and Strabane sites to accommodate surface runoff within landscape SuDS features, which will reduce the necessity to consider permeable pavement.<br>Lifford site - Donegal County Council do not currently take in charge permeable paving. This requires consideration in terms of future ongoing maintenance consideration.<br>The Lifford site contains a large events space to the rear of the main building. There is potential that this could be permeable surface with storage of surface runoff provided within the structural build up. |
| Rain harvesting | Rainwater harvesting (RWH) involves the collection of rainwater runoff for reuse. | No | Lifford site - Rainwater reuse could be utilised to reduce surface water runoff and reduce demand on potable water supply. It is unlikely to yield sufficient decreases in flow rates to satisfy the requirements of the drainage strategy but may be considered at the discretion of the client/developer but will not form part of the primary drainage strategy.<br>Strabane site – there are no buildings present on the site. |
| Attenuation storage tanks | Attenuation tanks are used to create below ground storage before infiltrating or controlled release or use. | Possible | Elevated discharge level will limit the potential for storage tanks (they require sufficient cover to facilitate structural loading).<br>Preference should be given to above ground attenuation features to maximise benefits for water quality, amenity and biodiversity to support the Objectives outlined within the Development Plan.<br>Below ground storage / tanks should only be used as a last resort where it has been demonstrated that other 'green Infrastructure' measures are not feasible. |

| SuDS Component | Description | Suitable? | Rationale |
|---|---|---|---|
| Detention basins | Detention basins are landscaped depressions that are normally dry except during and immediately after storms. | Yes | Detention basins could be utilised to attenuate flows, improve water quality, and reduce runoff rates prior to discharge.<br>There is available space within both the Lifford and Strabane site to facilitate basins.<br>Design of basins should deliver multifunctionality where appropriate. I.e. the basins can serve other functions and only small proportions of the basin should be wet after the majority of rainfall events. This can be provided through provision of a low-flow channel. |
| Ponds & wetlands | Ponds and wetlands are features with a permanent pool of water that provide attenuation and treatment of surface water runoff. | Possible | There is potential to utilise ponds and wetlands within the Lifford and Strabane sites.<br>Careful consideration needs to be given to the proposed landscape character of the Lifford and Strabane sites to facilitate incorporation. |

## 5.3 Proposed SuDS Strategy

In consideration of the suitable SuDS components the following is proposed as a basis for the drainage strategy for the Lifford and Strabane sites

### 5.3.1 Lifford site

The drainage method of main areas of the development which generate runoff is described as follows;

- Access road and carpark – runoff collected in linear swale and conveyed to site control basin for storage.
- Community building – Roofs and surrounding paving drained to rain gardens adjacent to the building. Flows conveyed onwards to storage provided as part of the construction of the events space.
- Events space – a permeable surface will be provided, which will allow runoff to drain directly through the surface to the underlying voided subbase. Flows are controlled with in the subbase and released slowly onwards to the site control basin.
- Play spaces – flows collected in swales which run along the perimeter of the play areas, with flows conveyed to the site control basin.
- Access track – track is formed of reinforced grass. No additional formalised drainage provided.

### 5.3.2 Strabane Site

Carpark and access road – carpark runoff flows are collected within swales which are situated throughout the carpark. Flows from the swales are conveyed to a basin situated to the south of the carpark. A further swale is provided along the southern perimeter to the carpark. The swale along the southern boundary integrates with a basin which provides further attenuation storage.

Pathways and access road - flows are shed via crossfall into a swale which convey flows onwards to the flow control and discharge to the Nancy Burn. Further basins are provided within the expanding spaces between the access road and the pathway which provide additional storage.

Outflow from the site is controlled using two vortex flow controls which release flows at greenfield runoff rate to the Nancy Burn.

## 5.4 Water Quantity

New development will increase the impermeable area of the site. The proposal will lead to an increase in the overall impermeable area of the site, thus resulting in an increase to the rate and volume of runoff from the site, when compared to the existing scenario.

The effect of surface water flood risk to the site and elsewhere shall be by means of an effective surface water drainage network and surface water management. Sufficient attenuation is to be provided to ensure that there is no unpredictable flooding within the site, future buildings are protected and no increase in flood risk elsewhere.

### 5.4.1 Lifford site

Surface water drainage design will be as per the requirements of the Donegal County Council Development Plan 2018-2024 and to the standards of Donegal County Council Water Services Department.

The Development Plan Policy F-P-5 states that the Council shall promote the use of Sustainable Drainage Systems (SuDS), flood attenuation areas, controlled release of surface water, and use of open spaces and semi-permeable hard surfaces for appropriate development proposals.

Attenuation storage up to an including the 1 in 100 year rainfall event with allowance for climate change will be accommodated within the drainage scheme.

### 5.4.2 Strabane site

Surface water drainage design will be as per the requirements of the Derry and Strabane Council.

The Regional Development Strategy 2035 .states *Greater use of Sustainable Drainage Systems (SuDS) should be encouraged, particularly as part of significant development proposals. SuDS provide a water quality benefit and if designed appropriately can help control flows into rivers and drains thereby reduce the risk of flooding. All new urban storm water drainage systems should incorporate measures to manage the flow of waters which exceed design standards (exceedance flows) in order to help protect vulnerable areas.*

Attenuation storage up to an including the 1 in 100 year rainfall event with allowance for climate change will be accommodated within the drainage scheme..

### 5.4.3 Climate Change

The future impacts of climate change on rainfall should be accounted for within the design of the drainage scheme.

### 5.4.4 Lifford Site

Requirements for climate change allowances are as per OPW 'General Map User Guidance Notes' found through floodinfo.ie[4] which recommended a 20% uplift in extreme rainfall depths for the Mid-Range Future Scenario (MRFS) and 30% for the High-End Future Scenario (HEFS).

In line with the standard adopted in practice at the time of writing, the MRFS is applied for purposes of evaluation of the effect climate change to inform this SDS.

### 5.4.5 Strabane Site

Drainage will not be eligible for adoption and will be privately maintained; therefore NIW design standards are not applicable. Drainage shall comply with the following mandatory standards:

| | |
|---|---|
| • The drainage network / site layout should ensure containment and control of the 100-year (1% AEP) return period storm within the site to ensure no offsite effect elsewhere.<br>• The drainage network should also allow for a **20%** allowance for climate change at all the above listed return periods. | To suit DfI Rivers flood protection standards. |

Other drainage shall comply with Northern Ireland Building Regulations as appropriate. Any SuDS features shall be designed in accordance with guidance as stated in CIRIA C753 SuDS manual.

### 5.4.6 Runoff Rates - Lifford

The flow rates in the following table are based on the requirements of GDSDS and DCC for restriction of post-development runoff to greenfield rates. They provide guidance on the extent to which flows will be controlled from any proposed development within the Plan Area. The flow rates are calculated using IoH 124 methodologies based on catchment specific characteristics.

**Table 5-1 Attenuation Flow Rates – Lifford site**

| Return period | Qbar Attenuation Rate (l/s/ha) |
|---|---|
| 1% AEP (1 in 100 year) + CC | 20 |

[4] OPW (2019) General Map User Guidance Notes (2019) Available at: https://www.floodinfo.ie/map/general_map_user_guidance_notes/ [Accessed 18 June 2019]

### 5.4.7 Storage of Runoff & Discharge Location - Lifford

Runoff will be attenuated throughout the Plan Area within respective subcatchments. SuDS components for collection, storage and conveyance of flow will be selected on the basis of suitability for the development design and in consideration of relevant constraints.

Attenuation storage will be sized for the 1% AEP (with allowance for climate change) critical rainfall event. Specimen storage volumes, based on an outflow rate of Qbar or 2 l/s/ha, are provided in Table 5-2.

**Table 5-2 Indicative Attenuation Storage Volumes – Lifford site**

| Return period | Indicative Attenuation Volume* ($m^3$) |
|---|---|
| 1% AEP (1 in 100 year) + CC | 1837 $m^3$ |
| * Attenuated to Qbar | |

Final discharge from the proposed development is to the realigned ditch to the north of the final basin. The method of conveyance to the watercourse from the site will be via shallow pipe through lands within the control of the applicant.

### 5.4.8 Runoff Rates – Strabane site

The flow rates in the following table are based on the requirements of DfI Rivers for restriction of post-development runoff to greenfield rates.

**Table 5-3 Attenuation Flow Rates – Strabane site**

| Return period | Attenuation Rate (l/s/ha) |
|---|---|
| 1% AEP (1 in 100 year) + CC | 11.13 |

### 5.4.9 Storage of Runoff & Discharge Location – Strabane site

Runoff will be attenuated throughout the Plan Area within respective subcatchments. SuDS components for collection, storage and conveyance of flow will be selected on the basis of suitability for the development design and in consideration of relevant constraints.

Attenuation storage will be sized for the 1% AEP (with allowance for climate change) critical rainfall event. Specimen storage volumes, based on an outflow rate of 10 l/s/ha, are provided in Table 5-2.

**Table 5-4 Indicative Attenuation Storage Volumes – Strabane site**

| Return period | Indicative Attenuation Volume ($m^3$) |
|---|---|
| 1% AEP (1 in 100 year) + CC | 452 $m^3$ |

Final discharge from the proposed development is to the Nancy Burn which runs through the site. The method of conveyance to the watercourse from the site will be via open channel (swales) or shallow pipe connections under pathways etc. through lands within the control of the applicant.

### 5.4.10 Designing for Exceedance

Site levels and landscaping are designed to route exceedance flows away from buildings. Overland flow routes are managed in a safe manner by utilising the drainage systems, roads and public spaces to convey and control floodwater during extreme events. Overflows will be provided within the flow control chambers to ensure that exceedance flows is conveyed onwards in a predictable manner.

## 5.5 Water Quality Management

Proposals for the site will comprise trafficked areas and pedestrian areas. The SuDS Manual 2015 is used to assess the risk and mitigation indices. Treatment provision is summarised as follows:

- Run-off from roofing – run-off from residential roofs is considered at very low risk of containing contaminants. Gross solids / debris and silt shall be removed by discharging to leaf guards and silt traps.
- Run-off from pedestrian hardstanding areas – run-off from pedestrian only areas has not been given a specific classification within the Pollution hazard Indices so has been conservatively placed in the low risk category.
- Runoff from trafficked areas - – medium classification risk category. within the Pollution hazard Indices

Table 5-5 assesses the risk posed by each type of run-off observed on site. The assessment demonstrates that water quality from pollution entrained within rainfall runoff can be addressed by the site drainage strategy proposed.

**Table 5-5 SuDS Mitigation Index and Pollution Hazard Indices for the site**

| Land Use Type/Treatment | Pollution Hazard Level | Total Suspended Solids (TSS) | Metals | Hydrocarbons |
|---|---|---|---|---|
| Roofs | Very Low | 0.2 | 0.2 | 0.05 |
| Treatment | Bioretention / rain garden | 0.8 | 0.8 | 0.8 |
| Pedestrian Areas | Low | 0.5 | 0.4 | 0.4 |
| Treatment (impermeable surface areas) | Swale | 0.5 | 0.6 | 0.6 |
| Treatment (Lifford events space) | Permeable surface | 0.7 | 0.6 | 0.6 |
| Trafficked areas (carpark and access road) | Medium | 0.7 | 0.6 | 0.7 |
| Treatment | Swale / basin | 0.75 | 0.85 | 0.9 |

The table above demonstrates that there is sufficient treatment across all surface area types for the Lifford and Strabane sites.

## 5.6 Amenity

Amenity focuses on the usefulness and aesthetic elements of SuDS design associated with features 'at or near the surface' and considers both multi-functionality and visual quality.

The following aspects were considered as part of the development of the SuDS design:

- SuDS components are 'legible', i.e. their function is understandable to people using the area as well as maintenance personnel.
- The visual character of the SuDS should enhance the appearance of the development.
- Spaces where main SuDS components are located are multi-functional and can be used when not providing a SuDS function for surface water management.
- The design shall ensure that's SuDS features are accessible and safe 'by design'.

## 5.7 Biodiversity

The following are highlighted as being used to inform the SuDS design for the Lifford and Strabane sites:

- Ensure water quality within the water environment by following the steps of the simple index approach as per CIRIA SuDS Manual 2015 guidance (Chapter 26, Box 26.2).
- The SuDS design seeks to keep water at or near the surface as it flows through the SuDS management train towards to wider landscape to ensure habitat connectivity. Low flow channels and varying topography are provided within the basins which will provide a varying habitat in the respective basins and make provision for a greater degree of flora and fauna biodiversity.
- Confirm management practices to enhance habitat development during maintenance.

In addition the following site specific considerations have been made.

### 5.7.1 Lifford site

An existing hedgerow has been identified for retention (as far as practicably possible. The proposed swales in proximity to the hedgerow have been aligned to allow for likely root extents. The presence of the swales will contribute to the hedgerow by hydrating soils in proximity to the hedgerow.

### 5.7.2 Strabane site

Ecology survey has identified the presence of invasive species across parts of the site. The management of invasive species to facilitate the presence of SuDS will replicate the same management procedure to facilitate the placement of infrastructure (footpaths and roads) that the SUDS are proposed to serve.

# 6 MAINTENANCE REQUIREMENTS

## 6.1 Maintenance responsibility

The maintenance schedule for the SuDS features located within the site is identified in the following table.

### 6.1.1 Lifford site

The site is under the ownership of Donegal County Council. Ongoing inspection and maintenance shall be the responsibility of Donegal County Council / appointment maintenance team.

### 6.1.2 Strabane site

The site is under the ownership of Derry and Strabane District Council. Ongoing inspection and maintenance shall be the responsibility of Derry and Strabane District Council parks team / appointment maintenance team.

## 6.2 Maintenance schedule

The following schedule details the maintenance likely to be required and the expected frequency of action. This schedule will be further refined in line with confirmed planting plan for the various SuDS features.

**Table 6-1 Maintenance Schedule of SuDS Features**

| Maintenance Schedule | Required action | Typical frequency |
|---|---|---|
| *Permeable Surface* | | |
| Regular Maintenance | Brushing (standard cosmetic sweep over whole surface) | Once a year, after autumn leaf fall, or as required, based on site-specific observations of clogging or manufacturer recommendations. Pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment. |
| Remedial Actions | Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material. | As required |
| | Rehabilitation of surface and upper substructure by remedial sweeping | Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging) |
| Monitoring | Initial inspection. | Annually |
| | Inspect for evidence of poor operation and/or weed growth and, if required, take remedial actions. | Every three months, or 48 hours after severe storms if within first six months |
| | Inspect silt accumulation rates and establish appropriate brushing frequencies. | Annually |

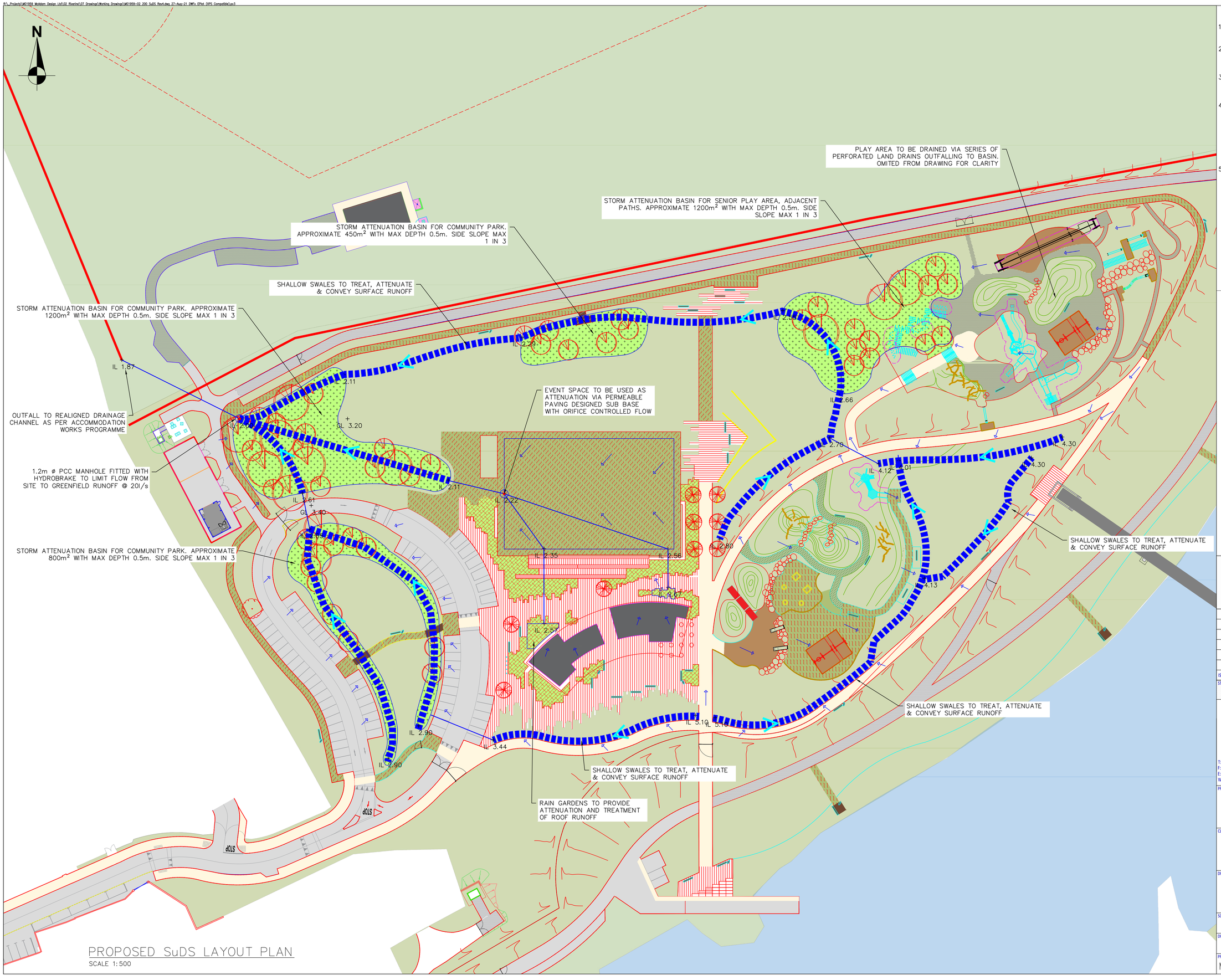
| Maintenance Schedule | Required action | Typical frequency |
|---|---|---|
| *Inlets, Outlets, Controls, and Inspection Chambers* | | |
| Regular Maintenance | Inspect and identify any areas that are not operating correctly. If required, take remedial action. | Monthly |
| | Remove debris and sediment from chambers | Monthly for first six months, then quarterly or after significant storm |
| Remedial actions | Repair/rehabilitate where required | As required |
| Monitoring | Check all structures to ensure all is in good condition and operating as designed. | Annually |
| | (Flow controls) check for evidence of blockage | Monthly or after significant storm |
| *Basin* | | |
| Regular Inspections | Inspect surfaces for silting and ponding, | Quarterly |
| | Check operation of any underdrains by inspection | Annually |
| | Assess plants for disease infection, poor growth, invasive species etc and maintain as necessary | Quarterly |
| | Inspect inlets and outlets for blockage | Quarterly |
| Regular maintenance | Remove litter and surface debris and weeds | Quarterly (or more frequently for tidiness or aesthetic reasons) |
| | Mow / strim vegetation.<br>Replace any planting, to maintain planting density | As required |
| | Remove sediment, litter, and debris build-up from around inlets | Quarterly to biannually |
| Occasional maintenance | Infill any holes or scour on surface with revegetation of surface as required. | As required |
| | Repair minor accumulations of silt by raking away surface mulch, scarifying surface of medium and replacing mulch | As required |
| *Swale* | | |
| Regular Inspections | Inspect surfaces for silting and ponding, | Quarterly |
| | Inspect surfaces for erosion, | Quarterly |
| | Assess plants for disease infection, poor growth, invasive species etc and maintain as necessary | Quarterly |
| | Inspect inlets and outlets for blockage | Quarterly |
| Regular maintenance | Remove litter and surface debris and weeds | Quarterly (or more frequently for tidiness or aesthetic reasons) |

| Maintenance Schedule | Required action | Typical frequency |
|---|---|---|
| | Mow or strim vegetation – amenity grass within swale to be maintained to 70-100mm.<br>Replace any planting, to maintain planting density | As required |
| | Remove sediment, litter, and debris build-up from around inlets | Quarterly to biannually |
| Occasional maintenance | Infill any holes or scour on surface with revegetation of surface as required. | As required |
| | Repair minor accumulations of silt by raking away surface mulch, scarifying surface of medium and replacing mulch | As required |

# Appendix A

# SuDS Drawings

R:_Projects\M01959 McAdam Design Ltd\02 Riverine\07 Drawings\Working Drawings\M01959-02_200_SuDS_Rev4.dwg 27-Aug-21 DWFx ePlot (XPS Compatible).pc3




PROPOSED SuDS LAYOUT PLAN
SCALE 1:500

## NOTES

1. ALL DIMENSIONS IN MILLIMETRES (UNLESS SHOWN OTHERWISE) AND ALL LEVELS IN METRES TO ORDNACE SURVEY BENCH MARK.
2. DRAWINGS TO BE READ IN CONJUNCTION WITH CIVIL SPECIFICATION AND IN ACCORDANCE WITH THE SPECIFICATION FOR HIGHWAY WORKS
3. THE CONTRACTOR IS TO CONFIRM THE ACCURACY OF EXISTING SURVEY AND LINES AND LEVELS OF EXISTING SERVICES INDICATED ON THE CONTRACT DRAWINGS.
4. THE CONTRACTOR IS TO LIAISE WITH ALL STATUTORY UNDERTAKERS IN REGARD TO LOCATING ALL EXISTING SERVICES WITHIN AND ADJACENT TO THE SITE OF THE WORKS. NO EXCAVATION IS TO COMMENCE UNTIL ALL EXISTING SERVICES HAVE BEEN LOCATED, MARKED ON SITE AND PROTECTED TO THE SATISFACTION OF THE RELEVANT AUTHORITY.
5. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER DRAWINGS PERTAINING TO THE WORKS.

## LEGEND

- PROPOSED SWALE
- PROPOSED PIPE
- PROPOSED FLOW CONTROL MANHOLE
- + IL 2.07 — PROPOSED INVERT LEVEL
- SURFACE FLOW DIRECTION
- PROPOSED ROAD
- PROPOSED FOOTPATH
- PROPOSED GRASS
- PROPOSED REINFORCED GRASS
- PROPOSED SuDS BASIN

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| ISSUE | DRN | APP | DATE | NOTES / DESCRIPTION |
|---|---|---|---|---|
| 1 | VB | AMC | 27/08/2021 | SuDS LAYOUT PLAN FOR PLANNING |

STATUS
PLANNING

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PROJECT
RIVERINE
COMMUNITY PARK

CLIENT
Comhairle Contae Dhún na nGall
Donegal County Council
Derry City & Strabane District Council
Comhairle Chathair Dhoire & Cheantar an tSratha Báin
Derry Cittie & Strabane Districk Council

DRAWING TITLE
LIFFORD
PROPOSED SuDS LAYOUT PLAN

| SCALE | ORIGINAL SIZE |
|---|---|
| AS SHOWN @ A1 | A1 |

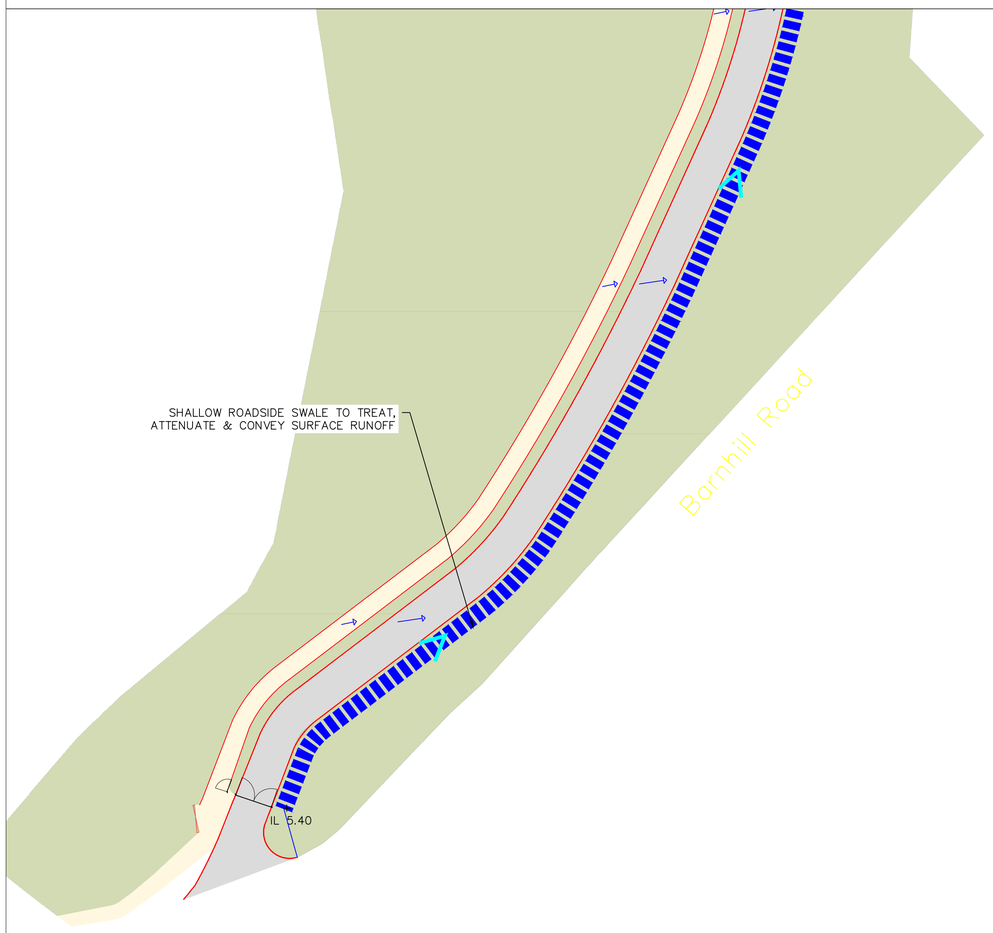
| DRAWN | CHECKED | DATE |
|---|---|---|
| VB | AMC | 27/08/2021 |

| PROJECT No. | DRAWING No. | ISSUE NO. |
|---|---|---|
| M01959-02 | DWG_201 | 1 |

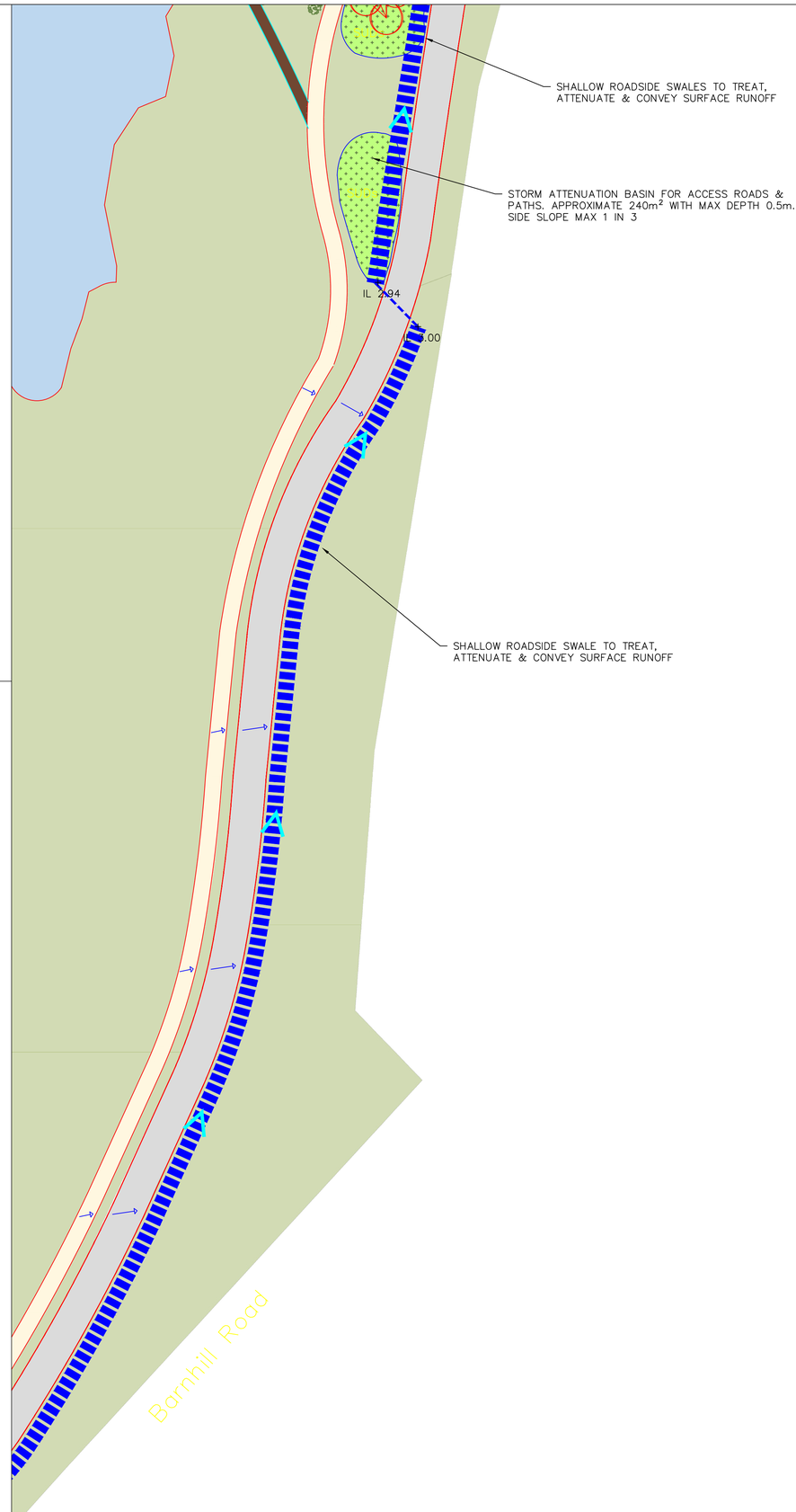
R:_Projects\M01959 McAdam Design Ltd\02 Riverine\07 Drawings\Working Drawings\M01959-02 100 SuDS Rev4.dwg 27-Aug-21 DWFx EPlot (XPS Compatible).pc3




KEY PLAN
SCALE 1:2500




PROPOSED SuDS LAYOUT PLAN – 1 OF 3
SCALE 1:500




PROPOSED SuDS LAYOUT PLAN – 2 OF 3
SCALE 1:500

## NOTES

1. ALL DIMENSIONS IN MILLIMETRES (UNLESS SHOWN OTHERWISE) AND ALL LEVELS IN METRES TO ORDNACE SURVEY BENCH MARK.
2. DRAWINGS TO BE READ IN CONJUNCTION WITH CIVIL SPECIFICATION AND IN ACCORDANCE WITH THE SPECIFICATION FOR HIGHWAY WORKS
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5. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER DRAWINGS PERTAINING TO THE WORKS.

## LEGEND

- PROPOSED SWALE
- PROPOSED PIPE
- PROPOSED HYDROBRAKE MANHOLE
- + IL 2.07 — PROPOSED INVERT LEVEL
- SURFACE FLOW DIRECTION
- PROPOSED ROAD
- PROPOSED FOOTPATH
- PROPOSED GRASS
- PROPOSED REINFORCED GRASS
- PROPOSED SuDS BASIN

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| ISSUE | DRN | APP | DATE | NOTES / DESCRIPTION |
|---|---|---|---|---|
| 1 | VB | AMC | 26/08/2021 | SuDS LAYOUT PLAN FOR PLANNING |

STATUS: PLANNING

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PROJECT: RIVERINE COMMUNITY PARK

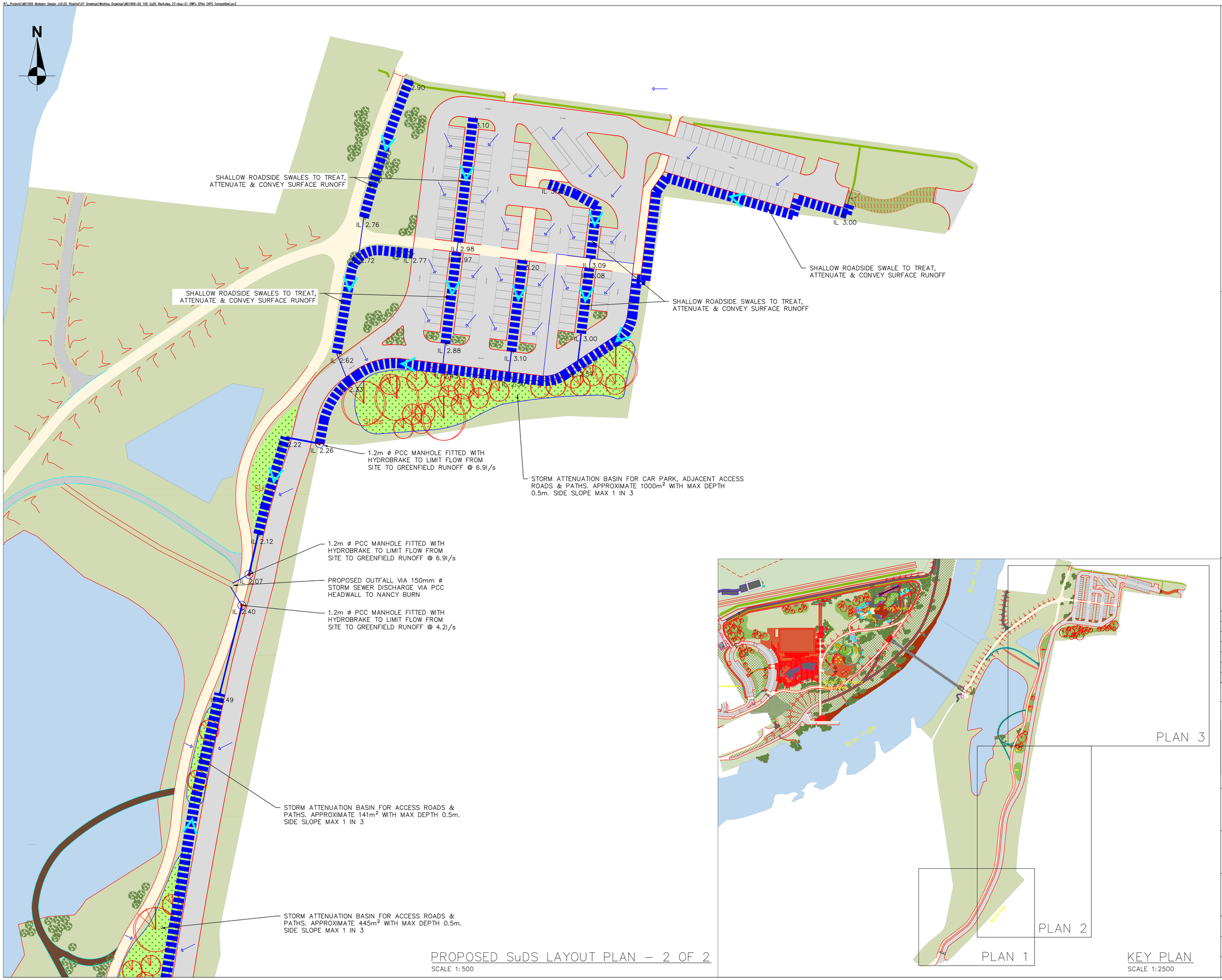
CLIENT: Comhairle Contae Dhún na nGall / Donegal County Council; Derry City & Strabane District Council

DRAWING TITLE: STRABANE PROPOSED SuDS LAYOUT PLAN SHEET 1 OF 2

| SCALE | ORIGINAL SIZE |
|---|---|
| AS SHOWN @ A1 | A1 |

| DRAWN | CHECKED | DATE |
|---|---|---|
| VB | AMC | 26/08/2021 |

| PROJECT No. | DRAWING No. | ISSUE NO. |
|---|---|---|
| M01959-02 | DWG_101 | 1 |




PROPOSED SuDS LAYOUT PLAN – 2 OF 2

SCALE 1:500

KEY PLAN

SCALE 1:2500

## NOTES

1. ALL DIMENSIONS IN MILLIMETRES (UNLESS SHOWN OTHERWISE) AND ALL LEVELS IN METRES TO ORDNACE SURVEY BENCH MARK.
2. DRAWINGS TO BE READ IN CONJUNCTION WITH CIVIL SPECIFICATION AND IN ACCORDANCE WITH THE SPECIFICATION FOR HIGHWAY WORKS
3. THE CONTRACTOR IS TO CONFIRM THE ACCURACY OF EXISTING SURVEY AND LINES AND LEVELS OF EXISTING SERVICES INDICATED ON THE CONTRACT DRAWINGS.
4. THE CONTRACTOR IS TO LIAISE WITH ALL STATUTORY UNDERTAKERS IN REGARD TO LOCATING ALL EXISTING SERVICES WITHIN AND ADJACENT TO THE SITE OF THE WORKS. NO EXCAVATION IS TO COMMENCE UNTIL ALL EXISTING SERVICES HAVE BEEN LOCATED, MARKED ON SITE AND PROTECTED TO THE SATISFACTION OF THE RELEVANT AUTHORITY.
5. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER DRAWINGS PERTAINING TO THE WORKS.

## LEGEND

- PROPOSED SWALE
- PROPOSED PIPE
- PROPOSED HYDROBRAKE MANHOLE
- + IL 2.07 — PROPOSED INVERT LEVEL
- SURFACE FLOW DIRECTION
- PROPOSED ROAD
- PROPOSED FOOTPATH
- PROPOSED GRASS
- PROPOSED REINFORCED GRASS
- PROPOSED SuDS BASIN

Project Manager, Civil & Structural Engineers
McAdam
ENHANCING LOCAL COMMUNITIES
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478 Castlereagh Road
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| ISSUE | DRN | APP | DATE | NOTES / DESCRIPTION |
|---|---|---|---|---|
| 1 | VB | AMC | 27/08/2021 | SuDS LAYOUT PLAN FOR PLANNING |

STATUS
PLANNING

McCloy Consulting
T: 028 9084 8694
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Mossley Mill, Lower Ground (West)
Carnmoney Road North
Newtownabbey
Co. Antrim, BT36 5QA

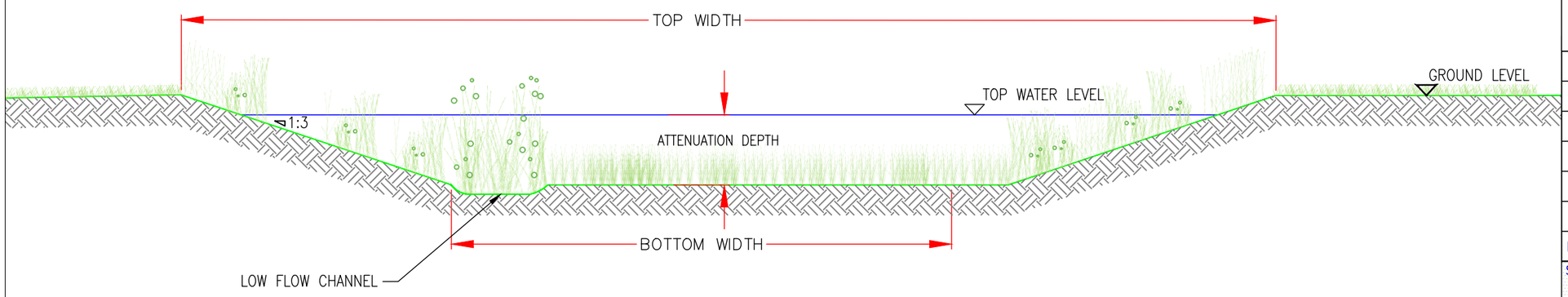
PROJECT
RIVERINE COMMUNITY PARK

CLIENT
Comhairle Contae Dhún na nGall
Donegal County Council
Derry City & Strabane District Council
Comhairle Chathair Dhoire & Cheantar an tSratha Bàin
Derry Cittie & Strabane Destrick Council

DRAWING TITLE
STRABANE
PROPOSED SuDS LAYOUT PLAN
SHEET 2 OF 2

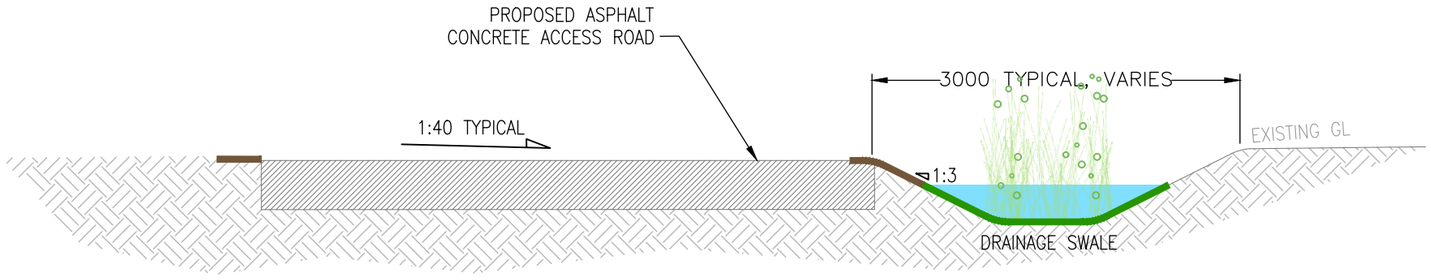
| SCALE | ORIGINAL SIZE | |
|---|---|---|
| AS SHOWN @ A1 | A1 | |
| DRAWN | CHECKED | DATE |
| VB | AMC | 26/08/2021 |
| PROJECT No. | DRAWING No. | ISSUE NO. |
| M01959-02 | DWG_102 | 1 |

R:_Projects\M01959 McAdam Design Ltd\02 Riverine\07 Drawings\Working Drawings\M01959-02 300 SuDS Typical Details.dwg 27-Aug-21 DWFx EPlot (XPS Compatible).pc3




TYPICAL SECTION SuDS BASIN

NTS




TYPICAL ROAD DRAINAGE SECTION

NTS


Project Manager, Civil & Structural Engineers

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| ISSUE | DRN | APP | DATE | NOTES / DESCRIPTION |
|---|---|---|---|---|
| 1 | VB | AMC | 26/08/2021 | SuDS DTYPICAL DETAILS FOR PLANNING |

STATUS

PLANNING


McCloy Consulting

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Newtownabbey
Co. Antrim, BT36 5QA


PROJECT

RIVERINE
COMMUNITY PARK

CLIENT

Comhairle Contae Dhún na nGall
Donegal County Council

Derry City & Strabane District Council
Comhairle Chathair Dhoire & Cheantar an tSratha Báin
Derry Cittie & Stràbane Destrick Cooncil

DRAWING TITLE

PROPOSED SuDS TYPICAL DETAILS

| SCALE | ORIGINAL SIZE |
|---|---|
| AS SHOWN @ A3 | A3 |

| DRAWN | CHECKED | DATE |
|---|---|---|
| VB | AMC | 26/08/2021 |

| PROJECT No. | DRAWING No. | ISSUE NO. |
|---|---|---|
| M01959-02 | DWG_300 | 1 |

# Appendix B

# Hydraulic calculations

## Design Settings

| | | | |
|---|---|---|---|
| Rainfall Methodology | FSR | Maximum Time of Concentration (mins) | 30.00 |
| Return Period (years) | 2 | Maximum Rainfall (mm/hr) | 50.0 |
| Additional Flow (%) | 0 | Minimum Velocity (m/s) | 1.00 |
| FSR Region | Scotland and Ireland | Connection Type | Level Soffits |
| M5-60 (mm) | 17.000 | Minimum Backdrop Height (m) | 0.200 |
| Ratio-R | 0.300 | Preferred Cover Depth (m) | 1.200 |
| CV | 0.750 | Include Intermediate Ground | ✓ |
| Time of Entry (mins) | 5.00 | Enforce best practice design rules | ✓ |

## Links (Input)

| Name | US Node | DS Node | Length (m) | ks (mm) / n | US IL (m) | DS IL (m) | Fall (m) | Slope (1:X) | Dia (mm) | T of C (mins) | Rain (mm/hr) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 1 | 2 | 128.835 | 0.032 | 3.000 | 2.570 | 0.430 | 299.6 | 1000 | 7.65 | 44.8 |
| 1.001 | 2 | 3 | 21.354 | 0.032 | 2.570 | 2.500 | 0.070 | 305.1 | 1000 | 8.10 | 43.6 |
| 1.002 | 3 | 4 | 19.525 | 0.032 | 2.500 | 2.430 | 0.070 | 278.9 | 1000 | 8.48 | 42.7 |
| 1.003 | 4 | 5 | 50.000 | 0.032 | 2.430 | 2.260 | 0.170 | 294.1 | 1000 | 9.50 | 40.5 |
| 2.000 | 6 | 7 | 30.975 | 0.032 | 3.200 | 3.090 | 0.110 | 281.6 | 1000 | 5.62 | 50.0 |
| 2.001 | 7 | 8 | 3.000 | 0.032 | 3.090 | 3.080 | 0.010 | 300.0 | 300 | 5.77 | 50.0 |
| 2.002 | 8 | 9 | 19.205 | 0.032 | 3.080 | 3.000 | 0.080 | 240.1 | 1000 | 6.13 | 49.3 |
| 2.003 | 9 | 2 | 9.938 | 0.032 | 2.700 | 2.570 | 0.130 | 76.4 | 300 | 6.39 | 48.4 |
| 3.000 | 10 | 11 | 26.910 | 0.032 | 3.200 | 3.100 | 0.100 | 269.1 | 1000 | 5.52 | 50.0 |
| 3.001 | 11 | 3 | 7.500 | 0.032 | 2.700 | 2.500 | 0.200 | 37.5 | 225 | 5.69 | 50.0 |
| 4.000 | 12 | 13 | 36.599 | 0.032 | 3.100 | 2.980 | 0.120 | 305.0 | 1000 | 5.76 | 50.0 |
| 4.001 | 13 | 14 | 3.141 | 0.032 | 2.980 | 2.970 | 0.010 | 314.1 | 300 | 5.93 | 50.0 |
| 4.002 | 14 | 15 | 26.910 | 0.032 | 2.970 | 2.880 | 0.090 | 299.0 | 1000 | 6.48 | 48.2 |
| 4.003 | 15 | 4 | 6.933 | 0.032 | 2.500 | 2.430 | 0.070 | 99.0 | 300 | 6.69 | 47.5 |
| 5.000 | 17 | 18 | 42.440 | 0.032 | 2.900 | 2.760 | 0.140 | 303.1 | 1000 | 5.88 | 50.0 |
| 5.001 | 18 | 19 | 10.600 | 0.032 | 2.760 | 2.720 | 0.040 | 265.0 | 150 | 6.70 | 47.5 |
| 5.002 | 19 | 20 | 29.876 | 0.032 | 2.720 | 2.620 | 0.100 | 298.8 | 1000 | 7.31 | 45.7 |
| 5.003 | 20 | 16 | 9.000 | 0.032 | 2.620 | 2.488 | 0.132 | 68.2 | 150 | 7.67 | 44.7 |
| 1.004 | 5 | 22 | 10.163 | 0.032 | 2.260 | 2.220 | 0.040 | 254.1 | 450 | 9.87 | 39.7 |
| 1.005 | 22 | 23 | 29.550 | 0.032 | 2.220 | 2.120 | 0.100 | 295.5 | 1000 | 10.48 | 38.6 |
| 1.006 | 23 | 24 | 12.143 | 0.032 | 2.120 | 2.070 | 0.050 | 242.9 | 450 | 10.91 | 37.8 |

## Simulation Settings

| | | | |
|---|---|---|---|
| Rainfall Methodology | FSR | Analysis Speed | Normal |
| FSR Region | Scotland and Ireland | Skip Steady State | ✓ |
| M5-60 (mm) | 17.000 | Drain Down Time (mins) | 240 |
| Ratio-R | 0.300 | Additional Storage (m³/ha) | 20.0 |
| Summer CV | 0.750 | Check Discharge Rate(s) | x |
| Winter CV | 0.840 | Check Discharge Volume | x |

### Storm Durations

| 15 | 30 | 60 | 120 | 180 | 240 | 360 | 480 | 600 | 720 | 960 | 1440 |
|---|---|---|---|---|---|---|---|---|---|---|---|

| Return Period (years) | Climate Change (CC %) | Additional Area (A %) | Additional Flow (Q %) |
|---|---|---|---|
| 1 | 20 | 10 | 0 |
| 30 | 20 | 10 | 0 |
| 100 | 20 | 10 | 0 |

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## Node 5 Online Hydro-Brake® Control

| | | | |
|---|---|---|---|
| Flap Valve | ✓ | Objective | (HE) Minimise upstream storage |
| Replaces Downstream Link | ✓ | Sump Available | ✓ |
| Invert Level (m) | 2.260 | Product Number | CTL-SHE-0123-6900-1000-6900 |
| Design Depth (m) | 1.000 | Min Outlet Diameter (m) | 0.150 |
| Design Flow (l/s) | 6.9 | Min Node Diameter (mm) | 1200 |

## Node 24 Online Hydro-Brake® Control

| | | | |
|---|---|---|---|
| Flap Valve | x | Objective | (HE) Minimise upstream storage |
| Replaces Downstream Link | ✓ | Sump Available | ✓ |
| Invert Level (m) | 2.070 | Product Number | CTL-SHE-0123-6900-1000-6900 |
| Design Depth (m) | 1.000 | Min Outlet Diameter (m) | 0.150 |
| Design Flow (l/s) | 6.9 | Min Node Diameter (mm) | 1200 |

## Node 5 Depth/Area Storage Structure

| | | | | | |
|---|---|---|---|---|---|
| Base Inf Coefficient (m/hr) | 0.00000 | Safety Factor | 2.0 | Invert Level (m) | 2.260 |
| Side Inf Coefficient (m/hr) | 0.00000 | Porosity | 1.00 | Time to half empty (mins) | 0 |

| Depth (m) | Area (m²) | Inf Area (m²) | Depth (m) | Area (m²) | Inf Area (m²) |
|---|---|---|---|---|---|
| 0.000 | 756.0 | 0.0 | 0.500 | 983.0 | 0.0 |

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**Results for 1 year +20% CC +10% A Critical Storm Duration. Lowest mass balance: 99.85%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | 1 | 1 | 3.000 | 0.000 | 0.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 1.000:50% | 13 | 2.822 | 0.037 | 12.1 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 2 | 14 | 2.654 | 0.084 | 34.5 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 1.001:50% | 14 | 2.623 | 0.088 | 32.2 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 3 | 14 | 2.598 | 0.098 | 43.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 1.002:50% | 14 | 2.570 | 0.105 | 43.4 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 4 | 14 | 2.550 | 0.120 | 60.8 | 0.0000 | 0.0000 | OK |
| 30 minute winter | 1.003:50% | 24 | 2.486 | 0.141 | 62.0 | 0.0000 | 0.0000 | OK |
| 480 minute winter | 5 | 352 | 2.384 | 0.124 | 14.3 | 96.9678 | 0.0000 | OK |
| 15 minute winter | 6 | 12 | 3.223 | 0.023 | 1.8 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 2.000:50% | 12 | 3.223 | 0.078 | 22.3 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 7 | 12 | 3.215 | 0.125 | 18.9 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 8 | 12 | 3.139 | 0.059 | 18.4 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 2.002:50% | 12 | 3.120 | 0.080 | 27.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 9 | 12 | 2.862 | 0.162 | 26.7 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 10 | 11 | 3.212 | 0.012 | 0.9 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 3.000:50% | 11 | 3.212 | 0.062 | 15.1 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 11 | 11 | 2.808 | 0.108 | 13.6 | 0.0000 | 0.0000 | OK |
| 15 minute summer | 12 | 1 | 3.100 | 0.000 | 0.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 4.000:50% | 12 | 3.095 | 0.055 | 14.9 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 13 | 12 | 3.086 | 0.106 | 13.1 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 14 | 12 | 3.019 | 0.049 | 12.4 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 4.002:50% | 12 | 3.000 | 0.075 | 20.6 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 15 | 12 | 2.650 | 0.150 | 19.4 | 0.0000 | 0.0000 | OK |
| 120 minute winter | 16 | 92 | 2.507 | 0.019 | 0.5 | 0.0000 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | 1 | 1.000 | 1.000:50% | 0.0 | 0.000 | 0.000 | 1.2678 | |
| 15 minute summer | 1 | 1.000 | 2 | 7.2 | 0.132 | 0.007 | 4.4082 | |
| 15 minute winter | 2 | 1.001 | 1.001:50% | 31.0 | 0.289 | 0.031 | 1.1502 | |
| 15 minute winter | 2 | 1.001 | 3 | 32.3 | 0.272 | 0.032 | 1.2701 | |
| 15 minute winter | 3 | 1.002 | 1.002:50% | 42.4 | 0.325 | 0.040 | 1.2914 | |
| 15 minute winter | 3 | 1.002 | 4 | 43.3 | 0.289 | 0.041 | 1.4651 | |
| 15 minute winter | 4 | 1.003 | 1.003:50% | 60.5 | 0.373 | 0.059 | 4.1497 | |
| 15 minute winter | 4 | 1.003 | 5 | 63.8 | 0.829 | 0.062 | 2.7711 | |
| 480 minute winter | 5 | Hydro-Brake® | 22 | 5.6 | | | | |
| 15 minute winter | 6 | 2.000 | 2.000:50% | -1.8 | -0.045 | -0.002 | 0.9326 | |
| 15 minute winter | 6 | 2.000 | 7 | 18.9 | 0.154 | 0.018 | 2.0768 | |
| 15 minute winter | 7 | 2.001 | 8 | 18.4 | 1.002 | 0.812 | 0.0565 | |
| 15 minute winter | 8 | 2.002 | 2.002:50% | 18.4 | 0.219 | 0.016 | 0.8132 | |
| 15 minute winter | 8 | 2.002 | 9 | 26.7 | 0.376 | 0.024 | 0.6935 | |
| 15 minute winter | 9 | 2.003 | 2 | 26.8 | 1.083 | 0.596 | 0.2644 | |
| 15 minute winter | 10 | 3.000 | 3.000:50% | -0.9 | -0.030 | -0.001 | 0.5749 | |
| 15 minute winter | 10 | 3.000 | 11 | 13.6 | 0.274 | 0.013 | 0.6795 | |
| 15 minute winter | 11 | 3.001 | 3 | 13.5 | 0.945 | 0.454 | 0.1262 | |
| 15 minute summer | 12 | 4.000 | 4.000:50% | 0.0 | 0.000 | 0.000 | 0.5645 | |
| 15 minute summer | 12 | 4.000 | 13 | 12.7 | 0.147 | 0.013 | 1.8147 | |
| 15 minute winter | 13 | 4.001 | 14 | 12.4 | 0.862 | 0.561 | 0.0468 | |
| 15 minute winter | 14 | 4.002 | 4.002:50% | 12.3 | 0.168 | 0.012 | 0.9942 | |
| 15 minute winter | 14 | 4.002 | 15 | 19.4 | 0.310 | 0.019 | 0.8593 | |
| 15 minute winter | 15 | 4.003 | 4 | 19.2 | 0.695 | 0.486 | 0.2084 | |

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**Results for 1 year +20% CC +10% A Critical Storm Duration. Lowest mass balance: 99.85%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | 17 | 1 | 2.900 | 0.000 | 0.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 5.000:50% | 11 | 2.847 | 0.017 | 2.1 | 0.0000 | 0.0000 | OK |
| 60 minute winter | 18 | 44 | 2.821 | 0.061 | 1.1 | 0.0000 | 0.0000 | OK |
| 30 minute winter | 19 | 28 | 2.730 | 0.010 | 0.6 | 0.0000 | 0.0000 | OK |
| 120 minute winter | 20 | 92 | 2.650 | 0.030 | 0.6 | 0.0000 | 0.0000 | OK |
| 480 minute winter | 22 | 352 | 2.251 | 0.031 | 5.6 | 0.0000 | 0.0000 | OK |
| 480 minute winter | 1.005:50% | 336 | 2.220 | 0.050 | 6.0 | 0.0000 | 0.0000 | OK |
| 480 minute winter | 23 | 336 | 2.218 | 0.098 | 6.0 | 0.0000 | 0.0000 | OK |
| 480 minute winter | 24 | 336 | 2.203 | 0.133 | 6.0 | 0.1905 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | 17 | 5.000 | 5.000:50% | 0.0 | 0.000 | 0.000 | 0.1797 | |
| 15 minute summer | 17 | 5.000 | 18 | 1.8 | 0.107 | 0.002 | 0.6286 | |
| 60 minute winter | 18 | 5.001 | 19 | 0.7 | 0.209 | 0.172 | 0.0381 | |
| 30 minute winter | 19 | 5.002 | 20 | 0.7 | 0.076 | 0.001 | 0.4878 | |
| 120 minute winter | 20 | 5.003 | 16 | 0.5 | 0.255 | 0.064 | 0.0172 | 1.9 |
| 480 minute winter | 22 | 1.005 | 1.005:50% | 5.6 | 0.144 | 0.005 | 0.6722 | |
| 480 minute winter | 22 | 1.005 | 23 | 6.0 | 0.075 | 0.006 | 1.3612 | |
| 480 minute winter | 23 | 1.006 | 24 | 6.0 | 0.204 | 0.081 | 0.3916 | |
| 480 minute winter | 24 | Hydro-Brake® | | 6.0 | | | | 132.9 |

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**Results for 30 year +20% CC +10% A Critical Storm Duration. Lowest mass balance: 99.85%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | 1 | 1 | 3.000 | 0.000 | 0.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 1.000:50% | 12 | 2.849 | 0.064 | 26.8 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 2 | 13 | 2.711 | 0.141 | 80.9 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 1.001:50% | 13 | 2.686 | 0.151 | 78.5 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 3 | 13 | 2.666 | 0.166 | 103.9 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 1.002:50% | 13 | 2.641 | 0.176 | 106.9 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 4 | 13 | 2.623 | 0.193 | 147.9 | 0.0000 | 0.0000 | OK |
| 30 minute winter | 1.003:50% | 23 | 2.541 | 0.196 | 144.1 | 0.0000 | 0.0000 | OK |
| 480 minute winter | 5 | 384 | 2.512 | 0.252 | 27.9 | 205.0621 | 0.0000 | OK |
| 15 minute winter | 6 | 12 | 3.281 | 0.081 | 4.6 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 2.000:50% | 12 | 3.281 | 0.136 | 49.6 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 7 | 12 | 3.275 | 0.185 | 42.6 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 8 | 12 | 3.177 | 0.097 | 41.5 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 2.002:50% | 12 | 3.156 | 0.116 | 61.5 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 9 | 12 | 3.031 | 0.331 | 60.5 | 0.0000 | 0.0000 | SURCHARGED |
| 15 minute winter | 10 | 11 | 3.244 | 0.044 | 2.3 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 3.000:50% | 11 | 3.244 | 0.094 | 33.7 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 11 | 11 | 2.899 | 0.199 | 31.5 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 12 | 12 | 3.140 | 0.040 | 3.2 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 4.000:50% | 12 | 3.140 | 0.100 | 33.1 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 13 | 12 | 3.131 | 0.151 | 27.3 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 14 | 12 | 3.053 | 0.083 | 26.5 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 4.002:50% | 12 | 3.036 | 0.111 | 44.7 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 15 | 12 | 2.745 | 0.245 | 43.8 | 0.0000 | 0.0000 | OK |
| 60 minute winter | 16 | 52 | 2.521 | 0.033 | 1.3 | 0.0000 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | 1 | 1.000 | 1.000:50% | 0.0 | 0.000 | 0.000 | 2.3554 | |
| 15 minute summer | 1 | 1.000 | 2 | 18.5 | 0.154 | 0.018 | 8.4144 | |
| 15 minute winter | 2 | 1.001 | 1.001:50% | 74.8 | 0.356 | 0.075 | 2.2442 | |
| 15 minute winter | 2 | 1.001 | 3 | 78.0 | 0.337 | 0.078 | 2.4951 | |
| 15 minute winter | 3 | 1.002 | 1.002:50% | 103.6 | 0.400 | 0.099 | 2.5288 | |
| 15 minute winter | 3 | 1.002 | 4 | 106.2 | 0.370 | 0.101 | 2.8025 | |
| 15 minute winter | 4 | 1.003 | 1.003:50% | 146.2 | 0.504 | 0.143 | 7.2543 | |
| 15 minute winter | 4 | 1.003 | 5 | 152.7 | 1.073 | 0.149 | 4.6561 | |
| 480 minute winter | 5 | Hydro-Brake® | 22 | 6.5 | | | | |
| 15 minute winter | 6 | 2.000 | 2.000:50% | -4.6 | -0.066 | -0.004 | 2.2715 | |
| 15 minute winter | 6 | 2.000 | 7 | 42.6 | 0.186 | 0.041 | 3.7091 | |
| 15 minute winter | 7 | 2.001 | 8 | 41.5 | 1.278 | 1.832 | 0.0979 | |
| 15 minute winter | 8 | 2.002 | 2.002:50% | 41.7 | 0.297 | 0.037 | 1.3517 | |
| 15 minute winter | 8 | 2.002 | 9 | 60.5 | 0.520 | 0.054 | 1.1349 | |
| 15 minute winter | 9 | 2.003 | 2 | 61.0 | 1.241 | 1.357 | 0.5120 | |
| 15 minute winter | 10 | 3.000 | 3.000:50% | -2.3 | -0.050 | -0.002 | 1.1438 | |
| 15 minute winter | 10 | 3.000 | 11 | 31.5 | 0.377 | 0.030 | 1.1484 | |
| 15 minute winter | 11 | 3.001 | 3 | 31.3 | 1.054 | 1.051 | 0.2478 | |
| 15 minute winter | 12 | 4.000 | 4.000:50% | -3.2 | -0.061 | -0.003 | 1.6010 | |
| 15 minute winter | 12 | 4.000 | 13 | 27.3 | 0.172 | 0.027 | 3.1998 | |
| 15 minute winter | 13 | 4.001 | 14 | 26.5 | 1.038 | 1.194 | 0.0809 | |
| 15 minute winter | 14 | 4.002 | 4.002:50% | 26.4 | 0.215 | 0.026 | 1.6948 | |
| 15 minute winter | 14 | 4.002 | 15 | 43.8 | 0.423 | 0.043 | 1.4258 | |
| 15 minute winter | 15 | 4.003 | 4 | 43.8 | 0.836 | 1.109 | 0.3740 | |

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**Results for 30 year +20% CC +10% A Critical Storm Duration. Lowest mass balance: 99.85%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | 17 | 1 | 2.900 | 0.000 | 0.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 5.000:50% | 11 | 2.856 | 0.026 | 4.6 | 0.0000 | 0.0000 | OK |
| 30 minute winter | 18 | 23 | 2.853 | 0.093 | 3.5 | 0.0000 | 0.0000 | OK |
| 30 minute winter | 19 | 23 | 2.737 | 0.017 | 1.7 | 0.0000 | 0.0000 | OK |
| 60 minute winter | 20 | 52 | 2.669 | 0.049 | 1.6 | 0.0000 | 0.0000 | OK |
| 480 minute winter | 22 | 368 | 2.356 | 0.136 | 6.5 | 0.0000 | 0.0000 | OK |
| 480 minute winter | 1.005:50% | 368 | 2.356 | 0.186 | 8.0 | 0.0000 | 0.0000 | OK |
| 480 minute winter | 23 | 368 | 2.356 | 0.236 | 7.3 | 0.0000 | 0.0000 | OK |
| 480 minute winter | 24 | 368 | 2.355 | 0.285 | 6.9 | 0.4081 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | 17 | 5.000 | 5.000:50% | 0.0 | 0.000 | 0.000 | 0.2886 | |
| 15 minute summer | 17 | 5.000 | 18 | 4.0 | 0.130 | 0.004 | 1.2791 | |
| 30 minute winter | 18 | 5.001 | 19 | 1.7 | 0.293 | 0.452 | 0.0666 | |
| 30 minute winter | 19 | 5.002 | 20 | 2.0 | 0.112 | 0.002 | 0.9679 | |
| 60 minute winter | 20 | 5.003 | 16 | 1.3 | 0.348 | 0.179 | 0.0350 | 3.5 |
| 480 minute winter | 22 | 1.005 | 1.005:50% | 6.5 | 0.118 | 0.006 | 3.5657 | |
| 480 minute winter | 22 | 1.005 | 23 | 7.3 | 0.076 | 0.007 | 5.1270 | |
| 480 minute winter | 23 | 1.006 | 24 | 6.9 | 0.205 | 0.093 | 1.1546 | |
| 480 minute winter | 24 | Hydro-Brake® | | 6.9 | | | | 225.4 |

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**Results for 100 year +20% CC +10% A Critical Storm Duration. Lowest mass balance: 99.85%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | 1 | 1 | 3.000 | 0.000 | 0.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 1.000:50% | 12 | 2.861 | 0.076 | 34.9 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 2 | 14 | 2.735 | 0.165 | 100.8 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 1.001:50% | 13 | 2.711 | 0.176 | 101.1 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 3 | 13 | 2.692 | 0.192 | 134.1 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 1.002:50% | 13 | 2.669 | 0.204 | 138.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 4 | 13 | 2.651 | 0.221 | 191.6 | 0.0000 | 0.0000 | OK |
| 600 minute winter | 1.003:50% | 495 | 2.582 | 0.237 | 30.4 | 0.0000 | 0.0000 | OK |
| 600 minute winter | 5 | 495 | 2.582 | 0.322 | 29.3 | 266.8007 | 0.0000 | OK |
| 15 minute winter | 6 | 12 | 3.308 | 0.108 | 5.3 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 2.000:50% | 12 | 3.308 | 0.163 | 64.4 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 7 | 12 | 3.302 | 0.212 | 55.4 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 8 | 12 | 3.197 | 0.117 | 53.6 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 2.002:50% | 12 | 3.180 | 0.140 | 79.7 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 9 | 12 | 3.160 | 0.460 | 76.6 | 0.0000 | 0.0000 | SURCHARGED |
| 15 minute winter | 10 | 11 | 3.256 | 0.056 | 2.6 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 3.000:50% | 11 | 3.256 | 0.106 | 43.7 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 11 | 11 | 3.037 | 0.337 | 41.7 | 0.0000 | 0.0000 | SURCHARGED |
| 15 minute winter | 12 | 12 | 3.161 | 0.061 | 4.5 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 4.000:50% | 12 | 3.160 | 0.120 | 43.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 13 | 12 | 3.152 | 0.172 | 35.3 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 14 | 12 | 3.068 | 0.098 | 34.5 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 4.002:50% | 12 | 3.050 | 0.125 | 58.5 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 15 | 12 | 2.803 | 0.303 | 57.4 | 0.0000 | 0.0000 | SURCHARGED |
| 60 minute winter | 16 | 50 | 2.525 | 0.037 | 1.8 | 0.0000 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | 1 | 1.000 | 1.000:50% | 0.0 | 0.000 | 0.000 | 2.8768 | |
| 15 minute summer | 1 | 1.000 | 2 | 25.0 | 0.170 | 0.025 | 10.3577 | |
| 15 minute winter | 2 | 1.001 | 1.001:50% | 97.7 | 0.381 | 0.097 | 2.7479 | |
| 15 minute winter | 2 | 1.001 | 3 | 102.4 | 0.365 | 0.102 | 3.0521 | |
| 15 minute winter | 3 | 1.002 | 1.002:50% | 133.8 | 0.424 | 0.128 | 3.0843 | |
| 15 minute winter | 3 | 1.002 | 4 | 137.5 | 0.396 | 0.131 | 3.3972 | |
| 15 minute winter | 4 | 1.003 | 1.003:50% | 190.9 | 0.550 | 0.187 | 8.6828 | |
| 15 minute winter | 4 | 1.003 | 5 | 199.6 | 1.180 | 0.195 | 5.7288 | |
| 600 minute winter | 5 | Hydro-Brake® | 22 | 6.4 | | | | |
| 15 minute winter | 6 | 2.000 | 2.000:50% | -5.3 | -0.075 | -0.005 | 2.9931 | |
| 15 minute winter | 6 | 2.000 | 7 | 55.4 | 0.200 | 0.053 | 4.5721 | |
| 15 minute winter | 7 | 2.001 | 8 | 53.6 | 1.373 | 2.362 | 0.1180 | |
| 15 minute winter | 8 | 2.002 | 2.002:50% | 53.2 | 0.310 | 0.047 | 1.7104 | |
| 15 minute winter | 8 | 2.002 | 9 | 76.6 | 0.539 | 0.068 | 2.0926 | |
| 15 minute winter | 9 | 2.003 | 2 | 74.1 | 1.278 | 1.649 | 0.5467 | |
| 15 minute winter | 10 | 3.000 | 3.000:50% | -2.6 | -0.055 | -0.002 | 1.3849 | |
| 15 minute winter | 10 | 3.000 | 11 | 41.7 | 0.422 | 0.039 | 1.3572 | |
| 15 minute winter | 11 | 3.001 | 3 | 41.4 | 1.089 | 1.388 | 0.2844 | |
| 15 minute winter | 12 | 4.000 | 4.000:50% | -4.5 | -0.068 | -0.005 | 2.1563 | |
| 15 minute winter | 12 | 4.000 | 13 | 35.3 | 0.189 | 0.035 | 3.8902 | |
| 15 minute winter | 13 | 4.001 | 14 | 34.5 | 1.122 | 1.555 | 0.0969 | |
| 15 minute winter | 14 | 4.002 | 4.002:50% | 34.5 | 0.238 | 0.034 | 2.0024 | |
| 15 minute winter | 14 | 4.002 | 15 | 57.4 | 0.471 | 0.057 | 1.6754 | |
| 15 minute winter | 15 | 4.003 | 4 | 57.5 | 0.899 | 1.456 | 0.4348 | |

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**Results for 100 year +20% CC +10% A Critical Storm Duration. Lowest mass balance: 99.85%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | 17 | 1 | 2.900 | 0.000 | 0.0 | 0.0000 | 0.0000 | OK |
| 30 minute winter | 5.000:50% | 23 | 2.865 | 0.035 | 4.8 | 0.0000 | 0.0000 | OK |
| 30 minute winter | 18 | 23 | 2.864 | 0.104 | 4.5 | 0.0000 | 0.0000 | OK |
| 30 minute winter | 19 | 22 | 2.739 | 0.019 | 2.2 | 0.0000 | 0.0000 | OK |
| 60 minute winter | 20 | 50 | 2.676 | 0.056 | 2.0 | 0.0000 | 0.0000 | OK |
| 600 minute winter | 22 | 480 | 2.424 | 0.204 | 6.4 | 0.0000 | 0.0000 | OK |
| 600 minute winter | 1.005:50% | 480 | 2.424 | 0.254 | 8.2 | 0.0000 | 0.0000 | OK |
| 600 minute winter | 23 | 480 | 2.424 | 0.304 | 7.5 | 0.0000 | 0.0000 | OK |
| 600 minute winter | 24 | 480 | 2.424 | 0.354 | 7.0 | 0.5064 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | 17 | 5.000 | 5.000:50% | 0.0 | 0.000 | 0.000 | 0.3399 | |
| 15 minute summer | 17 | 5.000 | 18 | 5.2 | 0.145 | 0.005 | 1.5769 | |
| 30 minute winter | 18 | 5.001 | 19 | 2.2 | 0.321 | 0.571 | 0.0758 | |
| 30 minute winter | 19 | 5.002 | 20 | 2.4 | 0.120 | 0.002 | 1.1559 | |
| 60 minute winter | 20 | 5.003 | 16 | 1.8 | 0.378 | 0.235 | 0.0422 | 4.6 |
| 600 minute winter | 22 | 1.005 | 1.005:50% | 6.5 | 0.121 | 0.006 | 5.7519 | |
| 600 minute winter | 22 | 1.005 | 23 | 7.5 | 0.075 | 0.007 | 7.6175 | |
| 600 minute winter | 23 | 1.006 | 24 | 7.0 | 0.204 | 0.094 | 1.5048 | |
| 600 minute winter | 24 | Hydro-Brake® | | 6.9 | | | | 266.9 |

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## Design Settings

| | | | |
|---|---|---|---|
| Rainfall Methodology | FSR | Maximum Time of Concentration (mins) | 30.00 |
| Return Period (years) | 2 | Maximum Rainfall (mm/hr) | 50.0 |
| Additional Flow (%) | 0 | Minimum Velocity (m/s) | 1.00 |
| FSR Region | Scotland and Ireland | Connection Type | Level Soffits |
| M5-60 (mm) | 17.000 | Minimum Backdrop Height (m) | 0.200 |
| Ratio-R | 0.300 | Preferred Cover Depth (m) | 1.200 |
| CV | 0.750 | Include Intermediate Ground | ✓ |
| Time of Entry (mins) | 5.00 | Enforce best practice design rules | ✓ |

## Links (Input)

| Name | US Node | DS Node | Length (m) | ks (mm) / n | US IL (m) | DS IL (m) | Fall (m) | Slope (1:X) | Dia (mm) | T of C (mins) | Rain (mm/hr) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 1 | 2 | 280.000 | 0.032 | 5.400 | 3.000 | 2.400 | 116.7 | 1000 | 8.60 | 42.5 |
| 1.001 | 2 | 3 | 20.926 | 0.032 | 3.000 | 2.940 | 0.060 | 348.8 | 375 | 9.61 | 40.3 |
| 1.002 | 3 | 4 | 135.140 | 0.032 | 2.940 | 2.490 | 0.450 | 300.3 | 1000 | 12.39 | 35.4 |
| 1.003 | 4 | 5 | 26.700 | 0.032 | 2.490 | 2.400 | 0.090 | 296.7 | 375 | 13.58 | 33.8 |

## Simulation Settings

| | | | |
|---|---|---|---|
| Rainfall Methodology | FSR | Drain Down Time (mins) | 240 |
| FSR Region | Scotland and Ireland | Additional Storage (m³/ha) | 20.0 |
| M5-60 (mm) | 17.000 | Check Discharge Rate(s) | ✓ |
| Ratio-R | 0.300 | 1 year (l/s) | 4.0 |
| Summer CV | 0.750 | 30 year (l/s) | 4.0 |
| Winter CV | 0.840 | 100 year (l/s) | 4.0 |
| Analysis Speed | Normal | Check Discharge Volume | x |
| Skip Steady State | ✓ | | |

### Storm Durations

| 15 | 30 | 60 | 120 | 180 | 240 | 360 | 480 | 600 | 720 | 960 | 1440 |
|---|---|---|---|---|---|---|---|---|---|---|---|

| Return Period (years) | Climate Change (CC %) | Additional Area (A %) | Additional Flow (Q %) |
|---|---|---|---|
| 1 | 20 | 10 | 0 |
| 30 | 20 | 10 | 0 |
| 100 | 20 | 10 | 0 |

## Pre-development Discharge Rate

| | | | |
|---|---|---|---|
| Site Makeup | Greenfield | Growth Factor 30 years | 1.95 |
| Greenfield Method | IH124 | Growth Factor 100 years | 2.48 |
| Positively Drained Area (ha) | 1.440 | Betterment (%) | 0 |
| SAAR (mm) | 1193 | QBar | 4.9 |
| Soil Index | 2 | Q 1 year (l/s) | 4.2 |
| SPR | 0.30 | Q 30 year (l/s) | 9.6 |
| Region | 1 | Q 100 year (l/s) | 12.1 |
| Growth Factor 1 year | 0.85 | | |

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## Node 5 Online Hydro-Brake® Control

| | | | |
|---|---|---|---|
| Flap Valve | x | Objective | (HE) Minimise upstream storage |
| Replaces Downstream Link | ✓ | Sump Available | ✓ |
| Invert Level (m) | 2.400 | Product Number | CTL-SHE-0084-4200-2000-4200 |
| Design Depth (m) | 2.000 | Min Outlet Diameter (m) | 0.100 |
| Design Flow (l/s) | 4.2 | Min Node Diameter (mm) | 1200 |

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**Results for 1 year +20% CC +10% A Critical Storm Duration. Lowest mass balance: 98.15%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | 1 | 1 | 5.400 | 0.000 | 0.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 1.000:50% | 13 | 4.266 | 0.066 | 39.9 | 0.0000 | 0.0000 | OK |
| 60 minute winter | 2 | 48 | 3.167 | 0.167 | 19.9 | 0.0000 | 0.0000 | OK |
| 60 minute winter | 3 | 51 | 2.984 | 0.044 | 10.5 | 0.0000 | 0.0000 | OK |
| 360 minute winter | 1.002:50% | 304 | 2.884 | 0.169 | 11.0 | 0.0000 | 0.0000 | OK |
| 360 minute winter | 4 | 304 | 2.884 | 0.394 | 10.1 | 0.0000 | 0.0000 | SURCHARGED |
| 360 minute winter | 5 | 304 | 2.883 | 0.483 | 3.8 | 0.6918 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | 1 | 1.000 | 1.000:50% | 0.0 | 0.000 | 0.000 | 5.2778 | |
| 15 minute summer | 1 | 1.000 | 2 | 27.8 | 0.397 | 0.017 | 13.1868 | |
| 60 minute winter | 2 | 1.001 | 3 | 10.5 | 0.415 | 0.275 | 0.5702 | |
| 60 minute winter | 3 | 1.002 | 1.002:50% | 10.4 | 0.188 | 0.010 | 5.2094 | |
| 60 minute winter | 3 | 1.002 | 4 | 15.5 | 0.142 | 0.015 | 25.7641 | |
| 360 minute winter | 4 | 1.003 | 5 | 3.8 | 0.155 | 0.091 | 2.9449 | |
| 360 minute winter | 5 | Hydro-Brake® | | 3.3 | | | | 98.0 |

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**Results for 30 year +20% CC +10% A Critical Storm Duration. Lowest mass balance: 98.15%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | 1 | 1 | 5.400 | 0.000 | 0.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 1.000:50% | 12 | 4.307 | 0.107 | 88.5 | 0.0000 | 0.0000 | OK |
| 60 minute winter | 2 | 44 | 3.257 | 0.257 | 44.6 | 0.0000 | 0.0000 | OK |
| 480 minute winter | 3 | 464 | 3.137 | 0.197 | 12.8 | 0.0000 | 0.0000 | OK |
| 480 minute winter | 1.002:50% | 464 | 3.137 | 0.422 | 19.1 | 0.0000 | 0.0000 | OK |
| 480 minute winter | 4 | 464 | 3.137 | 0.647 | 10.6 | 0.0000 | 0.0000 | SURCHARGED |
| 480 minute winter | 5 | 464 | 3.136 | 0.736 | 3.8 | 1.0538 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | 1 | 1.000 | 1.000:50% | 0.0 | 0.000 | 0.000 | 9.5502 | |
| 15 minute summer | 1 | 1.000 | 2 | 69.8 | 0.538 | 0.043 | 27.8620 | |
| 60 minute winter | 2 | 1.001 | 3 | 29.8 | 0.623 | 0.783 | 1.0215 | |
| 480 minute winter | 3 | 1.002 | 1.002:50% | 11.3 | 0.134 | 0.011 | 42.8634 | |
| 480 minute winter | 3 | 1.002 | 4 | 10.6 | 0.085 | 0.011 | 96.5501 | |
| 480 minute winter | 4 | 1.003 | 5 | 3.8 | 0.153 | 0.091 | 2.9449 | |
| 480 minute winter | 5 | Hydro-Brake® | | 3.3 | | | | 112.8 |

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**Results for 100 year +20% CC +10% A Critical Storm Duration. Lowest mass balance: 98.15%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | 1 | 1 | 5.400 | 0.000 | 0.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 1.000:50% | 11 | 4.322 | 0.122 | 115.0 | 0.0000 | 0.0000 | OK |
| 60 minute winter | 2 | 43 | 3.296 | 0.296 | 58.5 | 0.0000 | 0.0000 | OK |
| 480 minute winter | 3 | 472 | 3.225 | 0.285 | 16.8 | 0.0000 | 0.0000 | OK |
| 480 minute winter | 1.002:50% | 472 | 3.225 | 0.510 | 23.4 | 0.0000 | 0.0000 | SURCHARGED |
| 480 minute winter | 4 | 472 | 3.225 | 0.735 | 11.5 | 0.0000 | 0.0000 | SURCHARGED |
| 480 minute winter | 5 | 472 | 3.224 | 0.824 | 3.7 | 1.1796 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | 1 | 1.000 | 1.000:50% | 0.0 | 0.000 | 0.000 | 11.3671 | |
| 15 minute summer | 1 | 1.000 | 2 | 96.2 | 0.569 | 0.059 | 34.6185 | |
| 60 minute winter | 2 | 1.001 | 3 | 40.4 | 0.695 | 1.058 | 1.2071 | |
| 480 minute winter | 3 | 1.002 | 1.002:50% | 13.2 | 0.133 | 0.013 | 61.4104 | |
| 480 minute winter | 3 | 1.002 | 4 | 11.5 | 0.097 | 0.011 | 123.1225 | |
| 480 minute winter | 4 | 1.003 | 5 | 3.7 | 0.153 | 0.090 | 2.9449 | |
| 480 minute winter | 5 | Hydro-Brake® | | 3.3 | | | | 113.0 |

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## Design Settings

| | | | |
|---|---|---|---|
| Rainfall Methodology | FSR | Maximum Time of Concentration (mins) | 30.00 |
| Return Period (years) | 2 | Maximum Rainfall (mm/hr) | 50.0 |
| Additional Flow (%) | 0 | Minimum Velocity (m/s) | 1.00 |
| FSR Region | Scotland and Ireland | Connection Type | Level Soffits |
| M5-60 (mm) | 17.000 | Minimum Backdrop Height (m) | 0.200 |
| Ratio-R | 0.300 | Preferred Cover Depth (m) | 1.200 |
| CV | 0.750 | Include Intermediate Ground | ✓ |
| Time of Entry (mins) | 5.00 | Enforce best practice design rules | ✓ |

## Links (Input)

| Name | US Node | DS Node | Length (m) | ks (mm) / n | US IL (m) | DS IL (m) | Fall (m) | Slope (1:X) | Dia (mm) | T of C (mins) | Rain (mm/hr) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.001 | 1 | 2 | 35.128 | 0.032 | 4.130 | 4.010 | 0.120 | 292.7 | 300 | 6.98 | 46.6 |
| 1.002 | 2 | 3 | 5.986 | 0.032 | 4.010 | 3.990 | 0.020 | 299.3 | 300 | 7.12 | 46.3 |
| 1.003 | 3 | 4 | 15.933 | 0.032 | 2.800 | 2.700 | 0.100 | 159.3 | 150 | 8.07 | 43.7 |
| 1.004 | 4 | 5 | 13.272 | 0.032 | 2.700 | 2.660 | 0.040 | 331.8 | 300 | 8.39 | 42.9 |
| 1.005 | 5 | 6 | 32.923 | 0.032 | 2.660 | 2.550 | 0.110 | 299.3 | 300 | 9.14 | 41.3 |
| 1.006 | 6 | 7 | 78.858 | 0.032 | 2.550 | 2.290 | 0.260 | 303.3 | 300 | 10.93 | 37.8 |
| 1.007 | 7 | 8 | 52.729 | 0.032 | 2.290 | 2.110 | 0.180 | 292.9 | 300 | 12.12 | 35.9 |
| 1.008 | 8 | 9 | 33.785 | 0.032 | 2.110 | 2.000 | 0.110 | 307.1 | 300 | 12.89 | 34.7 |
| 1.009 | 9 | 10 | 38.798 | 0.032 | 2.000 | 1.268 | 0.732 | 53.0 | 225 | 13.92 | 33.3 |
| 1.000 | 11 | 1 | 82.078 | 0.032 | 5.100 | 4.130 | 0.970 | 84.6 | 300 | 5.99 | 49.8 |
| 2.000 | 12 | 1 | 51.090 | 0.032 | 4.300 | 4.130 | 0.170 | 300.5 | 150 | 6.19 | 49.1 |
| 3.000 | 13 | 2 | 49.087 | 0.032 | 4.300 | 4.010 | 0.290 | 169.3 | 225 | 5.85 | 50.0 |
| 4.000 | 14 | 4 | 45.044 | 0.032 | 2.850 | 2.700 | 0.150 | 300.3 | 300 | 6.02 | 49.7 |
| 8.000 | 15 | 16 | 11.207 | 0.600 | 2.670 | 2.560 | 0.110 | 101.9 | 150 | 5.19 | 50.0 |
| 8.001 | 16 | 17 | 50.944 | 0.600 | 2.560 | 2.220 | 0.340 | 149.8 | 225 | 5.98 | 49.8 |
| 8.002 | 17 | 18 | 16.489 | 0.600 | 2.220 | 2.110 | 0.110 | 149.9 | 225 | 6.24 | 48.9 |
| 8.003 | 18 | 9 | 64.563 | 0.032 | 2.110 | 2.000 | 0.110 | 586.9 | 300 | 8.29 | 43.2 |
| 9.001 | 19 | 17 | 20.052 | 0.600 | 2.350 | 2.220 | 0.130 | 154.2 | 225 | 5.68 | 50.0 |
| 9.000 | 20 | 19 | 22.019 | 0.600 | 2.570 | 2.350 | 0.220 | 100.1 | 150 | 5.37 | 50.0 |
| 6.000 | 21 | 22 | 62.179 | 0.032 | 5.100 | 3.440 | 1.660 | 37.5 | 300 | 5.50 | 50.0 |
| 6.001 | 22 | 23 | 19.906 | 0.032 | 3.440 | 2.900 | 0.540 | 36.9 | 150 | 6.07 | 49.5 |
| 6.002 | 23 | 24 | 80.329 | 0.032 | 2.900 | 2.650 | 0.250 | 321.3 | 300 | 7.96 | 44.0 |
| 6.003 | 24 | 25 | 10.776 | 0.032 | 2.650 | 2.460 | 0.190 | 56.7 | 150 | 8.35 | 43.0 |
| 6.004 | 25 | 9 | 29.737 | 0.032 | 2.260 | 2.000 | 0.260 | 114.4 | 300 | 8.76 | 42.1 |
| 7.000 | 26 | 24 | 75.252 | 0.032 | 2.900 | 2.650 | 0.250 | 301.0 | 300 | 6.71 | 47.4 |
| 5.000 | 27 | 6 | 50.000 | 0.032 | 2.700 | 2.550 | 0.150 | 333.3 | 225 | 6.21 | 49.0 |

## Simulation Settings

| | | | |
|---|---|---|---|
| Rainfall Methodology | FSR | Analysis Speed | Normal |
| FSR Region | Scotland and Ireland | Skip Steady State | ✓ |
| M5-60 (mm) | 17.000 | Drain Down Time (mins) | 240 |
| Ratio-R | 0.300 | Additional Storage (m³/ha) | 20.0 |
| Summer CV | 0.750 | Check Discharge Rate(s) | x |
| Winter CV | 0.840 | Check Discharge Volume | x |

### Storm Durations

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | 30 | 60 | 120 | 180 | 240 | 360 | 480 | 600 | 720 | 960 | 1440 |

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| Return Period (years) | Climate Change (CC %) | Additional Area (A %) | Additional Flow (Q %) |
|---|---|---|---|
| 1 | 20 | 10 | 0 |
| 30 | 20 | 10 | 0 |
| 100 | 20 | 10 | 0 |

**Node 9 Online Hydro-Brake® Control**

| | | | |
|---|---|---|---|
| Flap Valve | x | Objective | (HE) Minimise upstream storage |
| Replaces Downstream Link | ✓ | Sump Available | ✓ |
| Invert Level (m) | 2.000 | Product Number | CTL-SHE-0169-2000-3000-2000 |
| Design Depth (m) | 3.000 | Min Outlet Diameter (m) | 0.225 |
| Design Flow (l/s) | 20.0 | Min Node Diameter (mm) | 1800 |

**Node 18 Online Hydro-Brake® Control**

| | | | |
|---|---|---|---|
| Flap Valve | x | Objective | (HE) Minimise upstream storage |
| Replaces Downstream Link | ✓ | Sump Available | ✓ |
| Invert Level (m) | 2.110 | Product Number | CTL-SHE-0146-1000-1000-1000 |
| Design Depth (m) | 1.000 | Min Outlet Diameter (m) | 0.225 |
| Design Flow (l/s) | 10.0 | Min Node Diameter (mm) | 1200 |

**Node 18 Carpark Storage Structure**

| | | | | | |
|---|---|---|---|---|---|
| Base Inf Coefficient (m/hr) | 0.00000 | Invert Level (m) | 2.110 | Slope (1:X) | 600.0 |
| Side Inf Coefficient (m/hr) | 0.00000 | Time to half empty (mins) | 240 | Depth (m) | 1.000 |
| Safety Factor | 2.0 | Width (m) | 32.500 | Inf Depth (m) | |
| Porosity | 0.30 | Length (m) | 50.000 | | |

**Node 6 Depth/Area Storage Structure**

| | | | | | |
|---|---|---|---|---|---|
| Base Inf Coefficient (m/hr) | 0.00000 | Safety Factor | 2.0 | Invert Level (m) | 2.700 |
| Side Inf Coefficient (m/hr) | 0.00000 | Porosity | 1.00 | Time to half empty (mins) | 0 |

| Depth (m) | Area (m²) | Inf Area (m²) | Depth (m) | Area (m²) | Inf Area (m²) |
|---|---|---|---|---|---|
| 0.000 | 1032.0 | 0.0 | 0.300 | 1183.0 | 0.0 |

**Node 7 Depth/Area Storage Structure**

| | | | | | |
|---|---|---|---|---|---|
| Base Inf Coefficient (m/hr) | 0.00000 | Safety Factor | 2.0 | Invert Level (m) | 2.700 |
| Side Inf Coefficient (m/hr) | 0.00000 | Porosity | 1.00 | Time to half empty (mins) | 0 |

| Depth (m) | Area (m²) | Inf Area (m²) | Depth (m) | Area (m²) | Inf Area (m²) |
|---|---|---|---|---|---|
| 0.000 | 336.0 | 0.0 | 0.300 | 446.0 | 0.0 |

**Node 9 Depth/Area Storage Structure**

| | | | | | |
|---|---|---|---|---|---|
| Base Inf Coefficient (m/hr) | 0.00000 | Safety Factor | 2.0 | Invert Level (m) | 2.500 |
| Side Inf Coefficient (m/hr) | 0.00000 | Porosity | 1.00 | Time to half empty (mins) | 0 |

| Depth (m) | Area (m²) | Inf Area (m²) | Depth (m) | Area (m²) | Inf Area (m²) |
|---|---|---|---|---|---|
| 0.000 | 1109.0 | 0.0 | 0.300 | 1263.0 | 0.0 |

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## Node 24 Depth/Area Storage Structure

| | | | | | |
|---|---|---|---|---|---|
| Base Inf Coefficient (m/hr) | 0.00000 | Safety Factor | 2.0 | Invert Level (m) | 2.600 |
| Side Inf Coefficient (m/hr) | 0.00000 | Porosity | 1.00 | Time to half empty (mins) | 0 |

| Depth (m) | Area (m²) | Inf Area (m²) | Depth (m) | Area (m²) | Inf Area (m²) |
|---|---|---|---|---|---|
| 0.000 | 498.0 | 0.0 | 0.300 | 772.0 | 0.0 |

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**Results for 1 year +20% CC +10% A Critical Storm Duration. Lowest mass balance: 99.10%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 30 minute winter | 1 | 26 | 4.304 | 0.174 | 17.9 | 0.0000 | 0.0000 | OK |
| 30 minute winter | 1.001:50% | 25 | 4.304 | 0.234 | 15.6 | 0.0000 | 0.0000 | OK |
| 30 minute winter | 2 | 25 | 4.304 | 0.294 | 39.6 | 0.0000 | 0.0000 | OK |
| 30 minute winter | 3 | 25 | 4.304 | 1.504 | 25.6 | 0.0000 | 0.0000 | FLOOD RISK |
| 15 minute winter | 4 | 12 | 2.824 | 0.124 | 26.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 5 | 13 | 2.780 | 0.120 | 25.9 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 6 | 15 | 2.704 | 0.154 | 53.7 | 4.4232 | 0.0000 | OK |
| 15 minute winter | 7 | 19 | 2.450 | 0.160 | 42.3 | 0.0000 | 0.0000 | OK |
| 120 minute winter | 8 | 106 | 2.383 | 0.273 | 31.8 | 0.0000 | 0.0000 | OK |
| 120 minute winter | 9 | 106 | 2.382 | 0.382 | 26.2 | 0.0000 | 0.0000 | SURCHARGED |
| 15 minute summer | 10 | 1 | 1.268 | 0.000 | 15.9 | 0.0000 | 0.0000 | OK |
| 15 minute summer | 11 | 1 | 5.100 | 0.000 | 0.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 1.000:50% | 11 | 4.683 | 0.068 | 16.1 | 0.0000 | 0.0000 | OK |
| 30 minute winter | 12 | 25 | 4.305 | 0.005 | 0.3 | 0.0000 | 0.0000 | OK |
| 30 minute winter | 2.000:50% | 26 | 4.305 | 0.090 | 5.7 | 0.0000 | 0.0000 | OK |
| 30 minute winter | 13 | 25 | 4.306 | 0.006 | 0.5 | 0.0000 | 0.0000 | OK |
| 30 minute winter | 3.000:50% | 25 | 4.305 | 0.150 | 35.8 | 0.0000 | 0.0000 | OK |
| 15 minute summer | 14 | 1 | 2.850 | 0.000 | 0.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 4.000:50% | 11 | 2.839 | 0.064 | 7.8 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 15 | 10 | 2.715 | 0.045 | 3.2 | 0.0601 | 0.0000 | OK |
| 15 minute winter | 16 | 11 | 2.601 | 0.041 | 3.2 | 0.0460 | 0.0000 | OK |
| 15 minute winter | 17 | 11 | 2.376 | 0.156 | 21.7 | 0.1764 | 0.0000 | OK |
| 15 minute winter | 8.002:50% | 11 | 2.363 | 0.198 | 52.0 | 0.0000 | 0.0000 | OK |
| 180 minute winter | 18 | 180 | 2.307 | 0.197 | 17.7 | 75.6436 | 0.0000 | OK |
| 15 minute winter | 19 | 10 | 2.457 | 0.107 | 19.0 | 0.2954 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 30 minute winter | 1 | 1.001 | 1.001:50% | 10.7 | 0.212 | 0.016 | 3.3241 | |
| 30 minute winter | 1 | 1.001 | 2 | 10.3 | 0.145 | 0.015 | 5.1165 | |
| 30 minute winter | 2 | 1.002 | 3 | 25.6 | 0.468 | 0.039 | 2.2072 | |
| 30 minute winter | 3 | 1.003 | 4 | 19.1 | 1.107 | 3.894 | 0.2617 | |
| 15 minute winter | 4 | 1.004 | 5 | 25.9 | 0.360 | 0.041 | 1.0694 | |
| 15 minute winter | 5 | 1.005 | 6 | 25.3 | 0.287 | 0.038 | 3.2116 | |
| 15 minute winter | 6 | 1.006 | 7 | 42.3 | 0.363 | 0.064 | 9.4274 | |
| 15 minute winter | 7 | 1.007 | 8 | 43.4 | 0.381 | 0.065 | 6.3530 | |
| 120 minute winter | 8 | 1.008 | 9 | 26.2 | 0.179 | 0.040 | 14.5000 | |
| 120 minute winter | 9 | Hydro-Brake® | 10 | 17.1 | | | | 192.1 |
| | | | | | | | | |
| 15 minute summer | 11 | 1.000 | 1.000:50% | 0.0 | 0.000 | 0.000 | 0.6789 | |
| 15 minute summer | 11 | 1.000 | 1 | 14.4 | 0.404 | 0.012 | 2.6494 | |
| 30 minute winter | 12 | 2.000 | 2.000:50% | -0.3 | -0.020 | 0.000 | 0.4933 | |
| 30 minute winter | 12 | 2.000 | 1 | 5.4 | 0.173 | 0.009 | 1.9826 | |
| 30 minute winter | 13 | 3.000 | 3.000:50% | -0.5 | -0.014 | -0.001 | 1.2551 | |
| 30 minute winter | 13 | 3.000 | 2 | 35.4 | 0.357 | 0.043 | 5.2346 | |
| 15 minute summer | 14 | 4.000 | 4.000:50% | 0.0 | 0.000 | 0.000 | 0.3409 | |
| 15 minute summer | 14 | 4.000 | 4 | 6.8 | 0.141 | 0.010 | 1.2554 | |
| 15 minute winter | 15 | 8.000 | 16 | 3.2 | 0.777 | 0.179 | 0.0456 | |
| 15 minute winter | 16 | 8.001 | 17 | 3.1 | 0.193 | 0.072 | 0.8723 | |
| 15 minute winter | 17 | 8.002 | 8.002:50% | 22.0 | 0.708 | 0.520 | 0.2737 | |
| 15 minute winter | 17 | 8.002 | 18 | 54.6 | 2.267 | 1.289 | 0.1917 | |
| 180 minute winter | 18 | Hydro-Brake® | 9 | 7.5 | | | | |
| 15 minute winter | 19 | 9.001 | 17 | 18.8 | 0.843 | 0.451 | 0.4753 | |

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**Results for 1 year +20% CC +10% A Critical Storm Duration. Lowest mass balance: 99.10%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute winter | 20 | 10 | 2.613 | 0.043 | 3.2 | 0.0559 | 0.0000 | OK |
| 15 minute summer | 21 | 1 | 5.100 | 0.000 | 0.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 6.000:50% | 11 | 4.292 | 0.022 | 3.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 22 | 13 | 3.494 | 0.054 | 2.8 | 0.0000 | 0.0000 | OK |
| 30 minute winter | 23 | 23 | 2.933 | 0.033 | 2.2 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 6.002:50% | 13 | 2.890 | 0.115 | 19.8 | 0.0000 | 0.0000 | OK |
| 480 minute winter | 24 | 328 | 2.720 | 0.070 | 6.3 | 39.8396 | 0.0000 | OK |
| 120 minute winter | 25 | 106 | 2.382 | 0.122 | 2.3 | 0.0000 | 0.0000 | OK |
| 15 minute summer | 26 | 1 | 2.900 | 0.000 | 0.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 7.000:50% | 12 | 2.887 | 0.112 | 19.1 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 27 | 10 | 2.773 | 0.073 | 3.4 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 5.000:50% | 10 | 2.772 | 0.147 | 30.3 | 0.0000 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 15 minute winter | 20 | 9.000 | 19 | 3.1 | 0.358 | 0.176 | 0.1932 | |
| 15 minute summer | 21 | 6.000 | 6.000:50% | 0.0 | 0.000 | 0.000 | 0.1199 | |
| 15 minute summer | 21 | 6.000 | 22 | 2.7 | 0.243 | 0.001 | 0.4733 | |
| 15 minute winter | 22 | 6.001 | 23 | 2.4 | 0.651 | 0.232 | 0.0792 | |
| 30 minute winter | 23 | 6.002 | 6.002:50% | 2.0 | 0.055 | 0.003 | 1.7296 | |
| 30 minute winter | 23 | 6.002 | 24 | 13.6 | 0.302 | 0.021 | 1.9394 | |
| 480 minute winter | 24 | 6.003 | 25 | 3.1 | 0.467 | 0.372 | 0.0707 | |
| 120 minute winter | 25 | 6.004 | 9 | 3.4 | 0.042 | 0.003 | 9.4351 | |
| 15 minute summer | 26 | 7.000 | 7.000:50% | 0.0 | 0.000 | 0.000 | 1.2796 | |
| 15 minute summer | 26 | 7.000 | 24 | 12.5 | 0.300 | 0.019 | 1.6750 | |
| 15 minute winter | 27 | 5.000 | 5.000:50% | -3.4 | -0.088 | -0.006 | 1.6293 | |
| 15 minute winter | 27 | 5.000 | 6 | 31.7 | 0.364 | 0.053 | 2.3901 | |

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**Results for 30 year +20% CC +10% A Critical Storm Duration. Lowest mass balance: 99.10%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 60 minute winter | 1 | 50 | 4.490 | 0.360 | 20.9 | 0.0000 | 0.0000 | OK |
| 60 minute winter | 1.001:50% | 50 | 4.490 | 0.420 | 13.3 | 0.0000 | 0.0000 | OK |
| 60 minute winter | 2 | 50 | 4.490 | 0.480 | 41.5 | 0.0000 | 0.0000 | OK |
| 60 minute winter | 3 | 50 | 4.490 | 1.690 | 22.3 | 0.0000 | 0.0000 | FLOOD RISK |
| 15 minute winter | 4 | 12 | 2.841 | 0.141 | 34.5 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 5 | 13 | 2.797 | 0.137 | 34.2 | 0.0000 | 0.0000 | OK |
| 30 minute winter | 6 | 25 | 2.717 | 0.167 | 83.7 | 17.9777 | 0.0000 | OK |
| 360 minute winter | 7 | 296 | 2.540 | 0.250 | 32.5 | 0.0000 | 0.0000 | OK |
| 360 minute winter | 8 | 296 | 2.540 | 0.430 | 31.0 | 0.0000 | 0.0000 | OK |
| 360 minute winter | 9 | 296 | 2.540 | 0.540 | 34.1 | 44.9907 | 0.0000 | SURCHARGED |
| 15 minute summer | 10 | 1 | 1.268 | 0.000 | 17.2 | 0.0000 | 0.0000 | OK |
| 15 minute summer | 11 | 1 | 5.100 | 0.000 | 0.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 1.000:50% | 11 | 4.717 | 0.102 | 35.8 | 0.0000 | 0.0000 | OK |
| 60 minute winter | 12 | 50 | 4.490 | 0.190 | 3.4 | 0.0000 | 0.0000 | OK |
| 60 minute winter | 2.000:50% | 50 | 4.490 | 0.275 | 11.6 | 0.0000 | 0.0000 | OK |
| 60 minute winter | 13 | 50 | 4.490 | 0.190 | 3.4 | 0.0000 | 0.0000 | OK |
| 60 minute winter | 3.000:50% | 50 | 4.490 | 0.335 | 54.5 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 14 | 11 | 2.871 | 0.021 | 1.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 4.000:50% | 11 | 2.870 | 0.095 | 17.4 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 15 | 10 | 2.740 | 0.070 | 7.1 | 0.0934 | 0.0000 | OK |
| 15 minute winter | 16 | 12 | 2.718 | 0.158 | 9.2 | 0.1786 | 0.0000 | OK |
| 15 minute winter | 17 | 12 | 2.691 | 0.471 | 44.9 | 0.5321 | 0.0000 | SURCHARGED |
| 15 minute winter | 8.002:50% | 11 | 2.624 | 0.459 | 103.2 | 0.0000 | 0.0000 | SURCHARGED |
| 480 minute winter | 18 | 472 | 2.547 | 0.437 | 20.3 | 192.3388 | 0.0000 | OK |
| 15 minute winter | 19 | 11 | 2.824 | 0.474 | 39.6 | 1.3091 | 0.0000 | SURCHARGED |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 60 minute winter | 1 | 1.001 | 1.001:50% | 9.2 | 0.203 | 0.014 | 10.1286 | |
| 60 minute winter | 1 | 1.001 | 2 | 11.5 | 0.162 | 0.017 | 13.1018 | |
| 60 minute winter | 2 | 1.002 | 3 | 22.3 | 0.431 | 0.034 | 5.1976 | |
| 60 minute winter | 3 | 1.003 | 4 | 20.3 | 1.166 | 4.146 | 0.2703 | |
| 15 minute winter | 4 | 1.004 | 5 | 34.2 | 0.388 | 0.054 | 1.3170 | |
| 15 minute winter | 5 | 1.005 | 6 | 33.7 | 0.302 | 0.051 | 3.7348 | |
| 30 minute winter | 6 | 1.006 | 7 | 50.7 | 0.381 | 0.077 | 10.5074 | |
| 360 minute winter | 7 | 1.007 | 8 | 31.0 | 0.287 | 0.046 | 24.9247 | |
| 360 minute winter | 8 | 1.008 | 9 | 28.7 | 0.167 | 0.044 | 29.0338 | |
| 360 minute winter | 9 | Hydro-Brake® | 10 | 18.1 | | | | 523.4 |
| | | | | | | | | |
| 15 minute summer | 11 | 1.000 | 1.000:50% | 0.0 | 0.000 | 0.000 | 1.2221 | |
| 15 minute summer | 11 | 1.000 | 1 | 32.4 | 0.436 | 0.026 | 7.3803 | |
| 60 minute winter | 12 | 2.000 | 2.000:50% | -3.4 | -0.083 | -0.006 | 5.1808 | |
| 60 minute winter | 12 | 2.000 | 1 | 5.9 | 0.159 | 0.010 | 9.0918 | |
| 60 minute winter | 13 | 3.000 | 3.000:50% | -3.4 | -0.055 | -0.004 | 6.9220 | |
| 60 minute winter | 13 | 3.000 | 2 | 41.5 | 0.314 | 0.050 | 14.8801 | |
| 15 minute winter | 14 | 4.000 | 4.000:50% | -1.0 | -0.048 | -0.002 | 0.7119 | |
| 15 minute winter | 14 | 4.000 | 4 | 15.6 | 0.205 | 0.024 | 1.7576 | |
| 15 minute winter | 15 | 8.000 | 16 | 7.0 | 0.957 | 0.400 | 0.1348 | |
| 15 minute winter | 16 | 8.001 | 17 | 11.8 | 0.351 | 0.279 | 1.7715 | |
| 15 minute winter | 17 | 8.002 | 8.002:50% | 49.3 | 1.240 | 1.164 | 0.3279 | |
| 15 minute winter | 17 | 8.002 | 18 | 103.5 | 3.216 | 2.442 | 0.2630 | |
| 480 minute winter | 18 | Hydro-Brake® | 9 | 9.8 | | | | |
| 15 minute winter | 19 | 9.001 | 17 | 39.2 | 0.987 | 0.940 | 0.7975 | |

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**Results for 30 year +20% CC +10% A Critical Storm Duration. Lowest mass balance: 99.10%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute winter | 20 | 11 | 2.861 | 0.291 | 7.1 | 0.3816 | 0.0000 | SURCHARGED |
| 15 minute summer | 21 | 1 | 5.100 | 0.000 | 0.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 6.000:50% | 11 | 4.304 | 0.034 | 6.7 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 22 | 12 | 3.525 | 0.085 | 6.4 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 23 | 14 | 2.955 | 0.055 | 5.5 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 6.002:50% | 12 | 2.946 | 0.171 | 43.7 | 0.0000 | 0.0000 | OK |
| 240 minute winter | 24 | 176 | 2.771 | 0.121 | 20.4 | 72.1879 | 0.0000 | OK |
| 360 minute winter | 25 | 296 | 2.540 | 0.280 | 7.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 26 | 12 | 2.940 | 0.040 | 3.3 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 7.000:50% | 12 | 2.937 | 0.162 | 42.5 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 27 | 11 | 2.830 | 0.130 | 5.4 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 5.000:50% | 11 | 2.830 | 0.205 | 67.4 | 0.0000 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 15 minute winter | 20 | 9.000 | 19 | 8.0 | 0.516 | 0.449 | 0.3876 | |
| 15 minute summer | 21 | 6.000 | 6.000:50% | 0.0 | 0.000 | 0.000 | 0.2102 | |
| 15 minute summer | 21 | 6.000 | 22 | 6.1 | 0.278 | 0.003 | 0.8924 | |
| 15 minute winter | 22 | 6.001 | 23 | 5.5 | 0.756 | 0.539 | 0.1596 | |
| 15 minute winter | 23 | 6.002 | 6.002:50% | 5.2 | 0.078 | 0.008 | 3.2928 | |
| 15 minute winter | 23 | 6.002 | 24 | 34.6 | 0.399 | 0.054 | 3.7125 | |
| 240 minute winter | 24 | 6.003 | 25 | 7.1 | 0.574 | 0.862 | 0.1312 | |
| 360 minute winter | 25 | 6.004 | 9 | 6.8 | 0.023 | 0.006 | 20.1401 | |
| 15 minute winter | 26 | 7.000 | 7.000:50% | -3.3 | -0.074 | -0.005 | 2.7156 | |
| 15 minute winter | 26 | 7.000 | 24 | 31.8 | 0.396 | 0.048 | 3.2120 | |
| 15 minute winter | 27 | 5.000 | 5.000:50% | -5.4 | -0.107 | -0.009 | 3.1477 | |
| 15 minute winter | 27 | 5.000 | 6 | 63.4 | 0.457 | 0.107 | 3.5092 | |

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**Results for 100 year +20% CC +10% A Critical Storm Duration. Lowest mass balance: 99.10%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 60 minute winter | 1 | 57 | 4.575 | 0.445 | 31.0 | 0.0000 | 0.0000 | OK |
| 60 minute winter | 1.001:50% | 57 | 4.575 | 0.505 | 19.3 | 0.0000 | 0.0000 | SURCHARGED |
| 60 minute winter | 2 | 57 | 4.575 | 0.565 | 51.6 | 0.0000 | 0.0000 | FLOOD RISK |
| 60 minute winter | 3 | 57 | 4.575 | 1.775 | 22.8 | 0.0000 | 0.0000 | FLOOD RISK |
| 15 minute winter | 4 | 12 | 2.849 | 0.149 | 39.3 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 5 | 13 | 2.805 | 0.145 | 38.9 | 0.0000 | 0.0000 | OK |
| 30 minute winter | 6 | 25 | 2.726 | 0.176 | 103.6 | 27.1455 | 0.0000 | OK |
| 360 minute winter | 7 | 360 | 2.599 | 0.309 | 36.8 | 0.0000 | 0.0000 | OK |
| 360 minute winter | 8 | 360 | 2.599 | 0.489 | 36.0 | 0.0000 | 0.0000 | OK |
| 360 minute winter | 9 | 360 | 2.599 | 0.599 | 42.1 | 112.6964 | 0.0000 | SURCHARGED |
| 15 minute summer | 10 | 1 | 1.268 | 0.000 | 17.6 | 0.0000 | 0.0000 | OK |
| 15 minute summer | 11 | 1 | 5.100 | 0.000 | 0.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 1.000:50% | 11 | 4.731 | 0.116 | 46.5 | 0.0000 | 0.0000 | OK |
| 60 minute winter | 12 | 57 | 4.575 | 0.275 | 4.9 | 0.0000 | 0.0000 | OK |
| 60 minute winter | 2.000:50% | 57 | 4.575 | 0.360 | 17.0 | 0.0000 | 0.0000 | OK |
| 60 minute winter | 13 | 57 | 4.575 | 0.275 | 5.0 | 0.0000 | 0.0000 | OK |
| 60 minute winter | 3.000:50% | 57 | 4.575 | 0.420 | 70.8 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 14 | 11 | 2.884 | 0.034 | 1.5 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 4.000:50% | 11 | 2.883 | 0.108 | 22.6 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 15 | 12 | 3.047 | 0.377 | 16.3 | 0.5041 | 0.0000 | SURCHARGED |
| 15 minute winter | 16 | 12 | 3.014 | 0.454 | 11.0 | 0.5135 | 0.0000 | SURCHARGED |
| 15 minute winter | 17 | 11 | 3.000 | 0.780 | 57.4 | 0.8823 | 0.0000 | SURCHARGED |
| 15 minute winter | 8.002:50% | 11 | 2.902 | 0.737 | 135.3 | 0.0000 | 0.0000 | SURCHARGED |
| 600 minute winter | 18 | 570 | 2.634 | 0.524 | 21.2 | 234.5205 | 0.0000 | SURCHARGED |
| 15 minute winter | 19 | 12 | 3.197 | 0.847 | 51.7 | 2.3383 | 0.0000 | SURCHARGED |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 60 minute winter | 1 | 1.001 | 1.001:50% | 9.8 | 0.206 | 0.015 | 14.4373 | |
| 60 minute winter | 1 | 1.001 | 2 | 12.0 | 0.163 | 0.018 | 17.9450 | |
| 60 minute winter | 2 | 1.002 | 3 | 22.8 | 0.436 | 0.034 | 6.9701 | |
| 60 minute winter | 3 | 1.003 | 4 | 20.9 | 1.193 | 4.257 | 0.2741 | |
| 15 minute winter | 4 | 1.004 | 5 | 38.9 | 0.389 | 0.062 | 1.4458 | |
| 15 minute winter | 5 | 1.005 | 6 | 38.1 | 0.319 | 0.058 | 4.0178 | |
| 30 minute winter | 6 | 1.006 | 7 | 56.2 | 0.393 | 0.085 | 12.9263 | |
| 360 minute winter | 7 | 1.007 | 8 | 36.0 | 0.280 | 0.054 | 32.7546 | |
| 360 minute winter | 8 | 1.008 | 9 | 35.0 | 0.180 | 0.053 | 35.8004 | |
| 360 minute winter | 9 | Hydro-Brake® | 10 | 18.2 | | | | 565.9 |
| | | | | | | | | |
| 15 minute summer | 11 | 1.000 | 1.000:50% | 0.0 | 0.000 | 0.000 | 1.4835 | |
| 15 minute summer | 11 | 1.000 | 1 | 42.2 | 0.451 | 0.034 | 10.0829 | |
| 60 minute winter | 12 | 2.000 | 2.000:50% | -4.9 | -0.092 | -0.008 | 9.0798 | |
| 60 minute winter | 12 | 2.000 | 1 | -5.7 | 0.168 | -0.010 | 14.0949 | |
| 60 minute winter | 13 | 3.000 | 3.000:50% | -5.0 | -0.061 | -0.006 | 11.1940 | |
| 60 minute winter | 13 | 3.000 | 2 | 51.6 | 0.334 | 0.062 | 20.9621 | |
| 15 minute winter | 14 | 4.000 | 4.000:50% | -1.5 | -0.058 | -0.002 | 0.9164 | |
| 15 minute winter | 14 | 4.000 | 4 | 20.4 | 0.233 | 0.031 | 1.9984 | |
| 15 minute winter | 15 | 8.000 | 16 | 9.0 | 0.983 | 0.514 | 0.1973 | |
| 15 minute winter | 16 | 8.001 | 17 | 14.2 | 0.423 | 0.336 | 2.0261 | |
| 15 minute winter | 17 | 8.002 | 8.002:50% | 60.6 | 1.524 | 1.431 | 0.3279 | |
| 15 minute winter | 17 | 8.002 | 18 | 134.6 | 3.976 | 3.177 | 0.3117 | |
| 600 minute winter | 18 | Hydro-Brake® | 9 | 9.6 | | | | |
| 15 minute winter | 19 | 9.001 | 17 | 47.1 | 1.185 | 1.128 | 0.7975 | |

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**Results for 100 year +20% CC +10% A Critical Storm Duration. Lowest mass balance: 99.10%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute winter | 20 | 12 | 3.257 | 0.687 | 9.2 | 0.9012 | 0.0000 | SURCHARGED |
| 15 minute summer | 21 | 1 | 5.100 | 0.000 | 0.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 6.000:50% | 11 | 4.310 | 0.040 | 8.7 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 22 | 12 | 3.539 | 0.099 | 8.3 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 23 | 13 | 2.974 | 0.074 | 8.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 6.002:50% | 12 | 2.968 | 0.193 | 57.0 | 0.0000 | 0.0000 | OK |
| 240 minute winter | 24 | 176 | 2.799 | 0.149 | 25.5 | 90.7904 | 0.0000 | OK |
| 360 minute winter | 25 | 360 | 2.599 | 0.339 | 8.9 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 26 | 12 | 2.961 | 0.061 | 5.2 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 7.000:50% | 12 | 2.957 | 0.182 | 55.2 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 27 | 11 | 2.858 | 0.158 | 5.9 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 5.000:50% | 11 | 2.857 | 0.232 | 87.5 | 0.0000 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 15 minute winter | 20 | 9.000 | 19 | 9.5 | 0.543 | 0.538 | 0.3876 | |
| 15 minute summer | 21 | 6.000 | 6.000:50% | 0.0 | 0.000 | 0.000 | 0.2524 | |
| 15 minute summer | 21 | 6.000 | 22 | 8.0 | 0.291 | 0.004 | 1.1092 | |
| 15 minute winter | 22 | 6.001 | 23 | 7.0 | 0.762 | 0.691 | 0.2095 | |
| 15 minute winter | 23 | 6.002 | 6.002:50% | 8.5 | 0.097 | 0.013 | 4.1590 | |
| 15 minute winter | 23 | 6.002 | 24 | 46.7 | 0.436 | 0.073 | 4.5795 | |
| 240 minute winter | 24 | 6.003 | 25 | 8.8 | 0.590 | 1.076 | 0.1691 | |
| 360 minute winter | 25 | 6.004 | 9 | 8.5 | 0.015 | 0.008 | 25.3045 | |
| 15 minute winter | 26 | 7.000 | 7.000:50% | -5.2 | -0.085 | -0.008 | 3.4563 | |
| 15 minute winter | 26 | 7.000 | 24 | 42.3 | 0.431 | 0.064 | 3.9188 | |
| 15 minute winter | 27 | 5.000 | 5.000:50% | -5.9 | -0.112 | -0.010 | 4.0391 | |
| 15 minute winter | 27 | 5.000 | 6 | 81.9 | 0.512 | 0.138 | 4.0896 | |

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## Appendix 9-4

### Water Features Survey

**APPENDIX 9-4**

**Water Survey Features Report**

**Riverine Community Park**
**Lifford-Strabane**

**Client: McAdam**

**Issued: August 2021**

**MCL Consulting Ltd**
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# CONTENTS


## 1.0 INTRODUCTION 3

1.1 Site Setting 4
1.2 Ground Investigation 7

## 2.0 WATER FEATURES SURVEY 11

2.1 Groundwater features 11
2.2 Water Quality Field Chemistry Survey 24
2.3 Freshwater Aquatic Ecology Survey (Watercourses and Ponds) 25
2.4 Surface Water Quality Testing 26
2.5 Electrical Conductivity and Level Logging, River Foyle 28
2.6 Groundwater & Surface Water Level Monitoring 29
2.7 Groundwater Quality Testing 30
2.8 Discussion of Results 31

### FIGURES

Figure 1: Lifford Site Setting
Figure 2: Strabane Site Setting
Figure 3: Lifford Ground Investigation
Figure 4: Strabane Ground Investigation
Figure 5: OSNI 1905 to 1957
Figure 6: Strabane Open Water Bodies
Figure 7: Lifford Watercourses
Figure 8: Strabane Watercourses
Figure 9: Lifford In-Situ Field Chemistry Sample Points
Figure 10: Strabane In-Situ Field Chemistry Sample Points
Figure 11: Lifford Watercourse Sample Points
Figure 12: Strabane Watercourse Sample Points
Figure 13: Logger Install Locations
Figure 14: EC Logging, River Foyle
Figure 15: EC Logging, River Foyle (1 day cycle)
Figure 16: Surface Water Hydrographs
Figure 17: Groundwater Hydrographs Lifford
Figure 18: Groundwater Flow Map Lifford
Figure 19: Groundwater Hydrographs Strabane
Figure 20: Groundwater Flow Map Strabane

### TABLES

Table 1: OSNI Mapped Features

## APPENDICES

**Appendix 1: Photographic Images, Lifford**
**Appendix 2: Photographic Images, Strabane**
**Appendix 3: Local Abstractions, Lifford**
**Appendix 4: Local Abstractions, Strabane**
**Appendix 5: Historical Mapping, Lifford**
**Appendix 6: Historical Mapping, Strabane**
**Appendix 7: Discharge Consents, Lifford**
**Appendix 8: Discharge Consents, Strabane**
**Appendix 9: Field Chemistry**
**Appendix 10: Laboratory Certificates, Surface Waters & Groundwaters**

# 1.0 INTRODUCTION

MCL Consulting (MCL) was appointed by McAdam to undertake a Water Features Survey Assessment within and surrounding the lands of a proposed cross community park known as Riverine, which is straddling the River Foyle between the eastern area of Lifford Town, County Donegal, Republic of Ireland and the western area of the town of Strabane in County Tyrone, Northern Ireland.

The project will comprise the creation of new community park infrastructure in excess of twenty-three hectares either side of the border connected through the creation of a new pedestrian and cycle bridge between Lifford and Strabane. The Park on the Lifford site will be a designed landscape incorporating indoor and outdoor recreational features, smaller meeting & events spaces for programmed activity, complemented by the use of the naturalised flood plain environment on the Strabane site for informal recreation and environmental education/conservation activities.

This report provides a review of local water features at and around the site, for the purposes of identifying all water features and water-dependent features that could potentially be influenced by the proposed development.

The report has been prepared in accordance with all statutory guidance including:-

- IGI Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements.
- DAERA Environmental Advice for Planning : Practice Guide, Water Features Survey, August 2018.

The assessment has been undertaken based on a desk-based review and detailed site walkover works including field data gathering works (undertaken during Spring – Summer 2021), and also drawing from recent investigations undertaken for land contamination, hydrology (flood risk) and aquatic ecology.

## 1.1 Site Setting

For ease of reference and to assist in the description of the site, the Lifford and Strabane sites have been divided into zones, as shown in **Fig. 1** (Lifford) and **Fig. 2** (Strabane). A range of photographic images of the site in its current form are also presented in **Appendix 1** (Lifford) and **Appendix 2** (Strabane).

**Lifford**

For reporting purposes, the site has been divided into various Zones. The Lifford Zone contains the Access Zone, the Western Zone, the Central Zone and the Eastern Zone, as shown in **Fig. 1** below.

**Fig. 1: Lifford Site Setting with Zones**



Lands to the west of the site comprise urbanised areas on the edge of Lifford Town, including a cinema complex, commercial and residential properties and areas of hardstanding and roads / footpaths. Lands to the north of the site comprise open grassland meadows and a playing field. Quarrying activities (sand and gravel excavation) are apparent along a short stretch of the Foyle River margin to the north of the site (just visible top right of frame in Fig. 1, and **Plate 5 Appendix 1**).

The site, primarily comprising relatively flat open improved grassland meadows / amenity land (Playing fields) with mature boundary hedgerows (**Plate 4, Appendix 1**), is characterised mainly by free-draining soils underlain by permeable sandy drift geology. A hare coursing training run comprising a bark-surfaced straight laneway edged on either side by hedging extends north-south through the site. This terminates close to a blockwork spectator stand with associated changing rooms and welfare facilities, including toilets (**Plate 1, Appendix 1**).

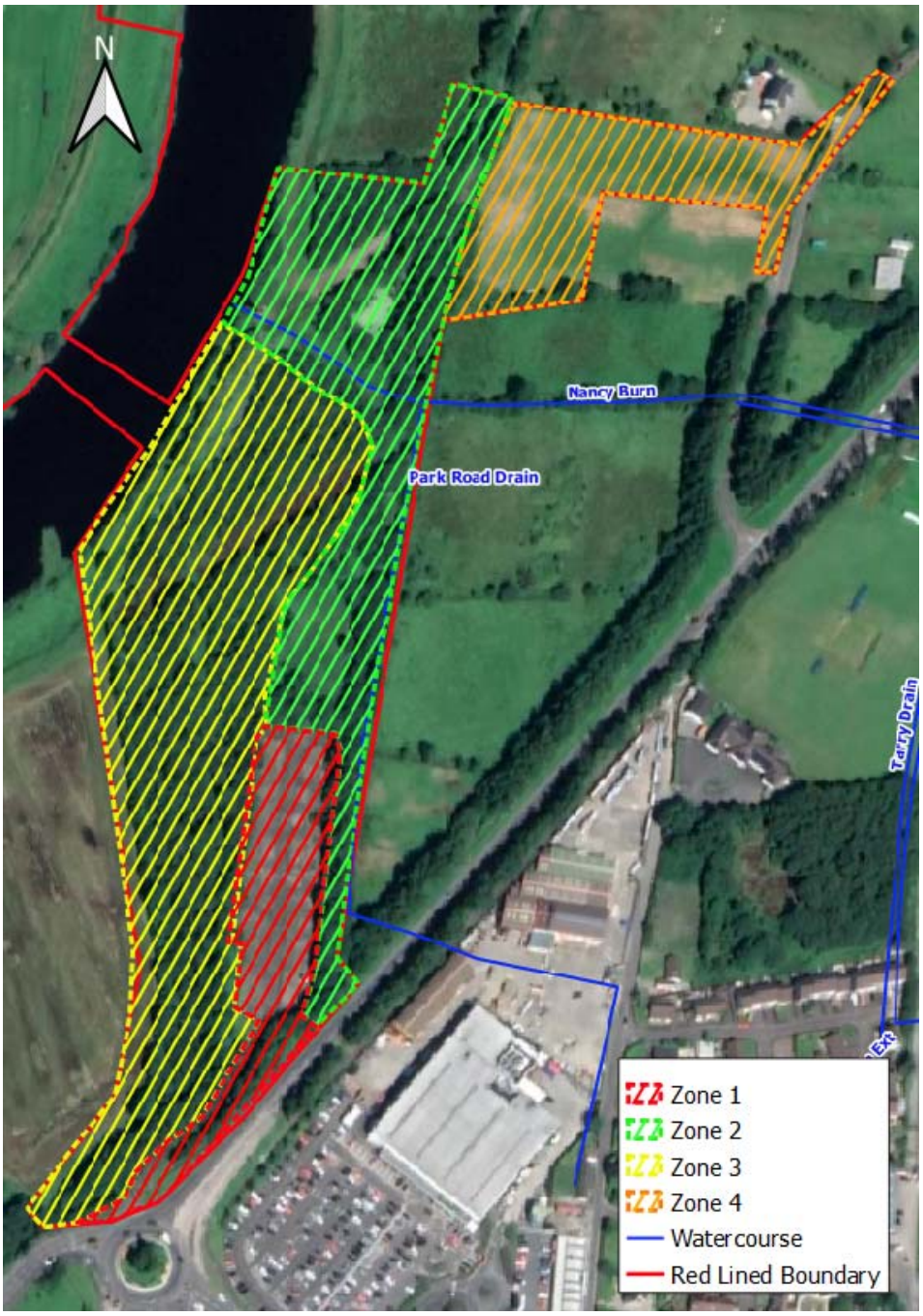
A small car parking area lies close to the spectator stand. The main competition coursing run, which comprises grassed area rising gradually to the south, extends through In the Central area of the site. A smaller single-storey blockwork structure, also associated with the hare coursing activities, is located at the northern end of the training run (**Plate 6, Appendix 1**). Prior to the competition, which occurs late in the year, hares are held in the grasslands area of the western zone. The eastern zone comprises formal grass playing fields for Lifford Football Football Club.

A grassed flood embankment runs parallel to the Foyle River along the entirety of the eastern margin, with relatively flat scrubland with occasional small trees beyond the embankment, extending to the riverbank. An informal path extends through the scrubland following the line of the riverbank.

**Strabane**

For ease of reference, the Strabane side of the site has been divided into Zone 1 to Zone 4 as shown in **Fig. 2** below.

**Fig. 2: Strabane Site Setting with Zones**



The Strabane site comprises a much more overgrown and historically developed site. Previously comprising railway lands including a railway embankment, ponds, sidings, engine house and goods shed, then later a bus depot (within Zone 1) and formal 'travellers rest' (within Zone 1), the site has naturalised over the last few decades.

Main access to the site is via the Asda Roundabout, where a tree-lined concrete road leads to a large area of concreted hardstanding, complete with services including mains water supply and mains sewerage (**Plate 1, Appendix 2**). The hardstanding area was previously developed as a 'travellers rest', for the travelling community to reside (now disused with the entrance from the roundabout blocked off). A partially overgrown (recently cleared) railway embankment skirts the eastern site boundary with a watercourse and open land beyond the east (**Plate 4, Appendix 2**). To the west of the embankment a path allows pedestrian access to the areas beyond the concrete hardstand. A clay bund is present immediately to the north of the concrete area (**Plate 2, Appendix 2**) with an open grassed area beyond (**Plate 3, Appendix 2**). Zone 3 comprises mainly wooded wetland, with standing water and abundant small trees (**Plate 6 & Plate 12, Appendix 2**).

A small water course (**Plate 9, Appendix 2**) and smaller triangle-shaped pond (**Plate 13, Appendix 2**) are located in Zone 2. The path divides turning left and southwestwards, extending along the top of the former railway embankment to the banks of the River Foyle (**Plate 10, Appendix 2**). A continuous earthen flood embankment runs parallel to the riverbanks to the north and to the south. Alternatively, following the path northwards leads to an open grassland field of Zone 4 (currently in agricultural grazing use).

## 1.2 Ground Investigation

Details of the Ground investigation carried out by MCL Consulting at the site in 2021 are useful context within this Water Features Survey Report. The ground investigation involved drilling 23 No. windowless sampling boreholes and the completion of 27 No. Hand Augers and various phase of sampling and testing of soils and waters.

The locations of all soil / groundwater monitoring points are presented in **Fig. 3** (Lifford) and **Fig. 4** (Strabane).

Monitoring standpipes were installed in the majority of investigation points to allow for groundwater (manual level and water quality) and ground gas monitoring. Soil and groundwater samples were retrieved across the site. Water level data loggers were also installed in selected boreholes for a period of several weeks. A water level data logger was also installed in a deeper borehole drilled by Causeway Geotech, labelled as CGBH03 on MCL Consulting maps (Strabane).

A programme of field chemistry surveying and surface water sampling was undertaken in relevant watercourses in and around the site. Water level data loggers were installed in pond features and EC-Level Data logger was installed in the River Foyle to monitor for tidal fluctuation range and salinity fluctuations. The MCL ecology team also completed kick sampling for aquatic invertebrates in local watercourses and biodiversity observations were made in the Strabane ponds. Relevant elements of these works will be described later in this report.

**Fig. 3: Lifford Ground Investigation**

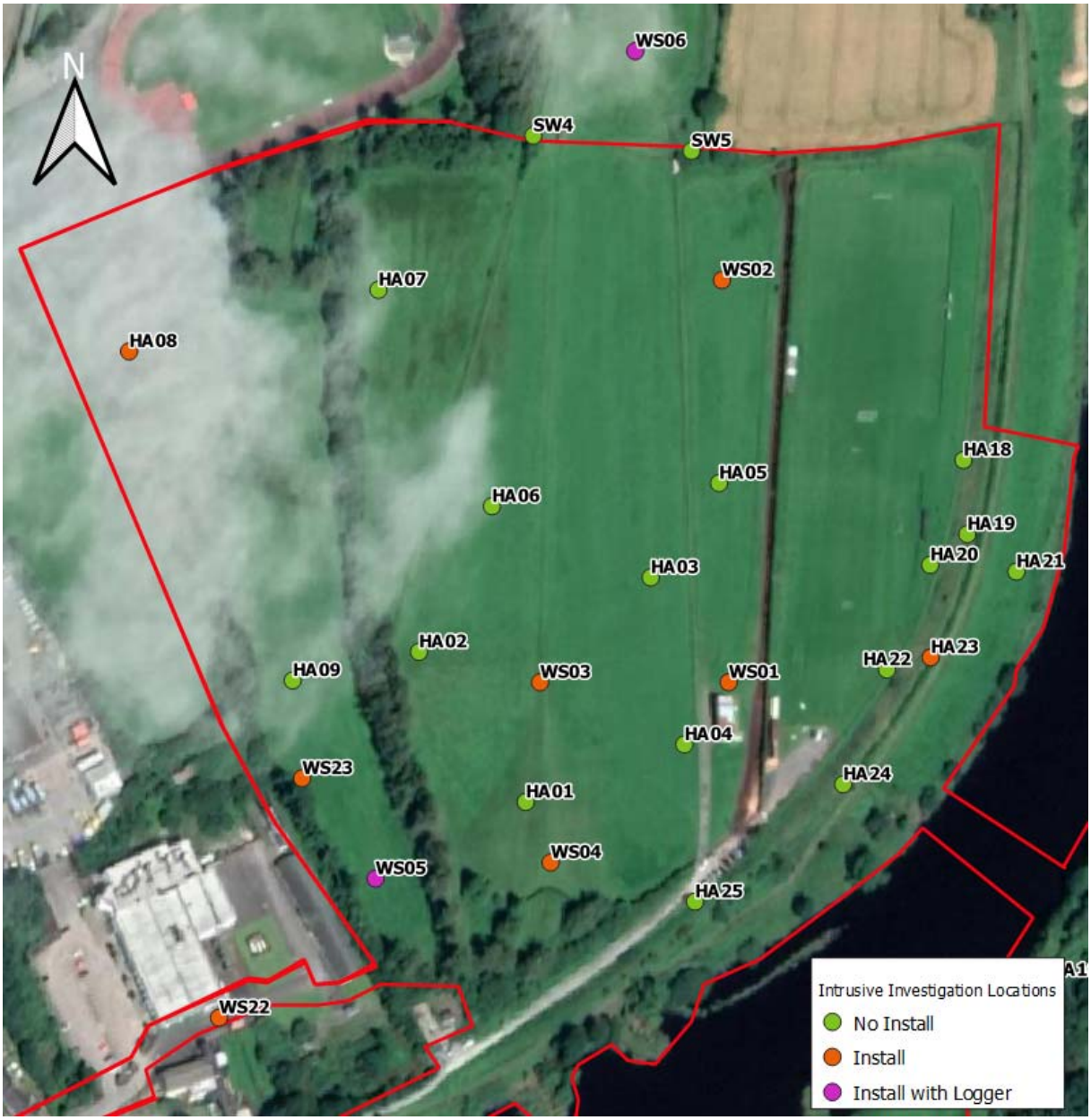
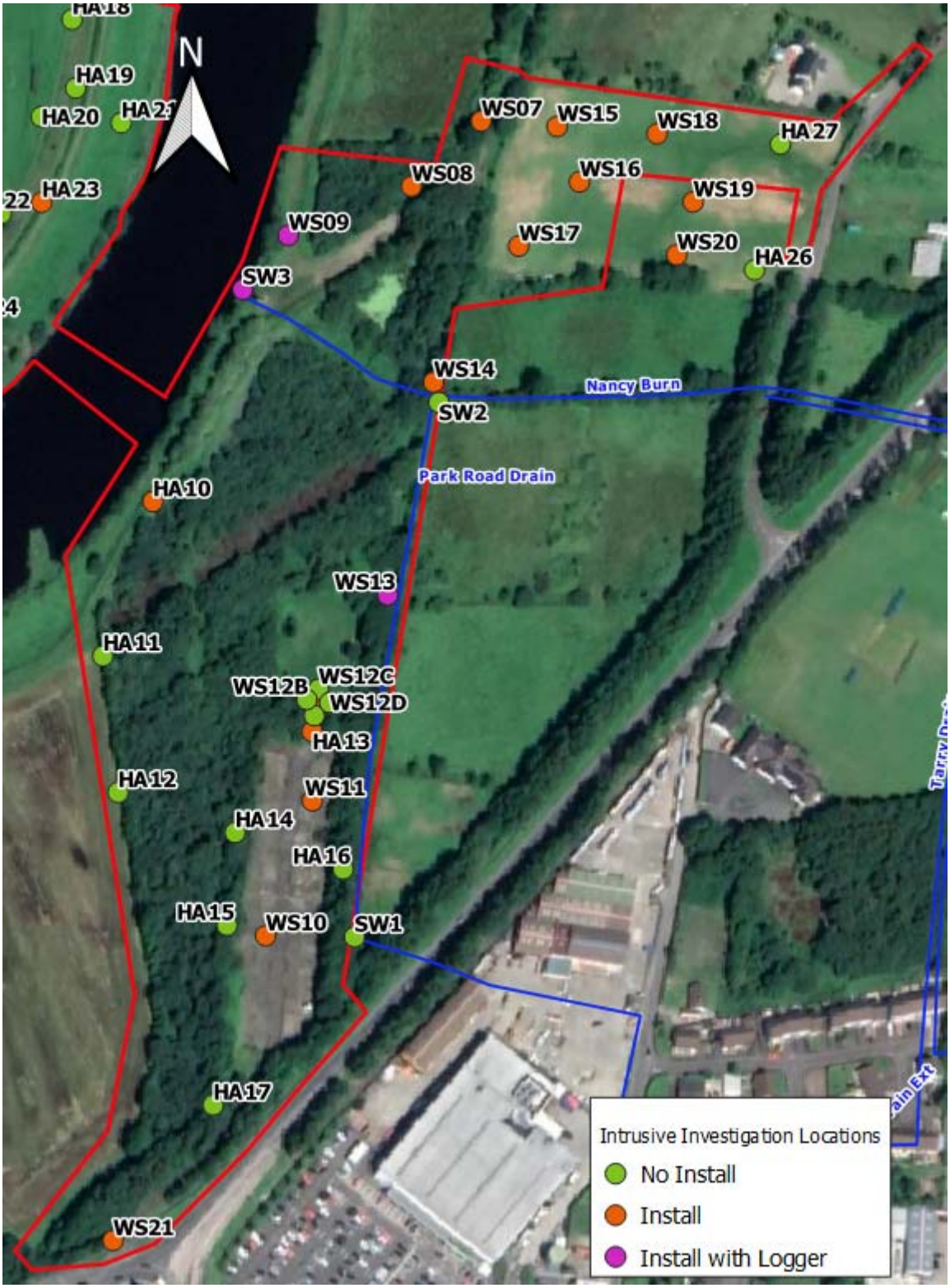


**Fig. 4: Strabane Ground Investigation**



# 2.0 WATER FEATURES SURVEY

## 2.1 Groundwater features

### 2.1.1 Licensed abstractions

**Lifford:** A review of Geological Survey Ireland (GSI) informs there are no abstraction licences within 1km of the site.

**Strabane:** A review of the NIEA Water Information Request Viewer informs there are no Groundwater Authorisation sites within 1km of the site. The database also shows 2 former surface water abstractions in the area, both of which are now abandoned (**Appendix 4)**.

### 2.1.2 Private Water Abstractions

A review of Geological Survey Ireland (GSI) informs there are no private water abstractions within 1km of the site. One recorded private absraction (2339SWW002) is located c.3km west of the site. This water supply borehole was drilled to a depth of 37mbgl, for domestic use only and is recorded to have a yield of 35m$^3$/day (see **Appendix 3**). No Source Protection Areas were identified within 1km of the site.

A review of the NIEA water abstraction licence applications dataset (09/06/2020 database updated) indicates there are no PWS within 1km of the site. The closest (Licence: DS002Z) is located 4km northeast (Appendix 4). Discussions with the company confirm that this is a shallow well located at the Lakeland Dairies Facility, Artigarvan and is disused.

A search of the MCL Groundwater Database, a private database of known abstractions derived from various sources identifies an unregistered private abstraction in the Strabane area (see Appendix 4). This is a 128m deep farm supply borehole at 63 Curlyhill Road, Strabane, 1.5km to the east of the site, yielding 27m3/day from the schist bedrock. A review of recent aerial photography suggests this land may have since been redeveloped for housing and therefore it is unlikely that this borehole still exists.

### 2.1.3 Water Features From Published Mapping

A review of relevant historical OS Maps has been undertaken to access the presence of all historical and mapped water features, including water bodies, wetlands, shallow wells and springs etc. in the vicinity of the site.

**Lifford**

The Historical Ordnance Survey mapping, as presented in **Appendix 5**, shows very few relevant water features in and around the site, with little change over time, the site remaining broadly undeveloped.

The River Foyle is mapped, with lands to the east of the railway embankment skirting the river bank on the Lifford site, annotated as 'Liable to Floods' on historical mapping from 1904 within the site boundary. A small open watercourse is also shown, flowing west to east along the northern site boundary, hence turning north and flowing toward and eventually into the River Deele 700m to the north of the site, near its confluence with the River Foyle. This water feature, draining from lands to the west, with a slight flow observed, remains virtually unmodified (bar a small section of culvert) to the present day.

**Strabane**

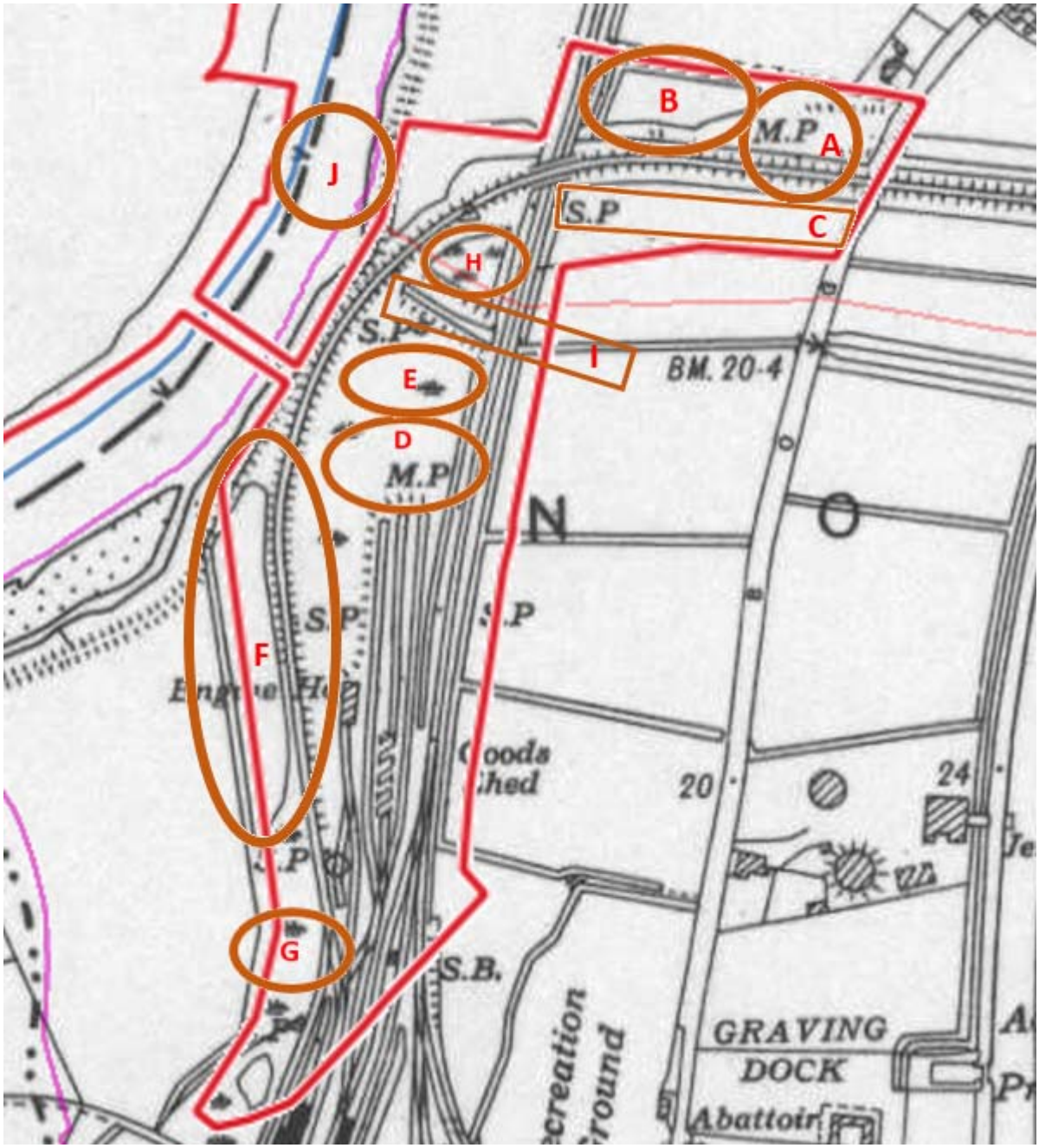
A c.1950s OSNI map with added annotations collating all evidence from OSNI Mapping, presented as **Fig. 5**, has been used to show the various water features identified in and around the site from historical mapping (see **Appendix 6** for collated historical mapping).

**Table 1: OSNI Mapped Features (Refer to Fig. 5 and Appendix 6)**

| Ref. | Feature | Locality | Comments |
|---|---|---|---|
| A | Mooring Post (suggests presence of open water) | Zone 4. Northeast of site within the area of the proposed Strabane car park, north of railway line embankment. Identified on OSNI c.1950s mapping. | Mooring post no longer present, railway line embankment no longer present. Lands currently comprising undulating grassland. |
| B | Open Water Body (un-labelled) | Zone 4. Northeast of site within the area of the proposed Strabane car park, north of railway line embankment. Identified on OSNI c. 1950s mapping. Located proximal to Mooring Point Ref A. | Open water body no longer present (infilled), railway line embankment no longer present. Lands currently comprising undulating grassland. |
| C | Open Water Body (un-labelled) | Zone 4 Northeast of site within the area of the proposed Strabane car park, south of railway line embankment. Identified on OSNI c. 1907 mapping. | Open water body no longer present (infilled), railway line embankment no longer present. Lands currently comprising undulating grassland. |
| D | Mooring Post (suggests presence of open water) | Zone 3. North of railway sidings within area labelled as marsh on 1950s OSNI Mapping (see Ref. D). | Mooring post no longer present, railway sidings no longer present. Much of this area currently comprises wooded bog (standing water). |
| E | Marsh | Zone 3. Area Proximal (north of) Morring Point Ref. A). Identified on OSNI 1905 and OSNI 1950s and OSNI 1960s mapping. Comprises lands to east of railway embankment. | Much of this area currently comprises wooded bog (with standing water). |

| Ref. | Feature | Locality | Comments |
|---|---|---|---|
| F | Open Water Body (un-labelled) | Zone 3. Elongate body of water running along western site boundary, west of railway embankment. Identified on OSNI 1905 and OSNI c1950s mapping. | This area plus lands to the south (See Ref. G) currently comprises wooded bog (with standing water, dries in summer). |
| G | Marsh | Zone 3. Lands to south of Ref. F. | Much of this area currently comprises wooded bog (with standing water, dries in summer). |
| H | Open water body (labelled as 'Pond') | Zone 2. Triangle-shaped water body located south of railway embankment. Identified (unlabelled) on 1905 OSNI and c.1950s OSNI and identified as 'pond' on 1960s OSNI Mapping. | This feature remains present on site currently. |
| I | Watercourse (unlabelled) | Zone 2 – Zone 3 Boundary. Unlabelled watercourse flows east to west across the site south of triangle pond, discharging to the River Foyle. First identified (unlabelled) on 1830s OSNI mapping. Shown to flow under the railway embankment from 1905 OSNI mapping onwards. | Water course still present on site in open channel (moderate flow observed). Labelled as 'Nancy Burn' on modern OSNI mapping. Discharges to River Foyle via modern concrete headwall culvert fitted with steel flap valve. |
| J | River Foyle | Separates Lifford site from Strabane Site. North-flowing past site. | - |

**Figure 5: OSNI 1950s With Additional Annotations (Collated OS Mapped Water Features)**




The historical mapping indicates a complex hydrological history across the Strabane site, with various water features past and present recorded. Whilst some open areas of water (possible providing water supply for steam engines), have been infilled, others remain in some form, either as retained open water (triangle-shaped pond) or have become invaded by trees and vegetation to form wooded bog, as discussed further in Section 2.1.6.

### 2.1.4 Local Property Survey (Lifford and Strabane)

**Lifford**

No owners/occupiers of nearby properties were approached directly but anecdotal information from the local community indicates that it is highly likely that there are any private water supplies in the vicinity of the site. The urban location dictates that the local population are served by mains water and sewerage systems.

The site walkover and discussions with the Lifford land owner's representative revealed that there is an unregistered historical (c 1970s) underground septic tank and associated sub-surface soakaway discharge in the underlying sands serving the existing spectator stand at the site. The landowner's representative was able to point out the approximate location of these underground structures, positioned under a flat grassed are to the rear of the building, close to the changing rooms / washing and toilet facilities at the spectator stand, as shown in **Fig. 1**.

A site walkover confirmed that there is no noticeable features of this septic tank-soakaway system at the location shown. The ground in the area was firm, with no signs of ponding or discolouration of vegetation. A photographic record for this area is presented as **Plate 3, Appendix 1**.

**Strabane**

No owners/occupiers of nearby properties were approached directly regarding water features, however, given the urban location it is very unlikely that many unrecorded private water supplies or unregistered operational septic tank-soakaway systems are present in the vicinity of the site. The area is properly served by extensive mains water and sewerage systems, extending throughout the area including along Park Road in proximity to the site.

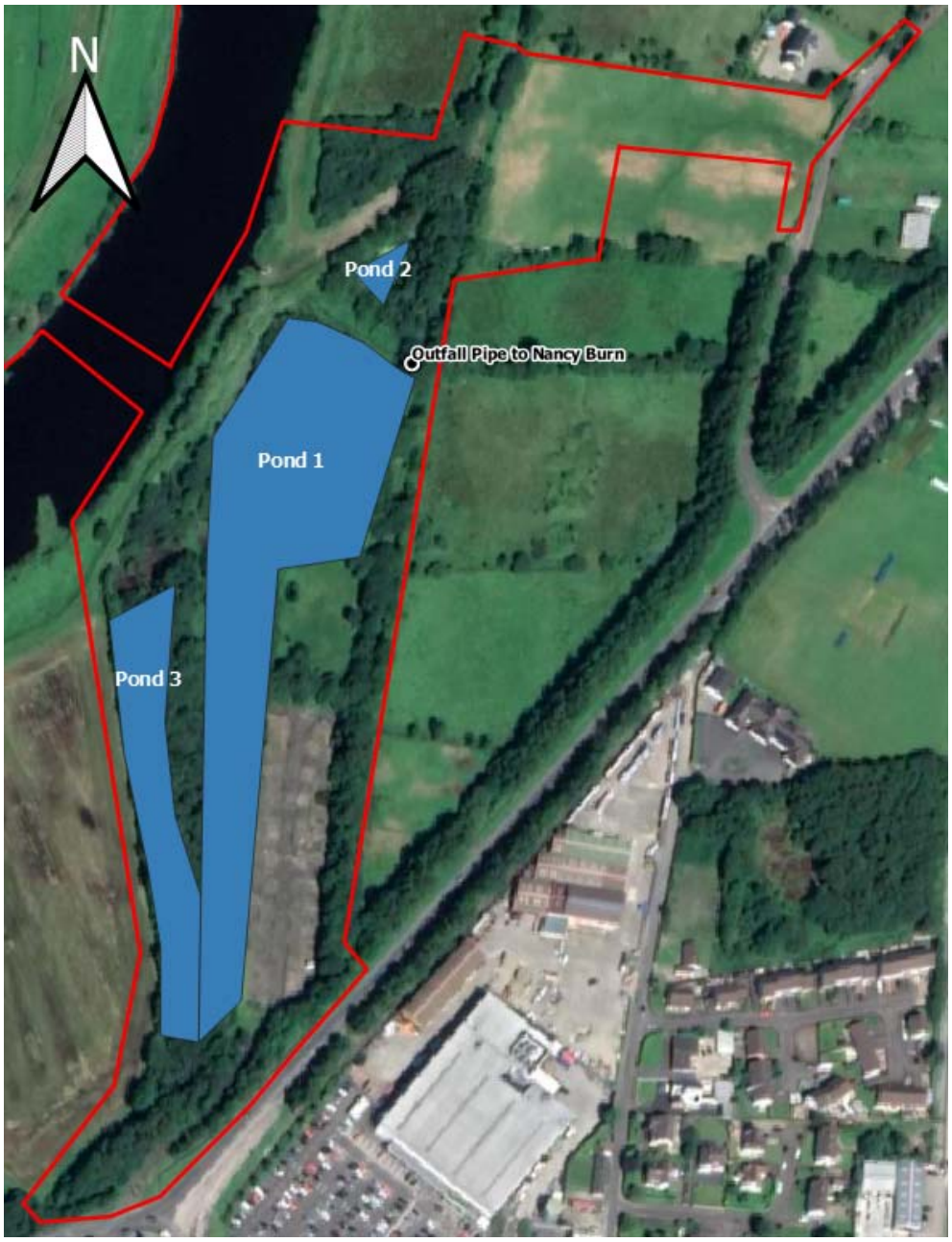
### 2.1.5 Open Water Bodies (Lifford)

There are no open water bodies located within or surrounding the Lifford site.

### 2.1.6 Open Water Bodies (Strabane)

There are 3no. ponds observed within the Strabane Site, as shown in **Fig. 6**.

**Fig. 6: Strabane Open Water Bodies**




Pond 1 (Historical Feature Ref. F, **Fig. 5, Plate 6 of Appendix 2**), the largest water body in the site in terms of area, is located in the west of the site, to the north and west of the present-day concrete hard standing area. This pond contains numerous small trees and pond-loving plants within and surrounding it. Pond 1 has been observed to dry up along its boundaries in the drier summer months, unveiling marshy wetland consisting of decomposed vegetation, but the majority of this area remains wet all year round. Water depths have been observed to be in the 0.5m – 1.0m deep range across this whole area with a soft muddy bottom (see Ecology reports for more details). No inflow was observed to this water feature, during the

survey work, through it appears to be fed periodically via Pond 3, with the outfall comprising a block wall weir at the northern end, holding water levels up in the pond, and discharging by overflow to the Nancy Burn (**Plate 7, Appendix 1**).

Pond 2 (Historical Feature Ref. H, **Fig. 5, Plate 13, Appendix 2**) is located within Zone 2 of the site, to the north of Pond 1. Pond 2 is a triangle-shaped pond of open water is stagnant in nature, with visible green surface algae throughout. Tree growth is confirmed to the margins, with no inflow or outfall structures observable. Water depths are in the order of 0.5m – 1.0m depth.

Pond 3 (Historical Feature Ref. F, **Fig. 5, Plate 12, Appendix 1**) is an elongate feature comprising a wooded wetland overgrown with small trees, located along the western boundary of the site within Zone 3. It is physically separated from Pond 1 by the old railway embankment now overgrown but which still cuts through this area of the site. However, Pond 3 is hydraulically linked periodically with Pond 1 at the south end of the site, where the railway embankment tapers out, hence this also would ultimately discharge to the Nancy Burn during wetter months. In the drier summer months such as July 2021, Pond 3 is observed to almost completely dry up, with decomposed vegetation and marshy land exposed in dry periods. Water depth in wetter periods have been observed to be in the order of 0.5m depth across this whole area. Pond 3 appears to be fed by a small watercourse SH02 (see Section 2.1.8) flowing into the site from lands to the southwest, likely to contain some urban drainage inputs including road runoff (dry at time of site surveys).

### 2.1.7 Watercourses and Drains (Lifford)

The site is located within the River Deele – River Foyle Catchment and all drainage arising from the site ultimately discharges to the River Foyle (SAC).

Lands to the west of the site comprise built up urban lands of Lifford Town, specifically a cinema complex with associated hardstand carparking, Council buildings, commercial and industrial buildings, private residential properties and Lifford Wastewater Treatment Works (WWTW).

The site itself is almost devoid of surface water features, the open areas being generally well-drained grassland (**Plate 4, Appendix 1**), with rainfall infiltrating to ground and hence to the shallow groundwater system. A small area of more poorly-drained land, where reeds are frequent across the ground surface and ground is wet underfoot with some localised puddles of very shallow (c. 10cm deep) standing water **Fig. 7, Plate 8, Appendix 1**). Borehole logs form MCL Site investigations (GQRA) indicate the underlying alluvium is slightly more clayey in this area, and this geology is likely attributing to the poor degree of surface water infiltration of this area, which is limited to a portion of field in the northern end of the site.

The Lifford site is located to the west of the River Foyle. An un-named watercourse (Our Ref. LHS02, **Fig. 7** and **Plate 6 of Appendix 1**) enters the northern area of the site flowing east in a c.1m wide c.1-2m deep steep-walled channel. This modest-flowing stream is partially culverted through the site (**Plate 7 of Appendix 1)**, to facilitate access to the northernmost field within the red line application area, hence flowing in an open channel (labelled as LHS01), turning sharply northwards and hence flowing through agricultural lands to the north of the site. The small stream ultimately discharges to the River Deele 700m north of the site.

**Figure 7: Lifford Watercourses**

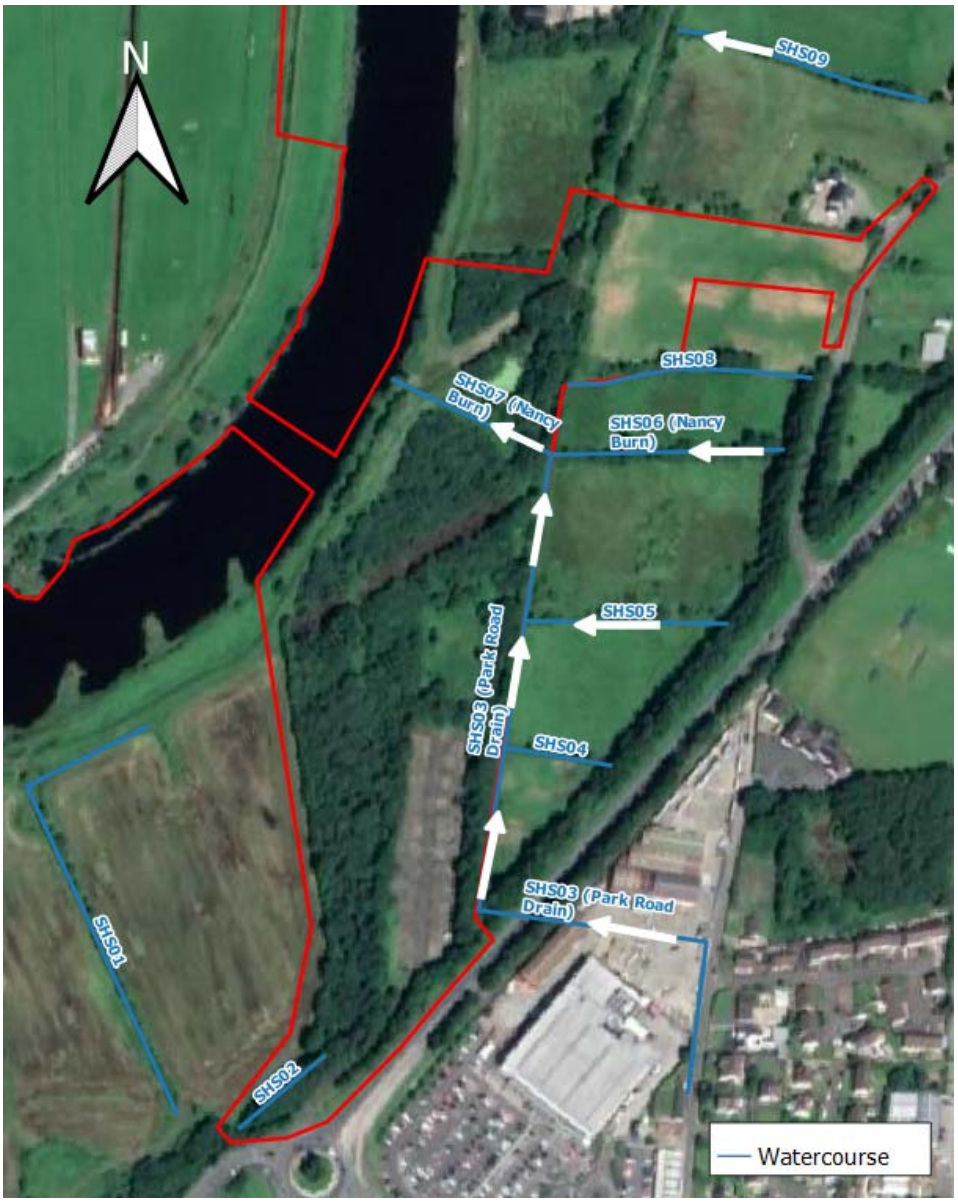


### 2.1.8 Watercourses and Drains (Strabane)

The site is located in the River Foyle catchment and all drainage from the site ultimately discharges to the River Foyle.

Extensive walkover surveys and review of historical and current OS Mapping, Spatial NI data and catchment mapping were undertaken to map out the local hydrology. Figure 8 details the Watercourses and Drains identified on the Strabane site, Strabane Hydrology Survey (SHS) points SHS01 to SHS09.

**Fig. 8: Strabane Watercourses**



The two main named watercourses draining the site and surrounding lands are the Park Road Drain (SH03, **Plate 5, Appendix 2**) and the Nancy Burn (SH06-SH07, **Plate 9, Appendix 1**).

Drainage waters from the urban area of Strabane, likely including some road runoff inputs are picked up by various minor field boundary watercourses (sheughs) flowing westwards which flow into the Park Road Drain at various points along the eastern site boundary. These comprise SH04 (low flowing at time of survey), SH05 (dry at time of survey) and SH06 (low flowing at time of survey) and SH08 (dry at time of survey).

A larger watercourse, the Nancy Burn (SH06 – SH07), also flows westwards through urban area of Strabane, passed a historical 'refuse tip' located 200m to the east of the site (see 1970s OSNI Mapping, **Appendix 6**), passing under the main A5 (Barnhill Road), flowing proximal to a small area of inert infilling occurring on agricultural lands to the west of the site.

The Park Road Drain (SH03) merges with the Nancy Burn along the eastern site boundary, with a concrete headwall and flap valve installed in the Park Road drain immediately upstream of the convergence point with the Nancy Burn. From this point, the Nancy Burn flows via a culvert under the main pedestrian path and hence in an c2m deep 2m wide open channel, flowing under the historical railway embankment (**Plate 8, Appendix 2**), discharging to the River Foyle via a large concrete headwall, fitted with a flap valve (**Plate 11, Appendix 2**).

Another small sheugh watercourse, SH01 - SHS02 (dry at time of survey), enters the site from the south, carrying drainage waters from open lands to the south with likely urban and road drainage inputs, flowing into Pond 3. This comprises the main input to Pond 3 and hence Pond 1.

Sheugh watercourse SH09 is located c.100m north of the Zone 4 boundary, drain from a semi-rural catchment on the outskirts of Strabane flowing west into the River Foyle.

### 2.1.9 Discharge Consents

**Lifford**

Lifford Wastewater Treatment Works is located on lands to the south. This facility has a consented treated effluent discharge to the River Foyle (NIEA Consent ref. D0352-01). A copy of the consent is provided in **Appendix 7**. Published data available on the EOA website (not reproduced here due to copywrite constraints) indicates that in 2019 there have been a number of non-compliances with the consent limits for COD (9 non-compliances over 13 samples), BOD (11 non-compliances over 13 samples), Suspended Solids (10 non-compliances over 13 samples), and ammonia (11 non-compliances over 13 samples) which has been put down to overloading of the plant. Planning Permission has been granted in October 2020 (Planning Ref. 2051105) to upgrade the Lifford WWTW in order to meet increased demands and this is anticipated to overcome non-compliance issues with respect to the discharge consent to the River Foyle.

**Strabane**

Strabane Wastewater Treatment Works is located on lands to the north. This facility has a consented treated effluent discharge to the River Foyle (NIEA Consent ref. 6606 / 2007), with no non-compliances noted by the regulator since monitoring commenced in 2007. A copy of the consent and correspondence from the NIEA are provided in **Appendix 8**.

Review of the NIEA Water Information Viewer informs of 1no. consented discharge within 250m of the site as presented in Appendix 8. This is located c.220m southeast, identified as 'Site Drainage: Unspecified' (Ref.11064/13/1). This discharge is an urban Site Drainage discharge to the Mourne River, from the retail park area. Another consent, also to the Mourne River, is located c.310m southwest, identified as 'Private Sewage: Unspecified' (Ref.10661/98) (Service Station with Car Wash) on lands close to the Lifford Bridge.

### 2.1.10 Water Dependent Ecological Features

The west of the Strabane site and east of the Lifford site is located within the *River Foyle and Tributaries* Area of Special Scientific Interest (ASSI) and a Special Area of Conservation (SAC). All drains and watercourses within both sides of the site flow into the River Foyle and therefore both the Lifford and Strabane portions of the site are hydraulic connected via the on-site surface water features to the River Foyle ASSI and SAC.

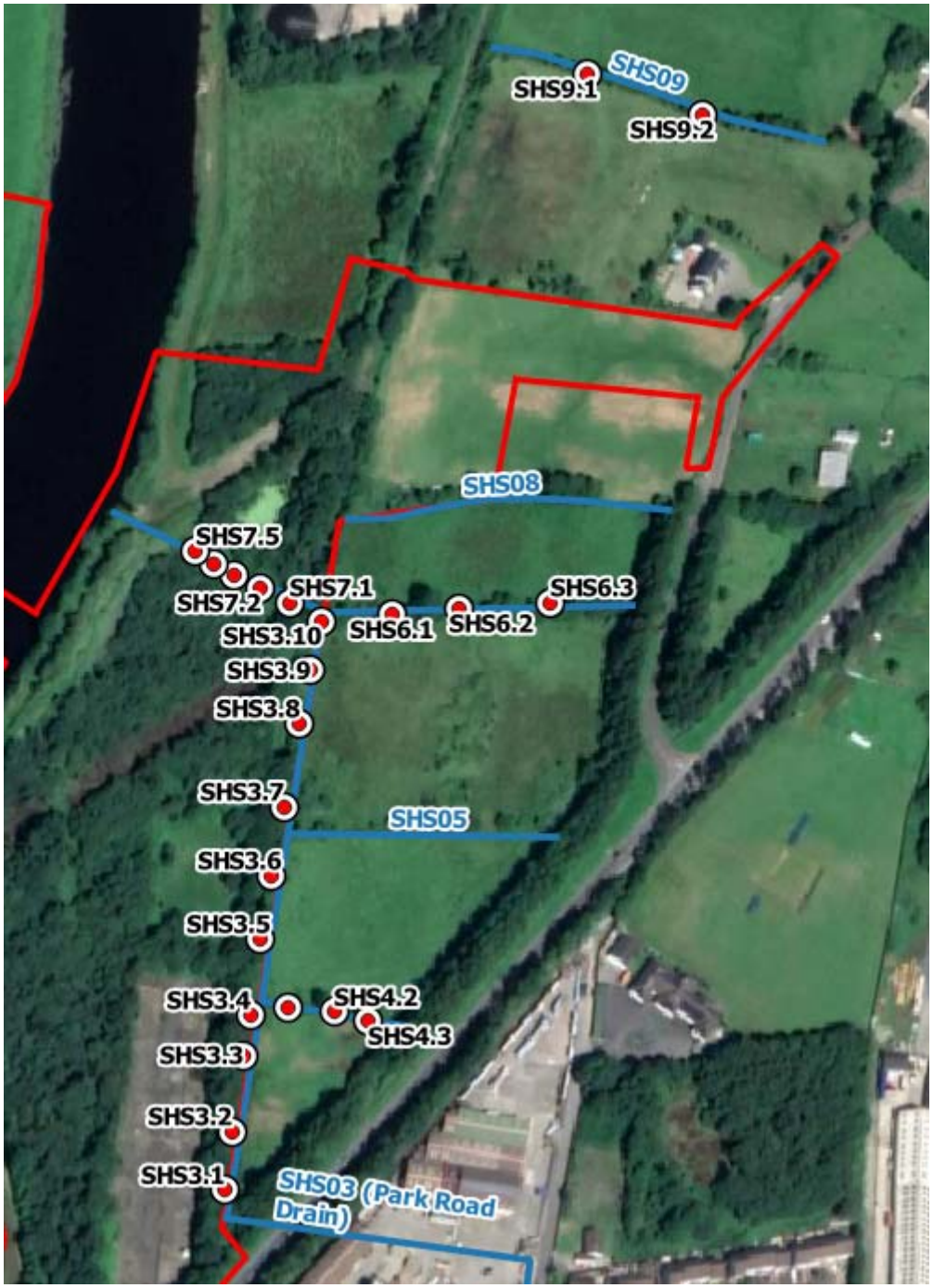
## 2.2 Water Quality Field Chemistry Survey

In-situ field chemistry was carried out at close intervals along all relevant water features identified, as shown in **Fig. 9** (Lifford) and **Fig. 10** (Strabane), for pH, Dissolved Oxygen, Electrical Conductivity (EC), Total Dissolved Solids (TDS), Salinity and Temperature using a multiparameter waterproof meter. The results of the field chemistry survey are presented in **Appendix 9**.

**Fig. 9: Lifford In-Situ Field Chemistry Sample Points**



**Fig. 10: Strabane In-Situ Field Chemistry Sample Points**




## 2.3 Freshwater Aquatic Ecology Survey (Watercourses and Ponds)

In July 2021, an Ecology team from MCL Consulting carried out a programme of freshwater invertebrate sampling at suitable locations in relevant watercourses at the site and the results are presented in a separate Freshwater Aquatic Ecology Report, contained in the Ecology Chapter of EIAr.

## 2.4 Surface Water Quality Testing

Two phases of Surface Water quality testing were undertaken at the site. Sampling points are presented in **Fig. 11** (Lifford) and **Fig. 12** (Strabane). Firstly, a small number of samples were obtained at key points in local surface waters on 26th-27th May 2021 comprising the following:-

**Lifford**

- SW4 Upgradient un-named field drain.
- SW5 Downgradient un-named field drain.

**Strabane**

- SW1 Upgradient Park Lane Drain.
- SW2 Upgradient Nancy Burn.
- SW3 Downgradient Nancy Burn (discharge to River Foyle).

Secondly, a further round of water samples were retrieved from local watercourses on 26th July 2021 comprising the following:-

**Lifford**

- WCS07 River Foyle Lifford side, upflow of the Wastewater Treatment Works discharge.
- WCS08 River Foyle Lifford side, upflow of the Wastewater Treatment Works discharge.
- WCS09 Downgradient un-named field drain.
- WCS10 Downgradient un-named field drain.

**Strabane**

- WCS01 Mid-gradient Park Road Drain (proximal to area of concrete hardstanding).
- WCS02 Downgradient Park Road Drain prior to confluence with Nancy Burn
- WCS03 Pond 2 (Triangle-shaped Pond).
- WCS05 River Foyle Strabane side, upflow of the Wastewater Treatment Works discharge.
- WCS04 River Foyle Strabane side, downflow of the Wastewater Treatment Works discharge.

- WCS06 Discharge to Nancy Burn from overflow weir at Pond 1.

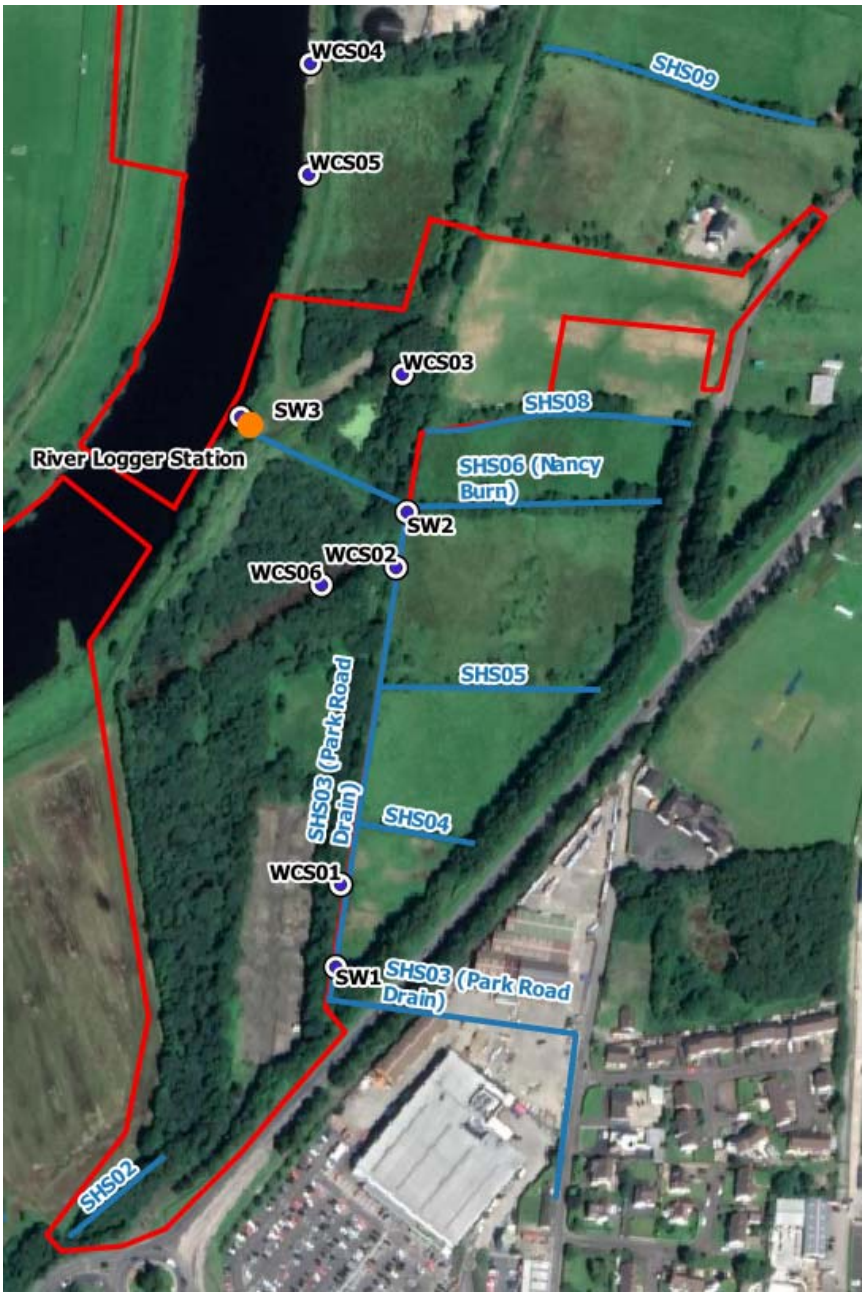
All samples were sent to Element Technologies Accredited laboratory using appropriate chain of custody documents and tested for PAH 16, TPH CWG, Metals (As, Ba, Be, B, Cd, Cr, Cu, Pb, Hg, Ni, Se, V, Zn), Cr III, Hexavalent Chromium, Sulphate as SO4, Free and Total Cyanide, Thiocyanate, pH, Chloride, Electrical Conductivity, TOC, Suspended Solids and Colour.

The results of surface water sampling are presented as laboratory certificates in **Appendix 10**.

**Figure 11: Lifford Watercourse Sample Points**



**Figure 12: Strabane Watercourse Sample Points**




## 2.5 Electrical Conductivity and Level Logging, River Foyle

A Data Logger capable of logging Electrical Conductivity and Water Level was installed into the River Foyle and a datum point established and surveyed to Ordnance Datum. The location of the installation, close to the bankside at Strabane, is shown in **Fig. 12**. The logger was set to record EC and River level at 10-minute intervals for a period of c.3 months (May 2021 – July 2021.

## 2.6 Groundwater & Surface Water Level Monitoring

As part of the Land Quality Ground Investigation, groundwater monitoring wells were installed in various boreholes throughout the site. Spot dips were taken at each point on 4no. occasions throughout the monitoring period.

Data loggers were also placed throughout the site, as shown in **Fig. 13**, to allow for continuous monitoring of groundwater levels for a period of up to 3 months (May 2021 – July 2021) in the following locations;

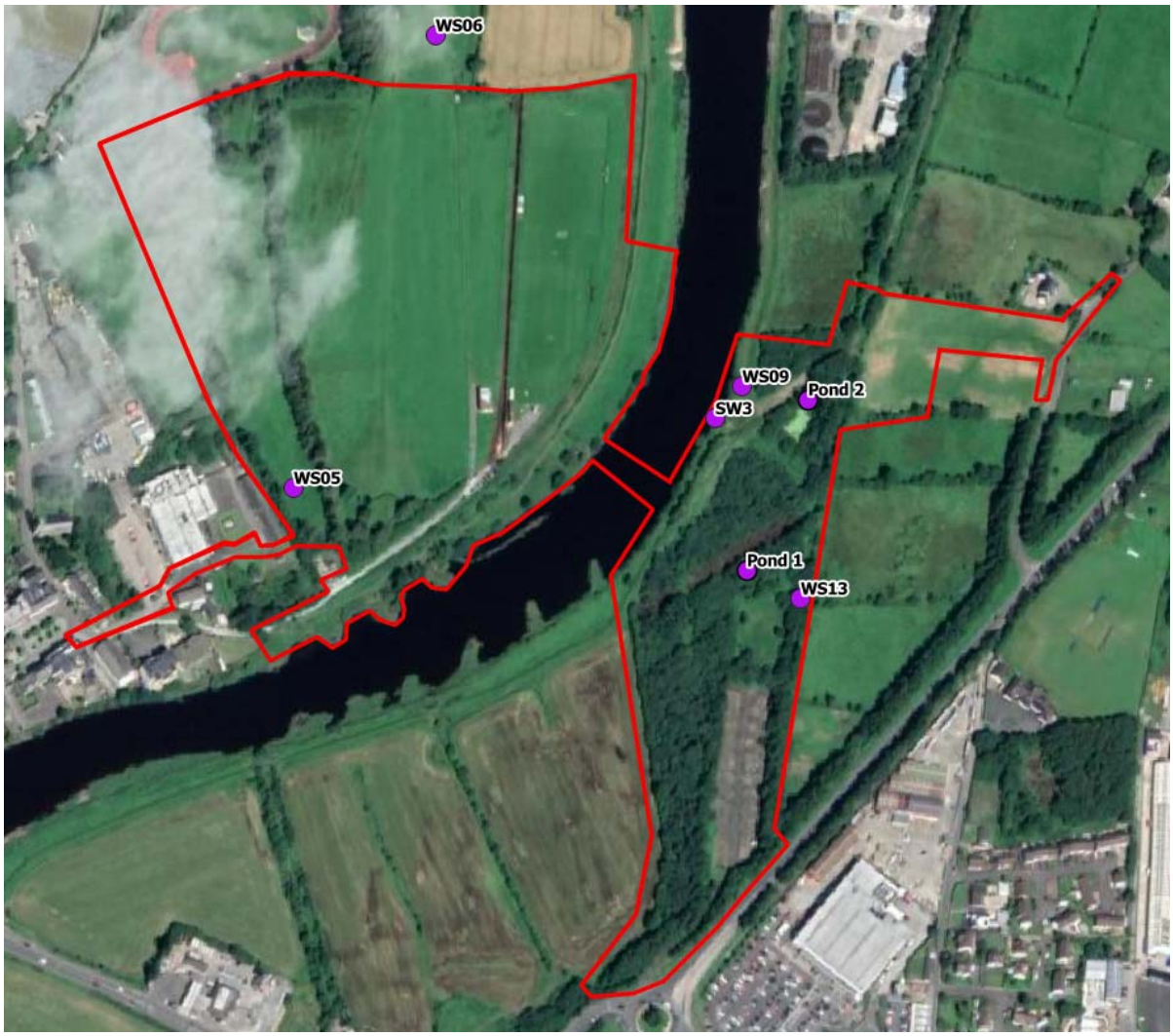
Groundwater Level Monitoring

- HA08 (Lifford)
- WS06 (Lifford)
- WS13 (Strabane)
- WS09 (Strabane)
- SW3(Strabane in the River Foyle)
- CGBH03 (Strabane)

Surface Water Level Monitoring

- River Foyle (location recorded on **Fig. 13**)
- Pond 1 (Strabane)
- Pond 2 (Strabane)

**Figure 13: Logger Install Locations**




The data loggers recorded water levels every ten minutes, calibrated against spot dip levels and were compensated with a barometric logger also installed at the site for the duration of the monitoring programme.

## 2.7 Groundwater Quality Testing

A programme of shallow groundwater sampling was undertaken in shallow boreholes drilled across the site as part of the GQRA Land Contamination Assessment. A total of 4 No. groundwater samples were obtained across the Lifford site and a total of 4 No. groundwater samples were obtained across the Strabane site.

Samples were tested for the following range of parameters:-

Metals (As, Ba, Be, B, Cd, Cr, Cu, Pb, Hg, Ni, Se, V, Zn, Hexavalent Chromium, TPH CWG, PAH16, VOC, Phenols, Sulphate as SO4, Free and Total Cyanide, Thiocyanate, pH, Total Suspended Solids and Hardness. The laboratory analysis was undertaken by UKAS accredited laboratory Element Material Technology.

The results are presented as laboratory certificates in **Appendix 10**.

## 2.8 Discussion of Results

### 2.8.1 Field Chemistry

**Lifford**

Field Chemistry data for local surface waters indicates generally well oxygenated waters, with a moderate degree of mineralogy and slightly alkaline in nature. Whilst the River Foyle demonstrated a low EC of c.112-130µS/cm, the small watercourses showed more mineralisation at EC c. 400-600µ/S/cm. No ammonia was detected at any locations.

**Strabane**

Field Chemistry data for local watercourses indicates generally well oxygenated waters, (upgradient Park Road Drain depleted) with a moderate degree of mineralogy and slightly alkaline in nature.

Field Chemistry data for the on-site ponds (Pond 1 and Pond 2, Pond 3 dry at time of July 2021 survey), indicates depleted oxygen levels and slightly alkaline non-saline waters with moderate mineralogy.

### 2.8.2 Water Quality Sampling

**Lifford**

Upstream at SW4, in the on-site watercourse entering the site from sub-urban lands beyond, a sample obtained on 27/5/21 indicates reasonably good chemical water quality, with low levels of metals, no oils or PAHs detected and very low BOD (1mg/l) and low suspended solids (14mg/l).

A short distance further downstream in the same watercourse at SW5 (sample from 27/5/21) / WCS09 (Sample from 24/6/21), trace quantities of PAH compounds were detected, including

benzo (a) pyrene 0.016µg/l (Total PAH 0.250µg/l) from the sample collected on 27/6/21 in a sample which demonstrated a high suspended solids of 725mg/l. Lower levels of PAH were detected at the same sample location (WS09) on 24/6/21 (though total PAH was reported as <0.195µg/l). The sample from WS09 obtained on 24/6/21 demonstrated elevated ammoniacal nitrogen (7.4mg/l), electrical conductivity (918µS/cm), chloride (195.2mg/l) and suspended solids (41mg/l). Further downstream in the same watercourse at WCS10, similar chemistry to that observed at WCS09 was observed. There is no clear identifiable point source for the trace levels of PAH, and the elevated ammonia and chloride detected in the downstream water samples in this small watercourse. The field chemistry data for these sample points from the same sampling date (**Appendix 9**) indicates no detectable ammonia at these locations.

The local low intensity land-use, and generally green-field nature of the land history does not provide any evidence of local pollution sources, however, the presence of ammonia may suggest agricultural spreading / fertiliser inputs form surrounding farmed land, such as the field to the northeast.

Insignificant small changes were observed in chemistry in the River Foyle between sample points WCS07 (upflow) and WCWs 08 (downflow) at the Lifford WWTW discharge, however it was difficult to establish whether a discharge was being made from the WWTW at that time.

**Strabane**

Upstream at SW1 in the Park Road Drain, a sample obtained on 26/5/21 indicates reasonably good chemical water quality, with low levels of metals, no oils detected and no detectable BOD, however Suspended Solids is high at 505mg/l and the sample also showed the presence of trace PAH compounds (including benzo(a)pyrene 0.025↕g/l, Total PAH 0.438µg/l), likely due road runoff inputs (off-site source) from surrounding road infrastructure.

A second water sample in the Park Road Drain proximal to SW1 at WCS01 from 24/6/21, shows the presence of oils (EPG C8-C40 at 3.23mg/l), PAH (Total PAH 2.273µg/l) and high suspended solids (588mg/l) and ammonia (1.19mg/l NH3_N), typical of an urban catchment. In the absence of an on-site source of oils in this vicinity of the site (this surface sample point is located upflow of the area where low levels of PAHs (Total PAH 0.308µg/l BH WS11, Fig. 4)

have been detected in groundwaters under the concrete area north of this location, see GQRA), an off-site source from the urban lands to the south would seem likely.

Upstream at SW2 in the Nancy Burn (downstream with respect to historical landfill and gasworks to east), a sample obtained on 26/5/21 indicates reasonably good chemical water quality, with low levels of metals, no oils detected and no detectable BOD, with a low level of suspended solids (22mg/l) and some insignificant trace PAH compounds (Fluoranthene 0.016µg/l, Pyrene 0.022µg/l).

The Park Road Drain was also sampled just before its confluence with the Nancy Burn, at WCS02 on 24/6/21. This indicates some discernible degradation in water quality as it flows along the eastern site boundary, with increased levels of nitrate (17.3mg/l) compared to the upflow conditions (<0.2mg/l), suggesting agricultural runoff input from farmed grasslands immediately to the east. However, oils and PAHs detected upflow (at SW1 and WCS01) appear to have dissipated by this point and levels of suspended solids have reduced to 73mg/l from over 500mg/l at the upflow sampling point.

Downflow in the main site discharge in the Nancy Burn at SW3, water quality appears good, with no significant organic or inorganic contamination detected indicating that there is no significant impact to the River Foyle from the watercourses draining the site.

With respect to water quality in the on-site ponds, a sample from Pond 2 (triangle-shaped pond) WSC03, obtained on 24/6/21, chemical water quality appears reasonable, though low levels of oils were detected in this sample (0.2mg/l). The water in this pond has a lower conductivity (140µS/cm) that local surface waters (c400µS/cm), more typical of rainfall, which is consistent with this feature having no discernible inflow and being primarily rainfall-derived. This pond has also no discernible outfall. The outfall from Pond 3, the main water feature on site, WCS06, low levels of oils were detected (0.11mg/l) and low levels of ammonia also present (0.55mg/l NH3_N) suggesting slightly anoxic inputs.

In relation to sampling in the River Foyle around the WWTW discharges, it was difficult to determine whether the sites were actively discharging at the time of sampling. However, for the Strabane WWTW, water quality appeared good at WSC04, with a slight increase in

Sulphate (2.3mg/l increasing to 9.7mg/l), Chloride (15.7mg/l increasing to 23.2mg/l) and Nitrate (4.2mg/l increasing to 6.3mg/l) between upflow and downflow (WCS05) samples.

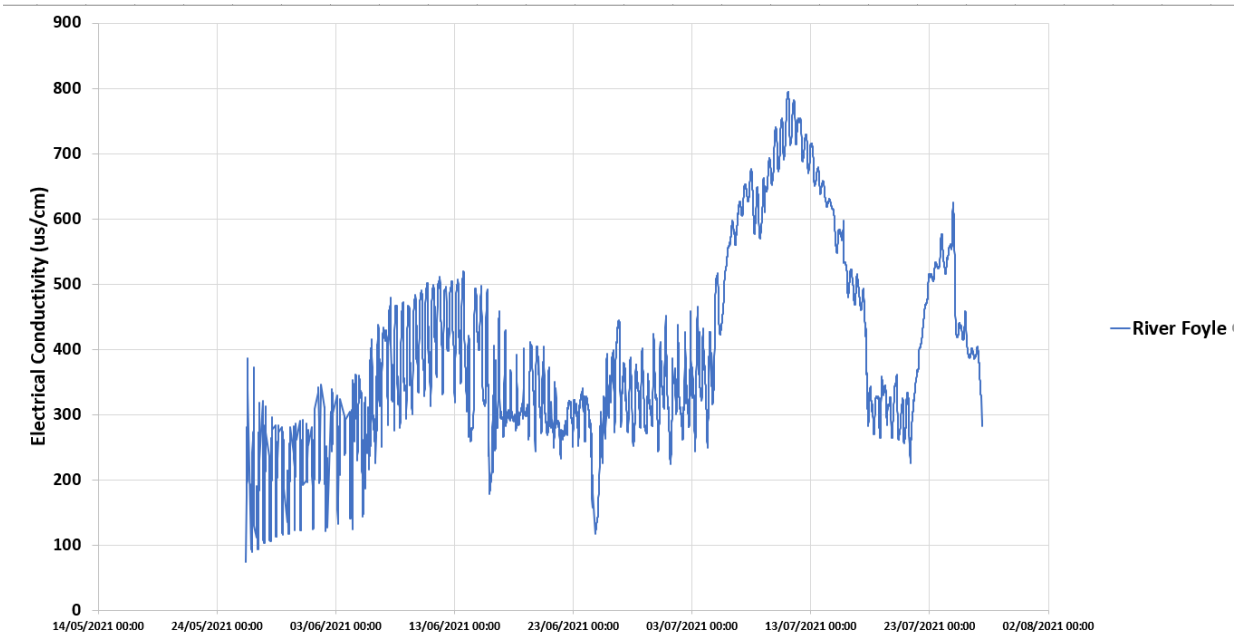
### 2.8.3 Freshwater Aquatic Survey

In summary, the results of the freshwater aquatic survey indicate generally low diversity of invertebrate assemblages in local watercourses in both Lifford and Strabane suggesting fairly poor biological water quality in these watercourses. The woodland ponds were considered as having a better biological water quality and greater diversity of aquatic life.

### 2.8.4 EC Monitoring, River Foyle

The results of EC Monitoring in the River Foyle between May 2021 and July 2021 are presented as **Fig. 14**.

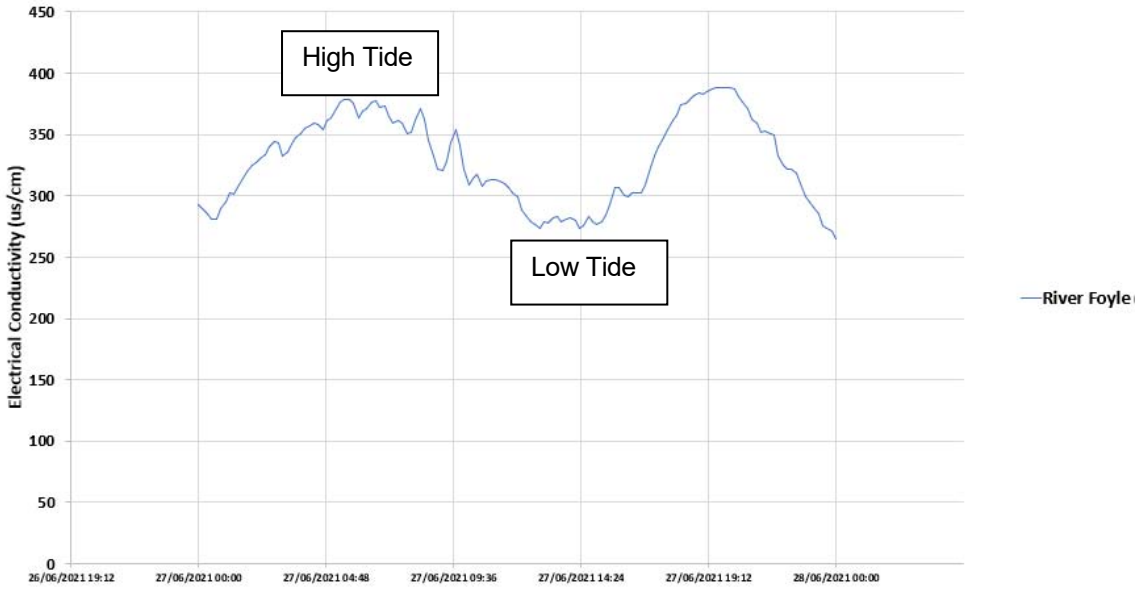
**Figure 14: EC Logging, River Foyle**




The monitoring data in **Fig. 14** shows variations in EC over time with fluctuations daily and periods of c. week duration where EC levels are generally more elevated that during other periods. Examining these trends in more detail over a typical day, as presented in **Fig. 15**, shows a typical semi-diurnal fluctuation in EC, following the trend of high (incoming) and low (outgoing) tides. EC increases over a high tide cycle and decreases again during a low tide cycle, and this occurs in the EC data twice daily indicating the introduction of more saline water inputs from the Estuary to the river system during periods of incoming tides.

However, the EC logging data suggests that the Foyle at Riverine typically remains in the non-saline, non-brackish state, i.e. remains as 'freshwater' despite the tidal influence on river levels and EC.

**Figure 15: EC Logging, River Foyle (1 day cycle)**




## 2.8.5 Surface Water Hydrographs

Surface water hydrographs were produced for the River Foyle, as well as Pond 1 and Pond 2. These are presented in **Fig. 16**.

**Figure 16: Surface Water Hydrographs**



The River Foyle Hydrograph shows typical semi-diurnal tidally influenced water level fluctuations in the order of 1.6m variation over the normal tidal cycle. It is of note that the river level is around 0.4mOD at low tide, which is surprising given the significant distance to the coast at this locality. These levels are, however. consistent with the bathymetry survey data which shows the floor of the riverbed to be between 0mOD and -2mOD at the site and the general observable water level in this stretch of river, which has been noted to be very shallow during the summer survey period.

Water levels in Pond 1 and Pond 2 are higher in elevation at around 2.4mOD in Pond 2 and 1.5mOD in Pond 1 than the water levels in the River Foyle and both ponds show a very slight tidal fluctuation / semidiurnal wobble. Whilst Pond 2 has no overflow, Pond 1 outfalls to the Nancy Burn and hence to the River Foyle.

### 2.8.6 Groundwater Level Monitoring and Flow Patterns

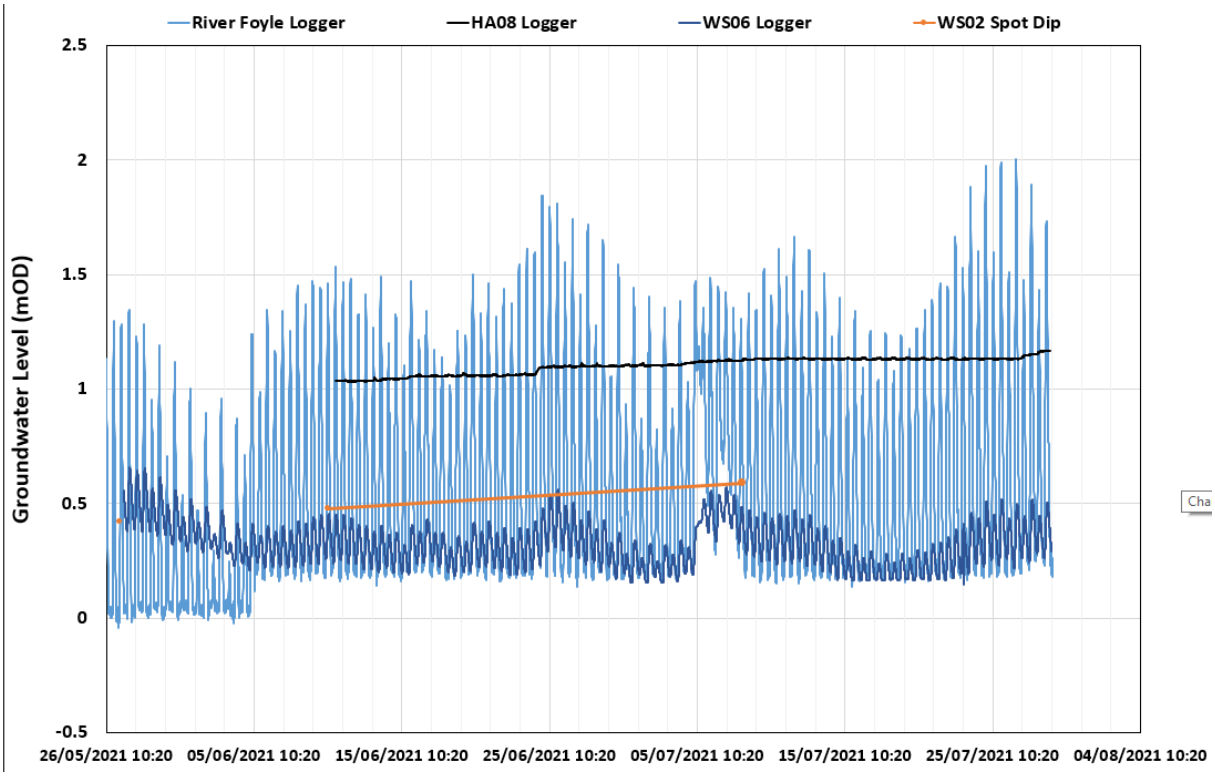
Groundwater hydrographs were produced from all manual and electronic water level data and are presented, along with level monitoring from the River Foyle logger for Lifford (**Fig. 17**) and Strabane (**Fig.18**).

**Lifford**

The hydrographs (**Fig. 17**) for Lifford indicate that shallow groundwater levels at WS06 in the north of the site and c.210m from the River Foyle are tidally influenced, displaying typical semidiurnal fluctuations of c 0.3m – 0.4m intensity, with baseflow recharge to the River Foyle occurring during low tide cycles.

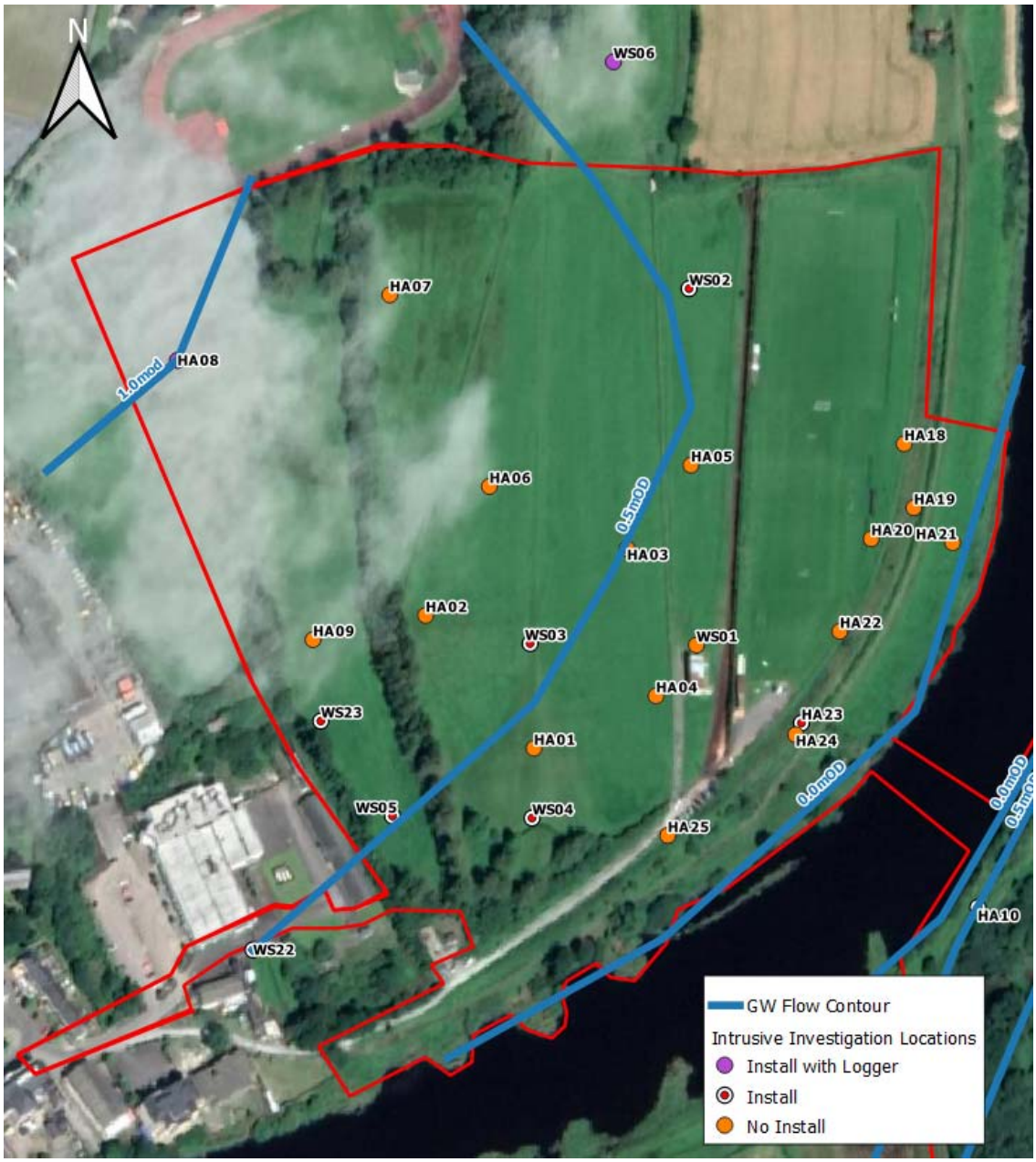
Tidal effects are however not observed at HA08, located in the south of the site and further inland at c.430m from the River Foyle. This may be due to the shallow nature of this auger borehole and it being wholly within the alluvium, not truly in the sands and gravels, with only a shallow water seepage recorded during drilling (see Borehole Logs, GQRA).

**Figure 17: Groundwater Hydrographs, Lifford**




A basic groundwater flow map for the general conditions in the sand and gravel unit has been produced from available site-specific groundwater data and is presented in **Fig.18**.

**Figure 18: Groundwater Flow Map, Lifford**




The results indicate a general groundwater flow direction toward the River Foyle from the shallow sand and gravel aquifer, with water levels ranging from c.1.0mOD in the inland western boundary to 0.0mOD at the River Foyle during low tide cycles. The groundwater hydrographs indicate some fluxing and reversal of groundwater flow direction occurs during high tide cycles.

Results from deeper drilling carried out as part of the Geotechnical Assessment (see Geotechnical Report), indicated other water strikes within the sand and gravel unit at greater

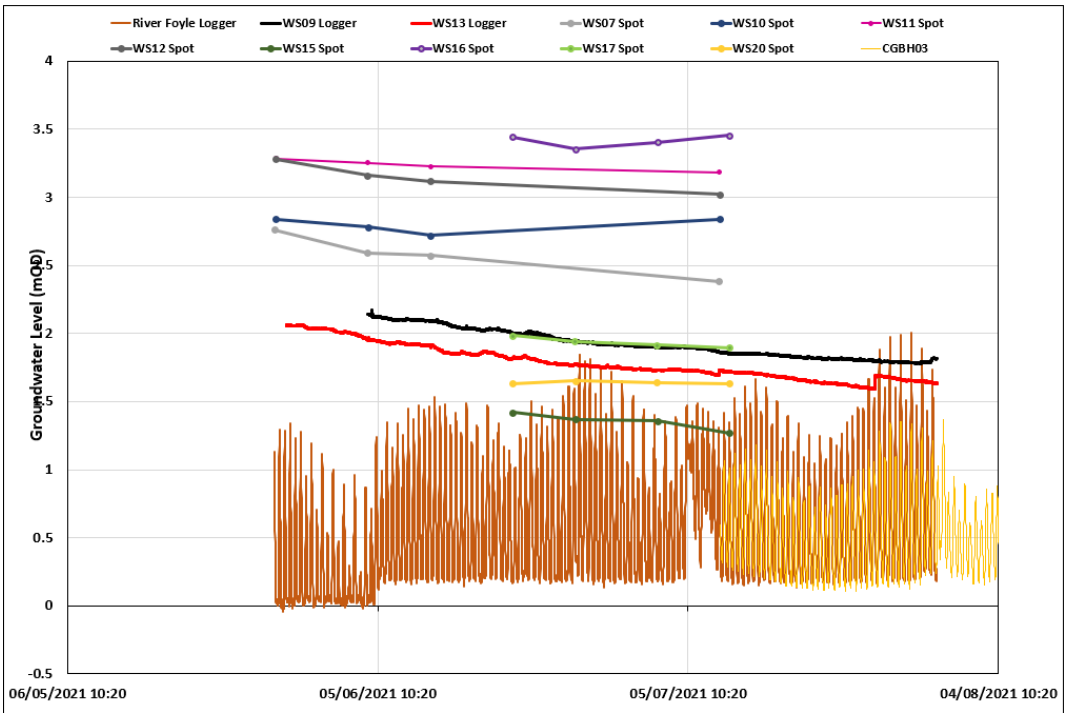
depths in excess of 10mbgl, with confining conditions apparent at depth from the drilling records.

**Strabane**

The hydrographs (**Fig. 19**) for Strabane indicate that groundwater levels in the sand & gravel drift deposits at CBH03 close to the banks of the River Foyle (c.15m) on the western boundary of the site are strongly tidally influenced, displaying typical semidiurnal fluctuations of c 0.8m – 0.9m intensity, with baseflow recharge to the River Foyle occurring during low tide cycles.

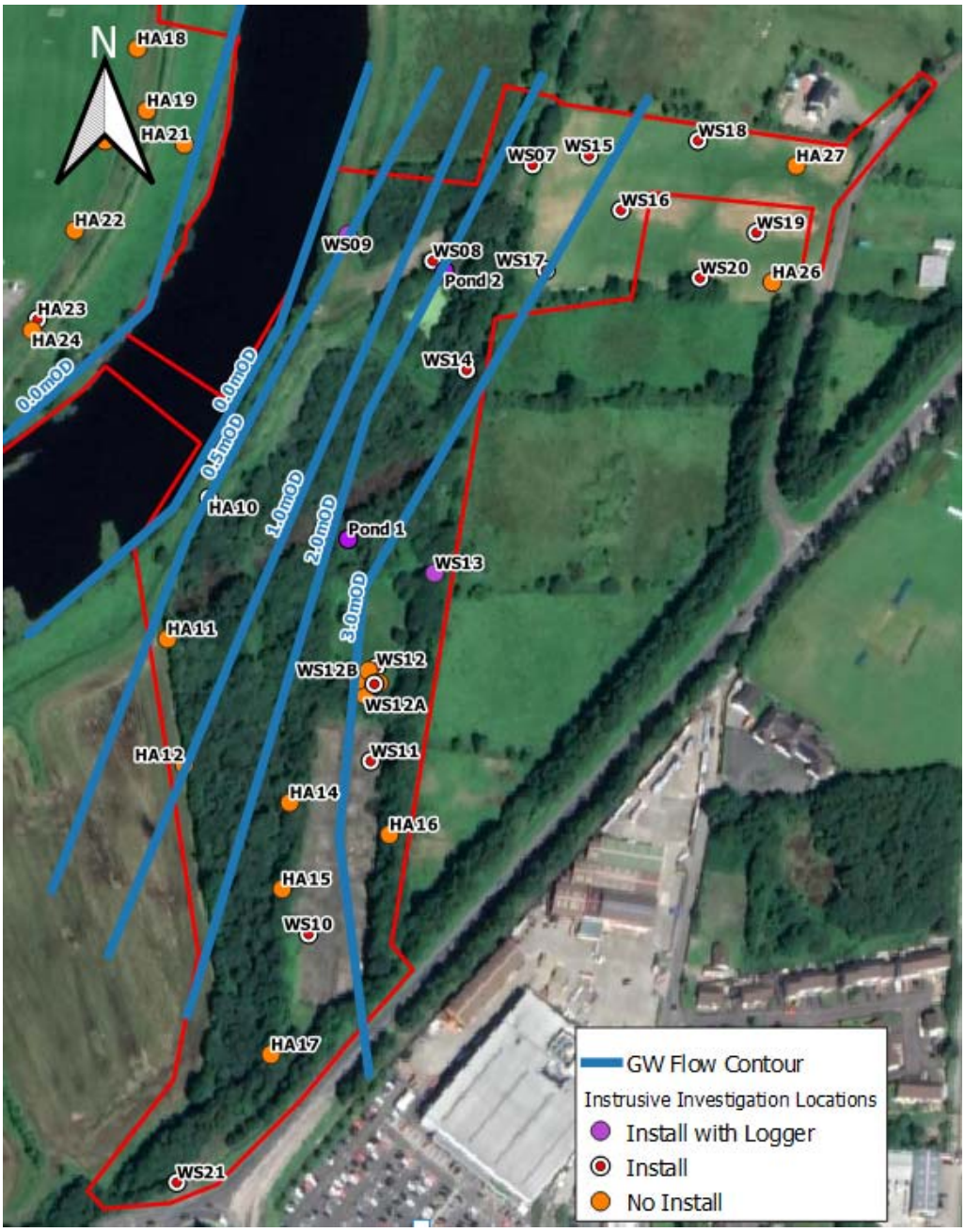
Tidal effects are however not observed at WS09, also located on the western boundary of the site, at c.15m from the River Foyle and at WS13 on the eastern boundary of the site at c.130m distance from the River Foyle. This may be due to the fact that the response zones for these boreholes are wholly within the alluvium, not truly in the sands and gravels, with no water seepage recorded during drilling in the case of WS09 (see Borehole Logs, GQRA). This pattern is similar to that observed at Lifford, where groundwaters in the sands and gravel appear to be tidally influenced, whilst groundwaters in the alluvium are not. These systems are likely to essentially be hydraulically separate from each other. The data does indicate a groundwater flow direction broadly to the west within the sands and gravels, toward the River Foyle as would be expected.

**Figure 19: Groundwater Hydrographs, Strabane**




A basic groundwater flow map for the general conditions in the sand and gravel unit has been produced from available site-specific groundwater data and is presented in **Fig.20**.

**Figure 20: Groundwater Flow Map, Strabane**




The results indicate a general groundwater flow direction toward the River Foyle from the shallow sand and gravel aquifer, with water levels ranging from c.3.0mOD in the inland eastern boundary to 0.0mOD at the River Foyle during low tide cycles.

### 2.8.7 Groundwater Sampling (see also GQRA)

Groundwater sampling was undertaken across the site as part of the Phase 2 GQRA Land Contamination Assessment and the results are summarised below.

**Lifford**

On the Lifford side, shallow groundwater samples were collected from WS02 (3m deep in sand & gravel), WS06 (1.8m Deep in alluvium) and HA08 (2.3m deep in alluvium) (see **Fig. 3**). All other monitoring points installed by MCL Consulting in Lifford were recorded as dry.

At HA08, the Nickel DWS of 20ug/l was exceeded at 76.5ug/l. The Arsenic DWS of 10ug/l was exceeded at WS02 at 32.4ug/l and WS06 at 19.2ug/l. The Nickel DWS of 20ug/l was exceeded at WS02 at 97.9ug/l and WS06 at 34.2ug/l. No groundwater sample test positive for the presence of oils or PAHs or other significant contamination.

The minor exceedances for some metals on the Lifford side are likely to be naturally occurring since no significant development has taken place on this site. These exceedances are unlikely to have an impact on human health as there are no groundwater abstractions or private water supplies within 1km of the site. Impacts to the SAC from the baseline groundwater condition would be negligible.

**Strabane**

On the Strabane side, groundwater samples were collected from WS07 (4m deep in alluvium) to WS17 (4m deep in alluvium), WS19 (3m deep in alluvium) and WS20 (4m deep in alluvium), see **Fig. 4**. In addition, a groundwater sample was obtained from a 20m deep borehole drilled into the sand & gravel unit for geotechnical purposes by Causeway Geotech Ltd, CGBH(S), see **Fig. 4**.

<u>Zone 1 (Made ground, area of Former Railway Sidings & Goods Shed)</u>

- The Benzo(a)pyrene (PAH) DWS of 0.01ug/l was exceeded at WS11 0.029ug/l in a shallow sample from under the concrete hardstand area (former railway sidings. This PAH compound is commonly found in ash clinker and in coal tar and heavier oils and

is likely present as a result of the presence of made ground and former railway uses in this area. A shallow soil sample from this borehole tested positive for low levels of PAHs including Benzo(a)pyrene, with BHWS10 and BWS 12 in the same area not showing any PAHs in soils. This indicates that a small on-site contamination source )made ground) is causing the very minor impact to groundwater limited to around, WS11-WS12 (see below), i.e. is localised.

Zone 2 (Made Ground, area of Former Railway Sidings & Engine House)

- The Lead DWS of 10ug/l was exceeded at WS12 20.5ug/l and WS13 12.6ug/l. These are no considered significant impacts.
- At WS12 the Benzo(a)pyrene (PAH) DWS of 0.01ug/l was exceeded at 0.035ug/l. Soil samples from this area do not show PAH, this occurrence is likely to be part of the same small area of groundwater very slightly contaminated by PAH associated with made ground and the former railway use, as detected at the nearby WS11.

Zone 4 (Made ground, Former Railway Embankment, Infilled Ponds)

- The Arsenic DWS of 10ug/l was exceeded at WS15 at 13.5ug/l. This is not considered as significant.
- The Benzo(a)pyrene (PAH) DWS of 0.01ug/l was exceeded at WS17 0.1ug/l and marginally exceeded at WS20 0.019ug/l.
- The Benzo(b)fluoranthene (PAH) DWS of 0.1ug/l was exceeded at WS17 0.13ug/l.
- The presence of trace concentrations of PAH compounds in the shallow groundwater in this area is due to the past industrial uses and made ground associated with the former railway infrastructure. Soils from WS17 and WS20 both showed the presence of a range of PAH compounds. The source of the groundwater contamination is therefore likely to be on-site historical made ground.
- The risk of this contamination to the River Foyle from this minor groundwater contamination is considered to be negligible due to the low concentrations at source, the distance to the receptor (c.120m) and the nature of the shallow aquifer system. Although groundwater flow direction will be toward the River Foyle from this location, attenuation within the shallow soils and clayey alluvium / sands between the source and receptor is likely to further reduce any PAH contamination present. On-site groundwater data in boreholes downflow of the car park area did not show

the presence of PAH indicating contamination is not migrating toward the River Foyle.

**Appendix 1 Photographic Images, Lifford**

**SITE PHOTOGRAPHS, WATER FEATURES SURVEY, LIFFORD**



**Plate 1 Spectator Stand (front)**



**Plate 2 Spectator Stand (rear)**



**Plate 3 Ground Surface in Vicinity of Soakaway Location (note training run)**



**Plate 4 Northward looking view across Coarsing lands (note small outbuilding at top of training run in distance)**



**Plate 5 View looking north from top of flood embankment northern site boundary, note unauthorised sand and gravel extraction north of site.**



**Plate 6 View looking eastwards along small watercourse in north of site**



**Plate 7 Culverted section of small watercourse in north of site**



**Plate 8 Marshy area of grassland, northern corner of western zone**

**Appendix 2 Photographic Images, Strabane**

**SITE PHOTOGRAPHS, WATER FEATURES SURVEY, STRABANE**



**Plate 1 Southward looking view across concreted area (former travellers rest)**



**Plate 2 Clay Embankment north of Concrete area**



**Plate 3 Open Grassland north of concrete area**



**Plate 4 Eastwards looking view from n-s path, Park Road Burn in ditch, with grasslands (outside site) beyond**



**Plate 5 Concrete headwall and flap valve in Park Road drain at confluence with Nancy Burn**



**Plate 6 Northward looking view into Pond 1 from southern end**



**Plate 7 Weir Overflow to Nancy Burn at northern end of Pond 1**



**Plate 8 Westward looking view across Nany Burn toward culvert under flood embankment**



**Plate 9 Eastwards looking view along Nancy Burn into site from top of flood embankment**



**Plate 10 Headwall at Discharge of Nany Burn to River Foyle as viewed from top of flood embankment (Lifford site in distance)**



**Plate 11 Flap Valve and Headwall at Dischareg Point of Nancy Burn to River Foyle**



**Plate 12 Pond 3 Viewed from top of flood embankment looking eastwards**

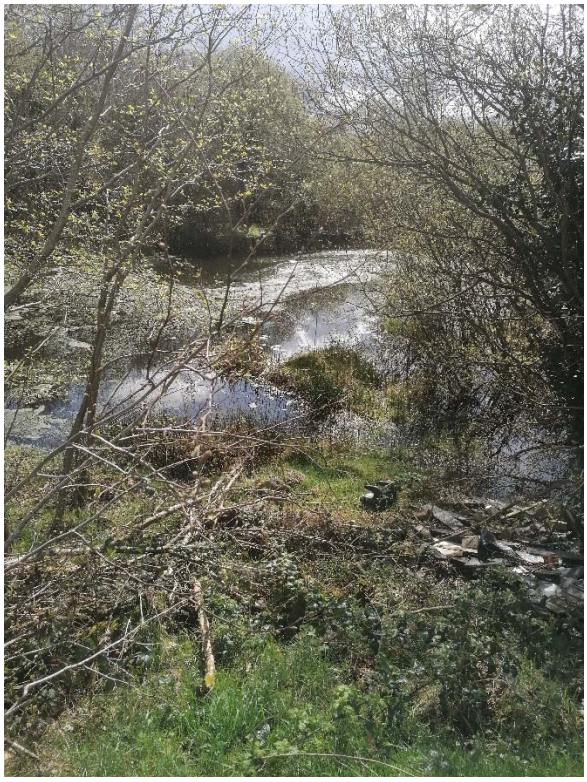


**Plate 13 Northward looking view into triangle-shaped pond (Pond 2)**

**Appendix 3 Local Abstractions, Lifford**




| | |
|---|---|
| GSI Name | 2339SWW002 |
| Well Type | Borehole |
| Original Name | WG 100 |
| Owner Name | |
| Drill Date | May 15, 1999 |
| Locational Accuracy (meters) | to 50m |
| Depth of hole (metres) | 37 |
| Depth to rock (metres) | |
| Townland | LIFFORD COMMON |
| County | Donegal |
| Six Inch Sheet No. | 71 |
| Easting | 232260 |
| Northing | 398720 |
| Source Use | Domestic use only |
| GSI yield class | Poor |
| Yield (source) cubic metres per day | 35 |
| Town | LIFFORD |
| Daily Abstraction cubic metres per day | |
| Drawdown Abstraction (m) | 24.5 |
| Capacity of the well (cubic m per day per m) | |
| Casing Diameter (mm) | |

**Appendix 4 Local Abstractions, Strabane**

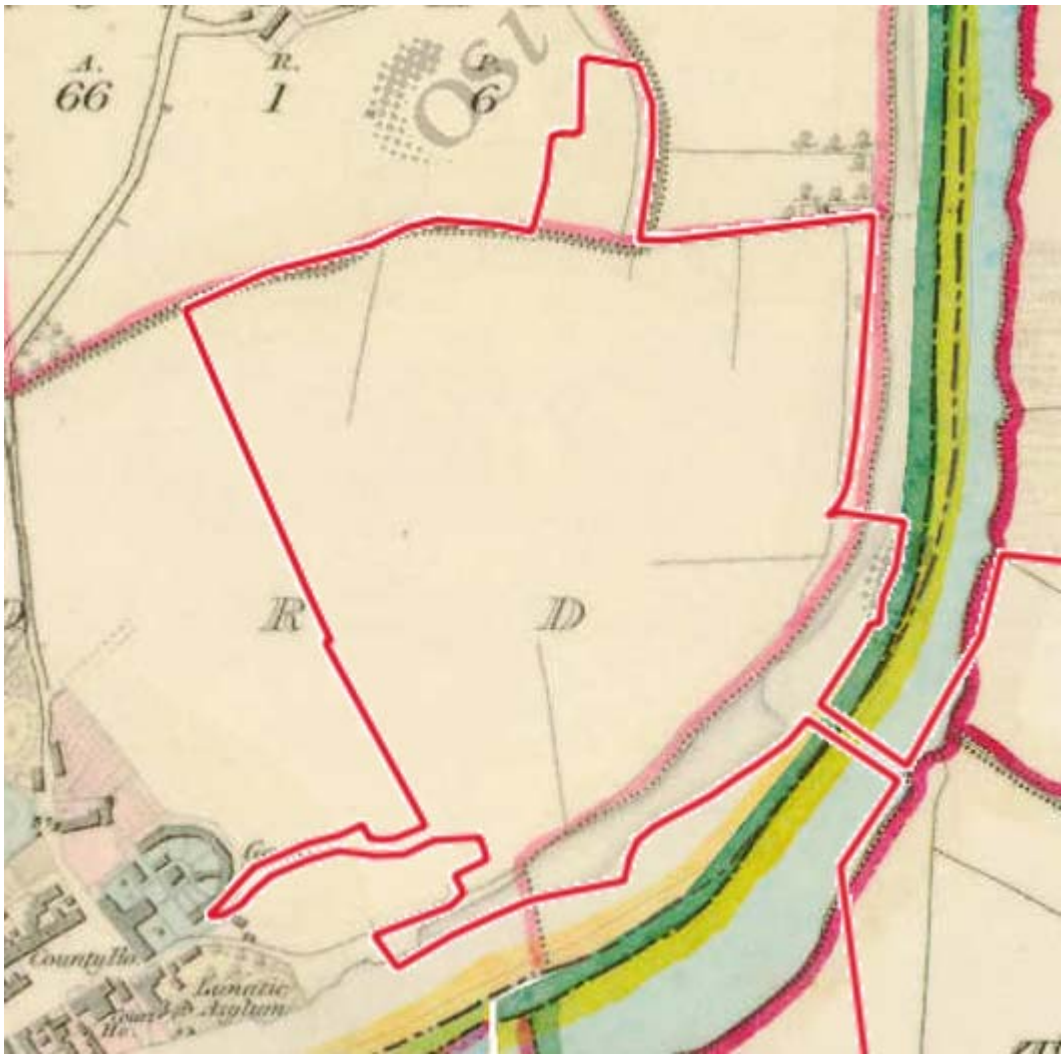
| ni_id | locality | address | easting | northing | diameter | di_unit | depth | de_unit | pump | yield | yi_unit | a_m | Driller | drift | Solid |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| '64 | STRABANE | 63 CURLYHILL RD STRABANE | 236280 | 398310 | 23.1 | mm | 128 | M | SUBMERSIBLE | 27.3 | M3/d | FARM,HOUSE | 1 | BOULDER CLAY | DALRADIAN SCHIST |

| NI Water Intake Type | Name | Operational Status | Year Built | Distance from site |
|---|---|---|---|---|
| River Intake | Milltown | Abandoned | 1969 | 1.08km East |
| Lough Intake | Curly Hill | Abandoned | 1908 | 1.96km Southeast |

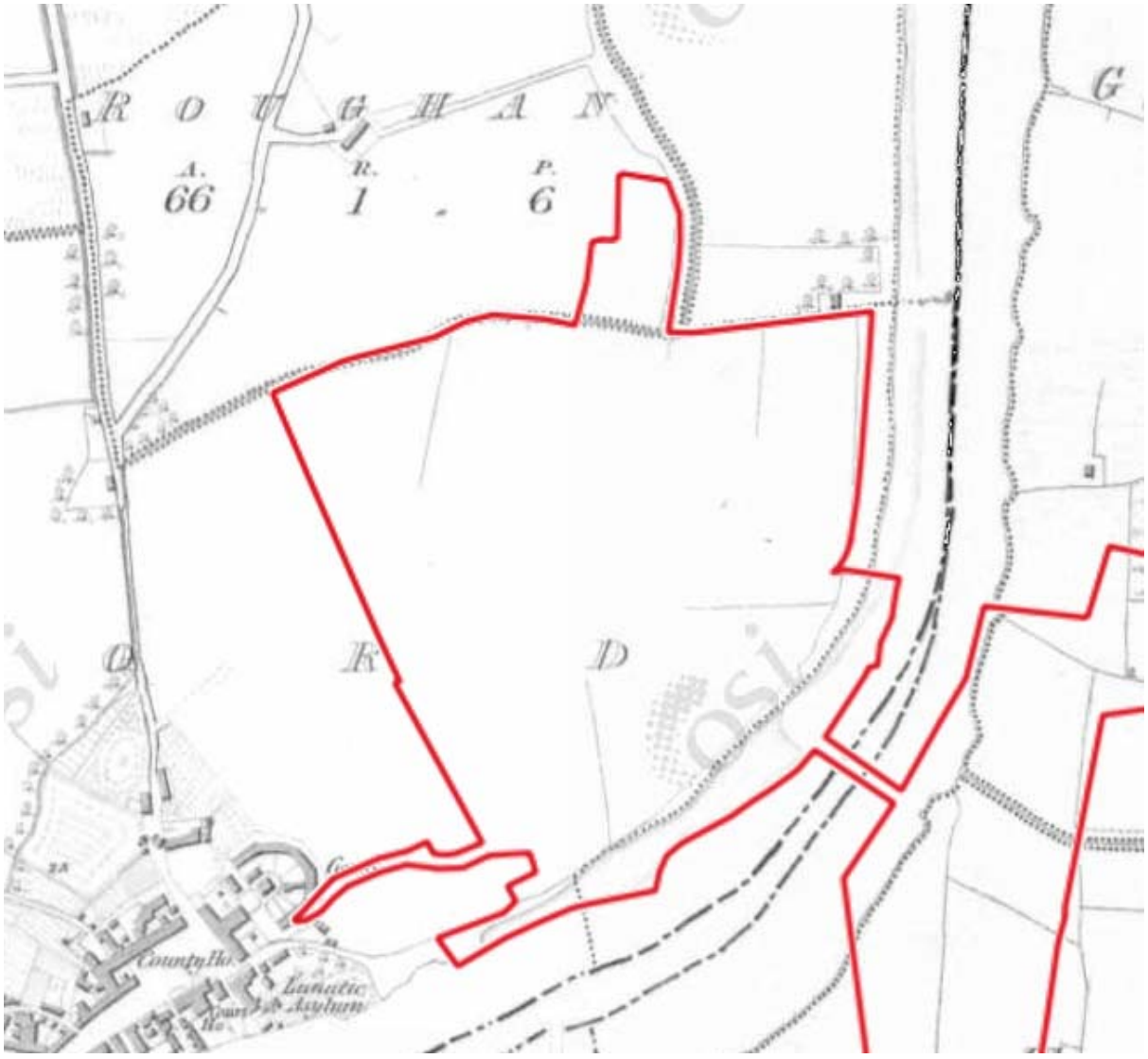


**Appendix 5 Historical Mapping, Lifford**

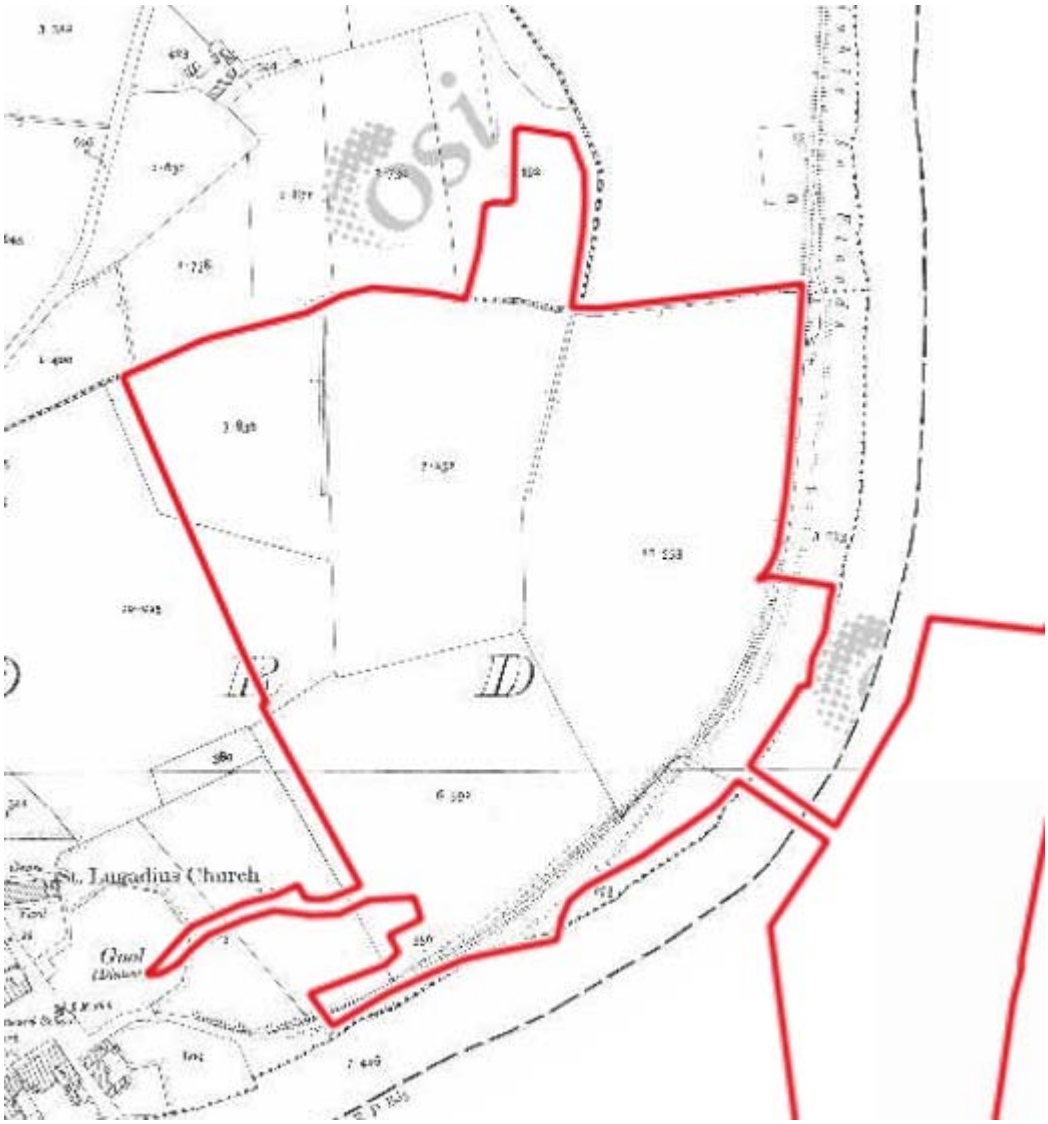
**Lifford OSNI Historical Map 1837 to 1842 (Colour)**



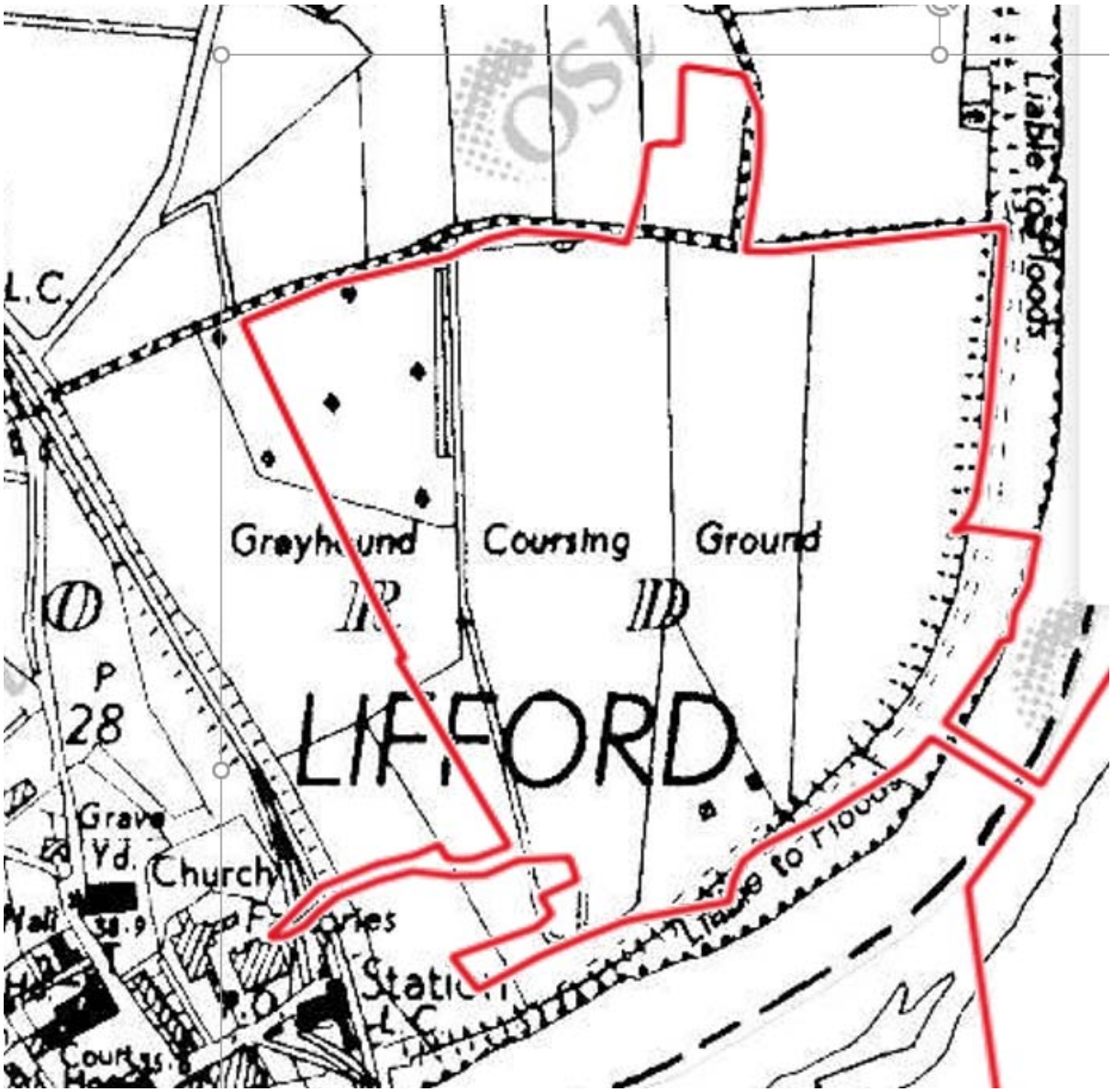
**Lifford OSNI Historical Map 1837 to 1842 (Black and White)**



**Lifford OSNI Historical Map 1888 to 1913**

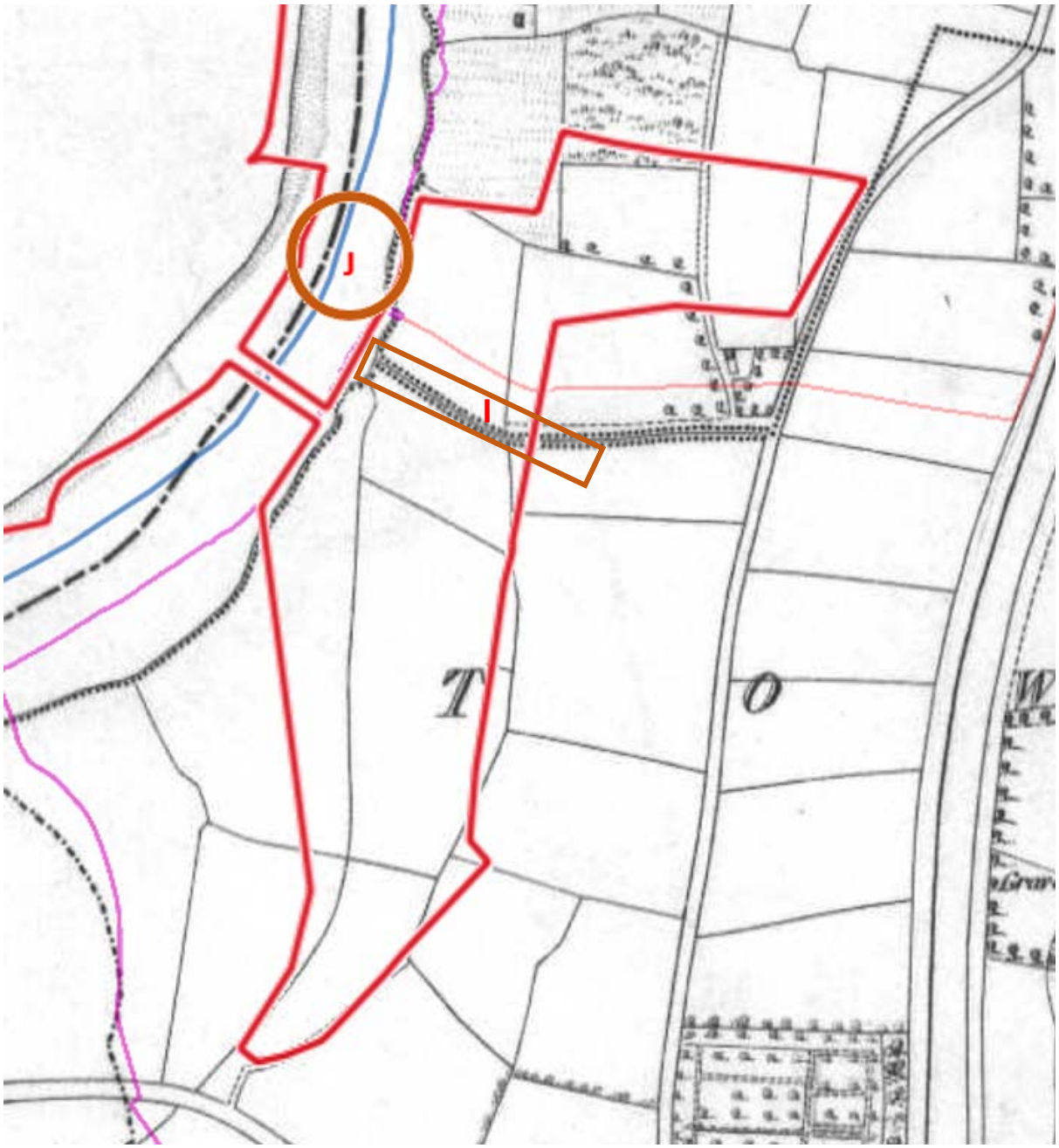


**Lifford OSNI Historical Map 1904**

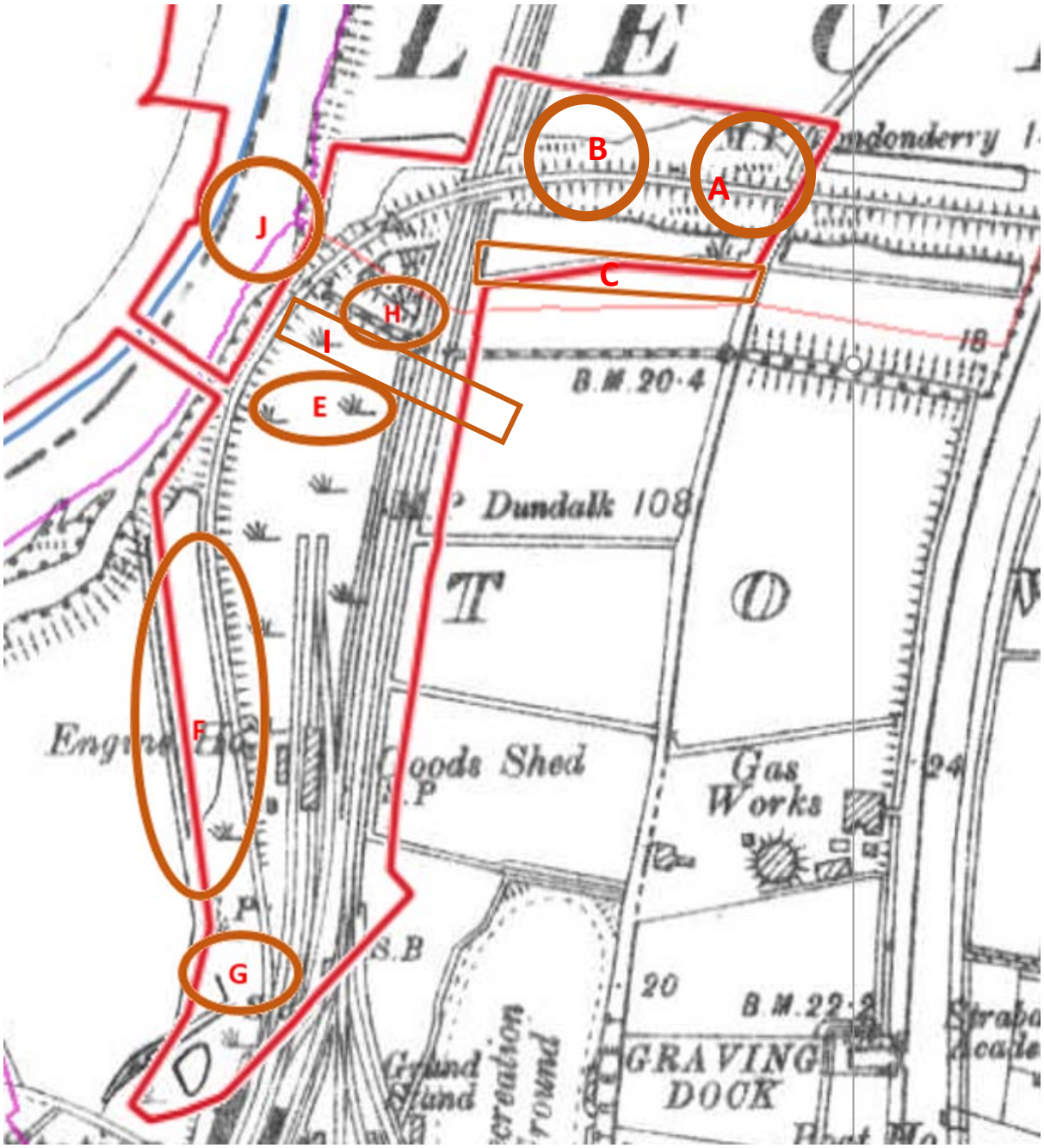


**Appendix 6 Historical Mapping, Strabane**

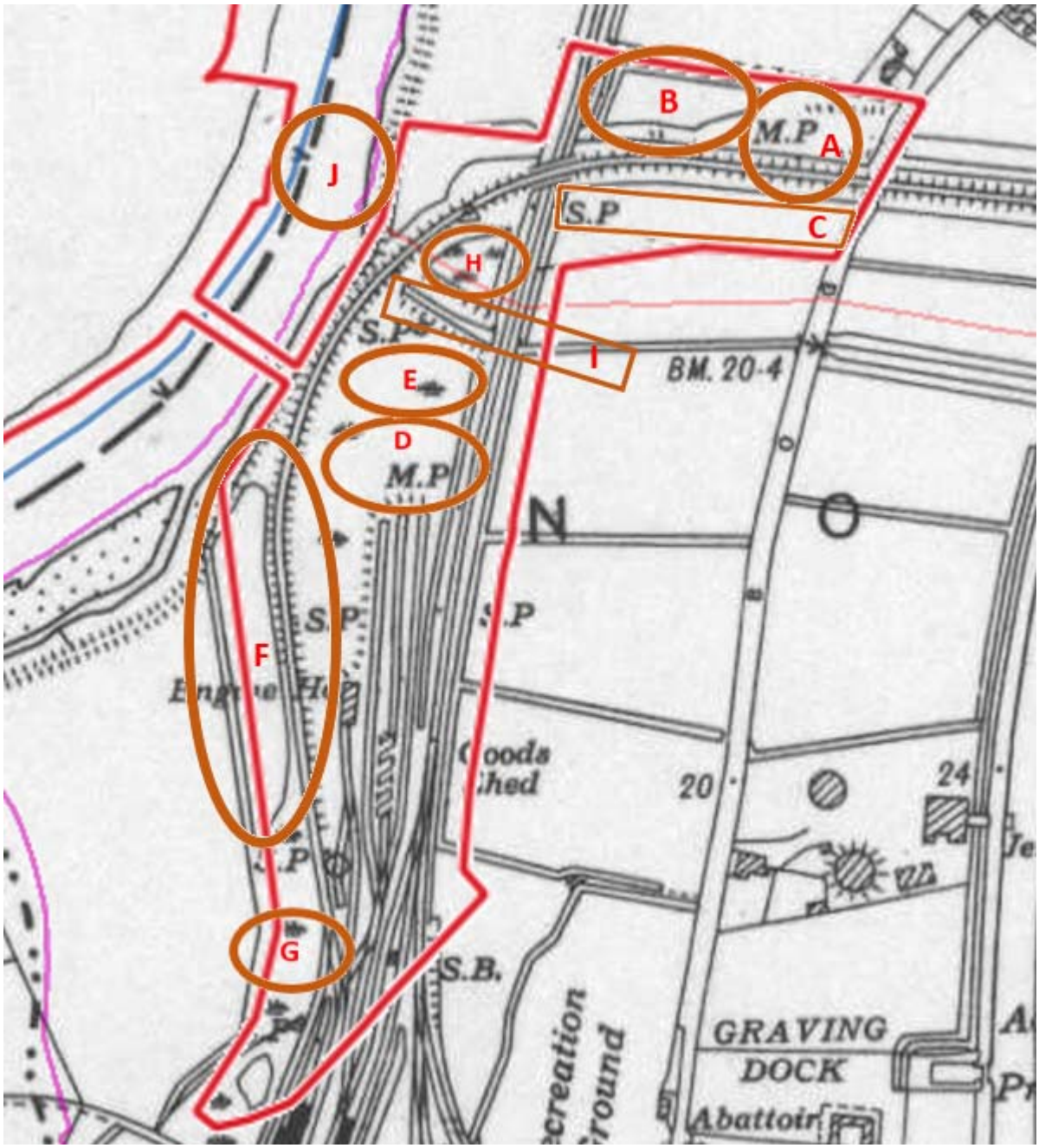
**Strabane OSNI Historical Map 1832-1846**



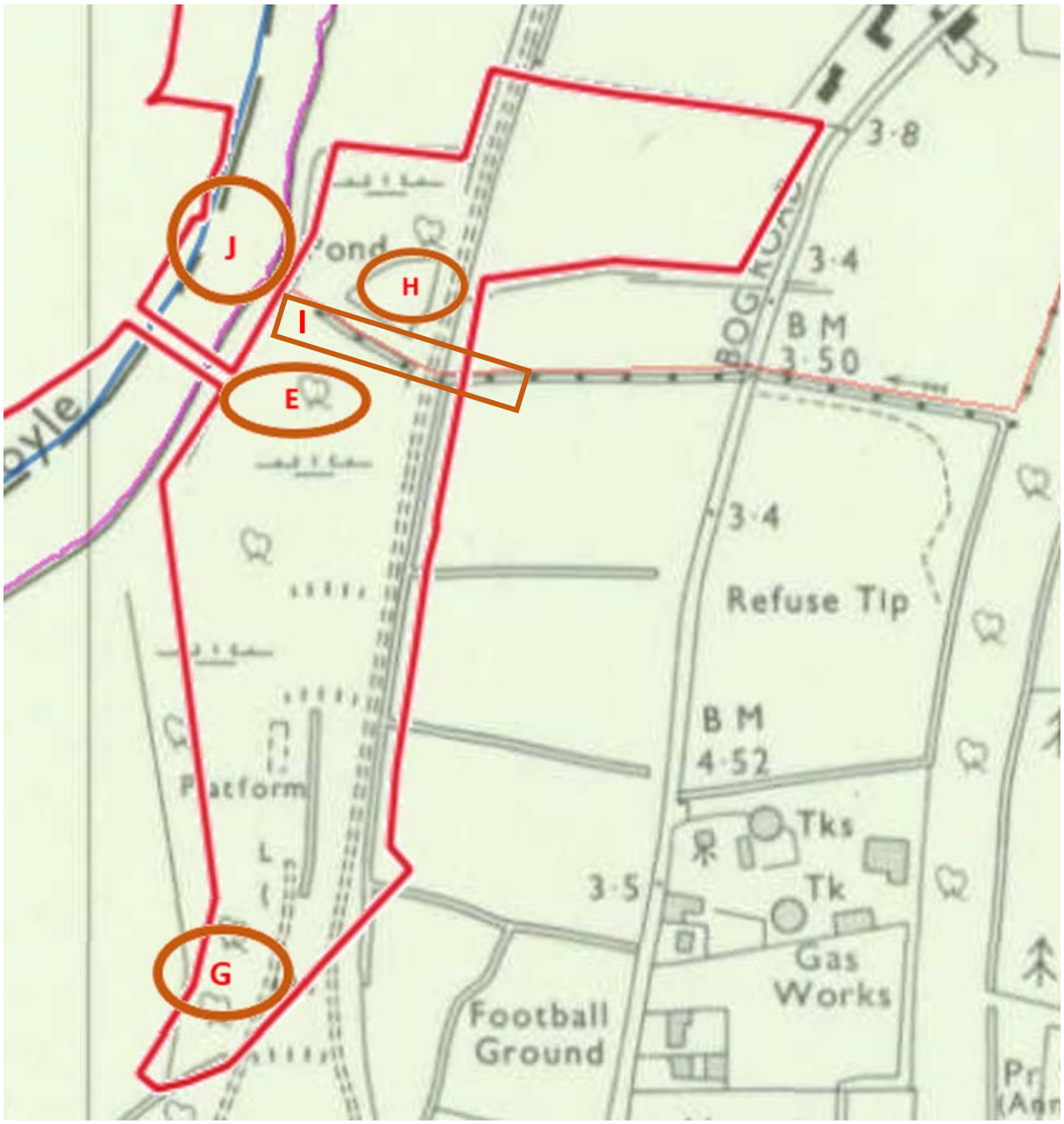
**Strabane OSNI Historical Map 1900-1907**



**Strabane OSNI Historical Map 1905-1957**



**Strabane OSNI Historical Map 1957-1986**



**Appendix 7 Discharge Consents, Lifford**

Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil

Headquarters
P.O. Box 3000
Johnstown Castle Estate
County Wexford
Ireland

# Waste Water Discharge Licence

| | |
|---|---|
| **Licence Register Number:** | D0352-01 |
| **Licensee:** | Donegal County Council |
| **Agglomeration:** | Lifford |

Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil
HEADQUARTERS
JOHNSTOWN CASTLE ESTATE
COUNTY WEXFORD, IRELAND
PHONE: +353-53-9160600
FAX: +353-53-9160699

WASTE WATER DISCHARGE (AUTHORISATION) REGULATIONS 2007, AS AMENDED

# WASTE WATER DISCHARGE LICENCE

Decision of Agency, under Regulation 28(1) of the Waste Water Discharge (Authorisation) Regulations 2007, as amended.

Reference Number: **D0352-01**

The Agency in exercise of the powers conferred on it by the Waste Water Discharge (Authorisation) Regulations 2007, as amended, for the reasons hereinafter set out, hereby grants this waste water discharge licence in respect of the agglomeration as specified in *Part 1 Schedule of Discharges Licensed* of the attached licence subject to Conditions, as set out in the schedules attached hereto.

The licence authorises the discharge of waste water from the waste water works which services the agglomeration described below subject to conditions.

A copy of the Decision is attached.

***Licensed Discharges, in accordance with the Second Schedule of the Waste Water Discharge (Authorisation) Regulations 2007, as amended***

| Discharges from agglomerations with a population equivalent of 1,001 to 2,000 |
|---|

**GIVEN under the Seal of the Agency this 01 day of November 2012**

PRESENT when the seal of the Agency was affixed hereto:

Frank Clinton

Director/Authorised Person

# *INTRODUCTION*

*This introduction is not part of the licence and does not purport to be a legal interpretation of the licence.*

This licence relates to the Lifford agglomeration in County Donegal. The current population equivalent (p.e.) of the agglomeration is 1,969 p.e.. The breakdown of waste water sources is approximately 74% domestic, 14% commercial, 10% institutional and 2% leisure/tourism. There are no identified sources of industrial waste water in the Lifford agglomeration.

The agglomeration is currently served by a septic tank, which was installed in 1967 to serve a population of 1,550 and has not received any major refurbishment since. The primary discharge (SW001) is the outfall from the septic tank to the Foyle estuary (transitional waters), located approximately 450m downstream of Lifford Bridge. There are two storm water overflows (SW002 & SW003) on the waste water collection network which both discharge at the same location into the River Foyle, just upstream of Lifford Bridge. There is one pumping station with an emergency overflow which discharges into the River Foyle.

Donegal County Council plan to upgrade Lifford sewerage scheme, however it is not listed in the Water Services Investment Programme 2010 - 2012. The licence requires secondary waste water treatment to be provided in Lifford by 31st December 2017.

The licence sets out in detail the conditions under which Donegal County Council will control and manage the waste water discharges from the agglomeration covered by this licence.

The licence requires appropriate remedial action, within specified timeframes, to be undertaken in order to address each of the discharge locations within the agglomeration. This remedial action will ensure that appropriate protection is afforded to the receiving water environment.

The legislation governing this licence relates specifically to, and is restricted to, the regulation and control of waste water discharges from the agglomeration. Therefore any odour or noise issue that may be associated with the waste water works including the treatment plant cannot be addressed by this licence.

# *TABLE OF CONTENTS*


| | | Page No. |
|---|---|---|
| Glossary of Terms | | 1 |
| Decision & Reasons for the Decision | | 6 |
| Part I Schedule of Discharges Licensed | | 7 |
| Part II Conditions | | 8 |
| Condition 1. | Scope | 8 |
| Condition 2. | Interpretation | 10 |
| Condition 3. | Discharges | 11 |
| Condition 4. | Control and Monitoring | 12 |
| Condition 5. | Programmes of Improvements | 15 |
| Condition 6. | Notifications, Records and Reports | 18 |
| Condition 7. | Financial Charges and Provisions | 20 |
| Schedule A: Discharges & Discharge Monitoring | | 21 |
| A.1: Primary Waste Water Discharge & Monitoring | | 21 |
| A.2: Secondary Waste Water Discharge(s) & Monitoring | | 22 |
| A.3: Storm Water Overflows | | 23 |
| A.4 Interpretation of Discharge Monitoring Results | | 24 |
| Schedule B: Ambient Monitoring | | 25 |
| B.1: Groundwater Monitoring | | 25 |
| B.2: Receiving Water Monitoring | | 25 |
| Schedule C: Specified Improvement Programme | | 26 |
| C.1: Specified Improvement Programme | | 26 |
| C.2: Discharges to be Discontinued | | 26 |
| Schedule D: Annual Environmental Report | | 27 |

# *GLOSSARY OF TERMS*

All terms in this licence should be interpreted in accordance with the definitions in the Waste Water Discharge (Authorisation) Regulations 2007, as amended, unless otherwise defined in this section.

| | |
|---|---|
| **AER** | Annual Environmental Report. |
| **Agglomeration** | An area where the population or economic activities or both are sufficiently concentrated for a waste water works to have been put in place. |
| **Agreement** | Agreement in writing. |
| **Annually** | At least one measurement in any one year. |
| **Application** | The application for this licence. |
| **Attachment** | Any reference to Attachments in this licence refers to attachments submitted as part of the licence application. |
| **Biannually** | At approximately six – monthly intervals. |
| **Biennially** | Once every two years. |
| **Bi-monthly** | At approximately two - monthly intervals. |
| **BIM** | Bord Iascaigh Mhara. |
| **BOD** | 5 day Biochemical Oxygen Demand (without nitrification suppression). |
| **cBOD** | 5 day Carbonaceous Biochemical Oxygen Demand (with nitrification suppression). |
| **CEN** | Comité Européen De Normalisation – European Committee for Standardisation. |
| **COD** | Chemical Oxygen Demand. |
| **Combined approach** | In relation to a waste water works, means the control of discharges and emissions to waters whereby the emission limits for the discharge are established on the basis of the stricter of either or both, the limits and controls required under the Urban Waste Water Regulations, and the limits determined under statute or Directive for the purpose of achieving the environmental objectives established for surface waters, groundwater or protected areas for the water body into which the discharge is made. |
| **Competent Laboratory** | A testing facility meeting the general management and technical requirements of EN ISO/IEC-17025 standard, or other equivalent standards accepted at international level and utilising methods of analysis, including laboratory, field, and on-line methods, which are validated and documented in accordance with the above standard(s) for the specific tests. |
| **Daily** | During all days when discharges are taking place; with at least one measurement/observation per day. |

| | |
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| **Day** | Any 24 hour period. |
| **Discharge limits** | Those limits, specified for a particular parameter in *Schedule A: Discharges and Discharge Monitoring*, of this licence. |
| **Discharge Point** | The point from which a waste water discharge occurs. |
| **DO** | Dissolved oxygen. |
| **Documentation** | Any report, record, result, data, drawing, proposal, interpretation or other document, in written or electronic form, that is required by this licence. |
| **DoECLG** | Department of the Environment, Community and Local Government. |
| **Domestic Waste Water** | Waste water from residential settlements and services that originates predominantly from human metabolism and from household activities. |
| **Drawing** | Any reference to a drawing or drawing number means a drawing or drawing number contained in the application, unless otherwise specified in this licence. |
| **ELV** | Emission Limit Value. |
| **EMP** | Environmental Management Programme. |
| **Environmental damage** | As defined in Directive 2004/35/EC. |
| **Environmental Pollution** | Means, in relation to waste water discharges, the direct or indirect introduction, as a result of human activity, of waste water discharges, substances (including any explosive, liquid or gas) or polluting matter (including any poisonous or noxious matter) into waters which may endanger human health or harm the aquatic environment, and in particular:<br>(i) create a risk to waters, sediment, plants or animals.<br>(ii) deleteriously interfere with the quality of aquatic ecosystems or terrestrial ecosystems directly depending on aquatic ecosystems including by:<br>• Rendering those or any other waters poisonous or injurious to fish, shellfish, spawning grounds or the food of any fish, or<br>• Impairing the usefulness of the bed and soil of any waters as spawning grounds or impairing their capacity to produce the food of fish or shellfish,<br>(iii) impair or interfere with amenities and other legitimate uses of the water, or<br>(iv) result in water failing to meet any environmental quality standards prescribed in regulations for the purposes of giving effect to the requirements of any Directive relating to the quality or use of water for the time being in force. |
| **EPA** | Environmental Protection Agency. |
| **Fortnightly** | A minimum of 24 times per year, at approximately two week intervals. |

| | |
|---|---|
| **FSAI** | Food Safety Authority of Ireland. |
| **GC/MS** | Gas chromatography/mass spectroscopy. |
| **ICP** | Inductively coupled plasma spectroscopy. |
| **Incident** | The following shall constitute an incident for the purposes of this licence:<br>(i) any discharge that does not comply with the requirements of this licence;<br>(ii) any incident with the potential for environmental contamination of surface water or groundwater, or posing an environmental threat to land, or requiring an emergency response by the relevant Water Services Authority. |
| **Industrial waste water** | Any waste water that is discharged from premises used for carrying on any trade or industry or other non-domestic use and excludes run-off rain water. |
| **Interim ELV** | Interim Emission Limit Value means an emission limit value that applies to a discharge for the period between the date of grant of licence and the date specified for the emission limit value to take effect. |
| **Licensee** | Donegal County Council, County House, Lifford, County Donegal. |
| **Licensing Regulations** | Waste Water Discharge (Authorisation) Regulations 2007, as amended. |
| **Local Authority** | Donegal County Council. |
| **Loughs Agency** | Loughs Agency, 22 Victoria Road, Londonderry, BT47 2AB, Northern Ireland. |
| **Maintain** | Keep equipment, plant and infrastructure in a fit state, including such regular inspection, servicing, calibration and repair as may be necessary to perform its function. |
| **Monthly** | A minimum of 12 times per year, at intervals of approximately one month. |
| **National Environmental Complaints Procedure** | As established under the National Environmental Enforcement Network. |
| **Population Equivalent** | A measurement of organic biodegradable load and a population equivalent of 1 (1 p.e.) means the organic biodegradable load having a five-day biochemical oxygen demand (BOD5) of 60g of oxygen per day; the load being calculated on the basis of the maximum average weekly load entering the waste water works during the year, excluding unusual situations such as those due to heavy rain. |
| **Primary Discharge** | The discharge with the largest volume being discharged from the waste water works. |
| **Primary Treatment** | Treatment of urban waste water by a physical and/or chemical process involving settlement of suspended solids, or other processes inwhich the |

| | |
|---|---|
| | BOD5 of the incoming waste water is reduced by at least 20% before discharge and the total suspended solids of the incoming waste water are reduced by at least 50%. |
| **Priority Substances** | Those substances or groups of substances, identified by the Commission in accordance with Article 16(2) of the Water Framework Directive and listed in Tables 11 and 12 of Schedule 6 of the European Communities Environmental Objectives (Surface Waters) Regulations, 2009 that have been prioritised for action by the setting of environmental quality standards at Community level. |
| **Protected Areas** | Areas designated as requiring special protection under specific Community legislation for the protection of their surface water and groundwater or for the conservation of habitats and species of European sites directly dependant on water and listed in the register established by the Agency in accordance with Article 8 of the Water Policy Regulations. |
| **PRTR** | Pollutant Release and Transfer Register. |
| **Quarterly** | All or part of a period of three consecutive months beginning on the first day of January, April, July or October. |
| **Sample(s)** | Unless the context of this licence indicates to the contrary, the term sample(s) shall include measurements taken by electronic instruments. |
| **Secondary Discharge** | A potential, occasional or continuous discharge from the waste water works other than a primary discharge or a storm water overflow. |
| **SFPA** | Sea Fisheries Protection Authority. |
| **Specified discharges** | Those discharges listed in *Schedule A: Discharges and Discharge Monitoring*, of this licence. |
| **SSRS** | Small Streams Risk Score. |
| **Standard method** | A relevant CEN, ISO, National, or other internationally recognized test procedure such as detailed in the current edition of "Standard Methods for the Examination of Water and Wastewater" (published jointly by A.P.H.A. / A.W.W.A. / W.E.F.), a documented and validated in-house procedure based on the above sources that will ensure the provision of data of an equivalent scientific quality, or an alternative method as may be agreed with the Agency. |
| **Storm water overflow** | A structure or device on a sewerage system designed and constructed for the purpose of relieving the system of excess flows that arise as a result of rain water or melting snow in the sewered catchment, the excess flow being discharged to receiving waters. |
| **The Agency** | Environmental Protection Agency. |
| **Waste Water** | Domestic waste water or the mixture of domestic waste water with industrial waste water. |
| **Waste Water Works** | Sewers and their accessories (or any part thereof) and all associated structural devices, including waste water treatment plants, which are owned by, vested in, controlled or used by a water services authority for the collection, storage, treatment or discharge of waste water. |

| | |
|---|---|
| **Water Services Authority** | Donegal County Council. |
| **Weekly** | During all weeks when discharges are taking place; with at least one measurement in any one week. |
| **WSIP** | Water Services Investment Programme. |
| **WWTP** | Waste water treatment plant. |

# *DECISION & REASONS FOR THE DECISION*

D0352-01

The Environmental Protection Agency is satisfied, on the basis of the information available, that subject to compliance with the conditions of this licence, any discharges from the agglomeration served by the waste water works will comply with and will not contravene any of the requirements of Regulation 6 of the Waste Water Discharge (Authorisation) Regulations 2007, as amended.

In reaching this decision the Environmental Protection Agency has had regard to the requirements and objectives of Regulation 6 of the Regulations and has considered the application and supporting documentation received from the applicant, all submissions received from other parties, and the report of its inspector.

# *PART I SCHEDULE OF DISCHARGES LICENSED*

In pursuance of the powers conferred on it by the Waste Water Discharge (Authorisation) Regulations 2007, as amended, the Environmental Protection Agency (the Agency), under Regulation 28(1) of the said Regulations grants this Waste Water Discharge Licence to Donegal County Council, County House, Lifford, County Donegal. The licence authorises the discharge of waste water from the waste water works servicing the Lifford agglomeration described below, subject to conditions listed in Part II, with the reasons therefor and the associated schedules attached thereto.

***Licensed Discharges, in accordance with the Second Schedule of the Waste Water Discharge (Authorisation) Regulations 2007, as amended***

| |
|---|
| Discharges from agglomerations with a population equivalent of 1,001 to 2,000 |

# *PART II CONDITIONS*

## Condition 1. Scope

1.1 Statutory Obligations

1.1.1 This licence is for the purposes of Waste Water Discharge licensing under the Waste Water Discharge (Authorisation) Regulations 2007, as amended, only and nothing in this licence shall be construed as negating the licensee's statutory obligations or requirements under any other enactments or regulations.

1.2 The agglomeration is the area outlined in red on Drawing No. LFD/LA/B1(i) 'Agglomeration Outline Plan 2015' in Attachment B.1 of the application. Any reference in this licence to agglomeration shall mean the area thus outlined in red.

1.3 The discharge(s) to waters from the waste water works shall be restricted to those listed and described in *Schedule A: Discharges and Discharge Monitoring*, of this licence and shall be as set out in the licence application or as modified under Condition 1.6 of this licence and subject to the conditions of this licence.

1.4 The discharge(s) to waters from the waste water works shall be controlled and managed and shall take place as set out in this licence. All programmes required to be carried out under the terms of this licence become part of this licence.

1.5 For the purposes of this licence, the location(s) of the waste water discharge(s) authorised by this licence is/are as presented on Drawing No. LFD/LA/B3(i) 'Existing Primary Discharge Point' and Drawing No. LFD/LA/B5(i) 'Stormwater Overflow Locations and Discharge Point to Aquatic Environment' of the application.

1.6 No alteration to the waste water works or any part thereof that would, or is likely to, result in a material change to or increase in discharges sufficient to represent a risk of causing a breach of emission standards specified in the licence shall be carried out or commenced without prior notice to, and without the agreement of, the Agency.

1.7 Treatment Capacities

1.7.1 From 31st December 2017 or upon completion of the proposed WWTP (whichever is the sooner) the licensee shall, on an annual basis, undertake an assessment of the remaining organic and hydraulic treatment capacities within the waste water works (design capacity of plant, less flow-load calculation for representative period).

1.7.2 The licensee shall maintain such available capacity within the waste water works as is necessary to ensure that there is no environmental risk posed to the receiving water environment as a result of the discharges.

1.7.3 Where the licensee determines, as part of those assessments undertaken in Condition 1.7.1 above, that the remaining treatment capacity will be exceeded within the ensuing three year period, the licensee shall notify the Agency and seek a licence review, as appropriate.

1.8 Infrastructural Works

1.8.1 Where a treatment plant associated with the Lifford agglomeration waste water works requires infrastructural improvements to the wastewater works that are subject to the European Communities (Environmental Impact Assessment) Regulations 1989 to 2001, as amended, the licensee shall notify the Agency.

1.8.2 Where the licensee has received approval in accordance with the Planning and Development Act 2000, as amended, for the infrastructural improvements in Condition 1.8.1 above, the licensee shall seek a determination from the Agency as to whether a review of the Waste Water Discharge licence is required.

| *Reason:* **To clarify the scope of this licence.** |
|---|

# Condition 2. Interpretation

2.1 Emission limit values for discharges to waters in this licence shall be interpreted in the following way:

2.1.1 Composite Sampling

2.1.1.1 No pH value shall deviate from the specified range.

2.1.1.2 For cBOD and COD, no more than the relevant number of samples specified in *Schedule A.4: Interpretation of Discharge Monitoring Results* – Column 2 or Column 4, of this licence, shall exceed the concentration Emission Limit Value based on the number of samples taken as listed in *Schedule A.4: Interpretation of Discharge Monitoring Results* – Column 1 or Column 3, of this licence. No individual result similarly calculated shall exceed the emission limit value by more than 100%.

2.1.1.3 For Suspended Solids, no more than the relevant number of samples specified in *Schedule A.4: Interpretation of Discharge Monitoring Results* – Column 2 or Column 4, of this licence, shall exceed the concentration Emission Limit Value based on the number of samples taken as listed in *Schedule A.4: Interpretation of Discharge Monitoring Results* – Column 1 or Column 3, of this licence. No individual result similarly calculated shall exceed the emission limit value by more than 150%.

2.1.1.4 For parameters Total Phosphorus and Total Nitrogen the annual mean of the samples shall not exceed the emission limit value. No individual result similarly calculated shall exceed the emission limit value by more than 20%.

2.1.1.5 For parameters other than pH, cBOD, COD, Suspended Solids, eight out of ten consecutive composite results shall not exceed the emission limit value. No individual result similarly calculated shall exceed the emission limit value by more than 20%.

2.1.2 Discrete Sampling

No cBOD, COD grab sample value shall exceed the emission limit value by more than 100% or Suspended Solids grab sample value shall exceed the emission limit value by more than 150%. For all other parameters, except pH, no grab sample value shall exceed the emission limit value by more than 20%.

*Reason:* **To clarify the interpretation of limit values fixed under the licence.**

# Condition 3. Discharges

3.1 Where discharges from the waste water works are required to comply with Emission Limit Values by a date specified in *Schedule A: Discharges and Discharge Monitoring*, of this licence, the Water Services Authority shall, prior to this date, take such measures as are necessary to ensure that environmental pollution is not caused as a result of the discharge.

3.2 No discharge(s) from the waste water works is/are permitted save under and in accordance with this licence.

3.3 No specified discharge from the waste water works shall exceed the emission limit values set out in *Schedule A: Discharges and Discharge Monitoring*, of this licence, subject to the requirements of Condition 2 above.

3.4 The Water Services Authority shall take such measures as are necessary to ensure that no deterioration in the quality of the receiving waters shall occur as a result of the discharge.

3.5 There shall be no discharge from the discharge point(s) specified in *Schedule C.2: Discharges to be Discontinued,* of this licence, from the dates specified therein.

3.6 Storm water overflows shall be as specified in *Schedule A.3: Storm Water Overflows*, of this licence, and shall include any other storm water overflows identified in the identification and assessment of storm water overflows required under this licence. All storm water overflows identified shall be notified in writing to the Agency.

3.7 The licensee shall ensure that all or any of the following:

- Gross solids
- Litter

associated with discharges from the waste water works do not result in an impairment of, or an interference with, amenities or the environment.

*Reason:* **To provide for the protection of the receiving environment by way of control and limitation of discharges to the River Foyle and Foyle estuary.**

# Condition 4. Control and Monitoring

4.1 The licensee shall carry out such sampling, analyses, measurements, examinations, maintenance and calibrations as set out below and in accordance with *Schedule A: Discharges and Discharge Monitoring*, of this licence.

4.1.1 Analyses shall be undertaken by competent staff in accordance with documented operating procedures. Analysis for compliance purposes, including any sub-contracted analysis, shall be done by a competent laboratory.

4.1.2 Such procedures shall be assessed for their suitability for the test matrix and performance characteristics shall be determined.

4.1.3 Such procedures shall be subject to a programme of Analytical Quality Control verified by a competent third party using control standards with evaluation of test responses.

4.2 The licensee shall ensure that:

4.2.1 Sampling and analysis for all parameters listed in the Schedules to this licence, and

4.2.2 Any reference measurement methods to calibrate automated measurement system

shall be carried out by an appropriate Standard Method.

4.3 The licensee shall install on all emission points such sampling points or equipment, including any data-logging or other electronic communication equipment, as may be required by the Agency. All such equipment shall be consistent with the safe operation of all sampling and monitoring systems.

4.4 All automatic monitors and samplers shall be functioning at all times (except during maintenance and calibration) when the discharges are being made unless alternative sampling or monitoring has been agreed in writing by the Agency for a limited period. In the event of the malfunction of any continuous monitor, the licensee shall contact the Agency as soon as practicable and alternative sampling and monitoring facilities shall be put in place. Agreement for the use of alternative equipment, other than in emergency situations, shall be obtained from the Agency.

4.5 Monitoring and analysis equipment shall be operated and maintained as necessary so that monitoring accurately reflects the discharge (or ambient conditions where that is the monitoring objective).

4.6 The licensee shall clearly label and provide safe and permanent access to all on-site sampling and monitoring points and to off-site points as required by the Agency.

4.7 The licensee shall ensure that a person in charge or a nominated deputy shall be available to meet with authorised person(s) of the Agency at all reasonable times and shall allow access to the waste water works or other premises that the Agency reasonably considers may contain information pertaining to a discharge from those works or other premises.

4.8 The licensee shall establish and maintain corrective action procedures and shall take corrective action should the specified requirements of this licence not be fulfilled. The responsibility and authority for persons initiating further investigation and corrective action in the event of a reported non-conformity with this licence shall be defined by the licensee.

4.9 The licensee shall establish and maintain a programme for maintenance and operation of all plant and equipment to ensure that no unauthorised waste water discharges take place. This programme shall be based on the instructions issued by the manufacturer/supplier or installer of the equipment. Appropriate record keeping and

diagnostic testing shall support this maintenance programme. The licensee shall clearly allocate responsibility for the planning management and execution of all aspects of this programme to appropriate personnel.

4.10 The location, frequency, methods and scope of monitoring, sampling and analyses, as set out in this licence, may be amended with the agreement of the Agency following evaluation of test results.

4.11 Storm Water Overflows

4.11.1 The licensee shall, prior to the date for submission of the second AER (required under Condition 6.8), carry out an investigation for the identification and assessment of storm water overflows. A report on the storm water overflows shall be submitted to the Agency as part of the second AER. All storm water overflows shall be in compliance with the criteria for storm water overflows, as set out in the DoECLG '*Procedures and Criteria in Relation to Storm Water Overflows*', 1995 and any other guidance as may be specified by the Agency.

4.11.2 The licensee shall carry out an assessment of storm water overflows at least once every three years thereafter and report to the Agency on each occasion as part of the AER. The assessment shall include a determination of compliance with the criteria for storm water overflows, as set out in the DoECLG '*Procedures and Criteria in Relation to Storm Water Overflows*', 1995 and any other guidance as may be specified by the Agency. The licensee shall maintain a written record of all assessments and remedial measures arising from the assessment.

4.12 The licensee shall prepare a PRTR report for the primary and secondary discharges. The substances to be included in the PRTR shall be as agreed by the Agency each year by reference to EC Regulation No. 166/2006 concerning the establishment of the European Pollutant Release and Transfer Register and amending Council Directives 91/689/EEC and 96/61/EC. The PRTR shall be prepared in accordance with any relevant guidelines issued by the Agency and shall be submitted electronically in specified format and as part of the AER.

4.13 The licensee shall, within six months of the date of grant of this licence, develop and establish a Data Management System for collation, archiving, assessing and graphically presenting the monitoring data generated as a result of this licence.

4.14 From 31st December 2017 or upon completion of the new WWTP (whichever is sooner), the licensee shall carry out monthly monitoring of the influent stream to the waste water treatment plant for cBOD, COD, Suspended Solids, Ammonia, Total Oxidised Nitrogen and Orthophosphate, in order to measure the mass loadings and removal efficiencies within the treatment plant.

4.15 Prior to submitting ambient monitoring data, the licensee must consult with the Agency with regard to the appropriate format for submittal.

4.16 Where such ambient monitoring results are available from any other statutory body, including the Agency, the licensee may submit those results in fulfilment of the requirements of *Schedule B: Ambient Monitoring* of this licence.

4.17 The licensee shall record the total effluent volume discharged over the 24-hour period in which any composite sample is collected.

4.18 Priority Substances

The licensee shall undertake a risk based assessment of the discharge(s) in order to identify the relevant priority substances or pollutants for monitoring. This assessment shall be undertaken in accordance with "Guidance on the Screening for Priority Substances for Waste Water Discharge Licences" issued by the Agency. Monitoring for

the identified priority substances or pollutants shall be carried out at least annually, unless a case for less frequent monitoring is agreed by the Agency.

4.19 The licensee shall provide a composite sampler on all monitoring points listed in *Schedule A.1: Primary Waste Water Discharge & Monitoring* of this licence, by 31/12/2017. All samples thereafter shall be collected on a 24-hour flow proportional or time based composite sampling basis.

4.20 From 31st December 2017 or upon completion of the new WWTP (whichever is sooner), the licensee shall carry out a daily visual inspection (sample and examine for colour and odour, oils, fats and greases) of the primary waste water discharge.

*Reason:* **To provide for the protection of the receiving environment by way of control and monitoring of discharges.**

# Condition 5. Programmes of Improvements

5.1 The licensee shall, as a part of the second AER (required under Condition 6.8), prepare and submit to the Agency a programme of infrastructural improvements to maximise the effectiveness and efficiency of the waste water works in order to:

5.1.1 achieve improvements in the quality of all discharges from the works;

5.1.2 meet the emission limit values specified in *Schedule A: Discharges and Discharge Monitoring*, of this licence;

5.1.3 give effect to Regulation 2 of the Waste Water Discharge (Authorisation) Regulations 2007, as amended;

5.1.4 reduce Total Phosphorus loadings in the discharge to the maximum practicable extent;

5.1.5 reduce Total Nitrogen loadings in the discharge to the maximum practicable extent;

5.1.6 meet the obligations of Condition 1.7.

5.2 The programme of infrastructural improvements referred to in Condition 5.1 shall include an assessment of:

5.2.1 the waste water treatment plant, having regard to the effectiveness of the treatment provided by reference to the following:

5.2.1.1 the existing level of treatment, capacity of treatment plant and associated equipment;

5.2.1.2 the emission limit values specified in *Schedule A: Discharges and Discharge Monitoring*, of this licence;

5.2.1.3 designations of the receiving water body;

5.2.1.4 water quality objective for the receiving water body;

5.2.1.5 the standards and volumetric limitations applied to any industrial waste water that is licensed to discharge to the waste water works.

5.2.2 the integrity of the waste water works having regard to:

5.2.2.1 capacity of the waste water works;

5.2.2.2 leaks from the waste water works;

5.2.2.3 misconnections between foul sewers and surface water drainage network;

5.2.2.4 infiltration by surface water;

5.2.2.5 infiltration by groundwater;

5.2.2.6 such other aspects of the works as may be specified by the Agency.

5.2.3 all storm water overflows associated with the waste water works to determine the effectiveness of their operation and in particular to identify improvements necessary to comply with the requirements of this licence.

5.2.4 All emergency overflows associated with the waste water works, to determine the effectiveness of their operation.

5.3 The programme of infrastructural improvements shall include a plan for implementation for each individual improvement identified. The plan for implementation shall:

5.3.1 in the case of the assessment carried out under Conditions 5.2.1 (waste water treatment plant), 5.2.3 (storm water overflows) and 5.2.4 (emergency overflows):

5.3.1.1 clearly identify and describe the improvement and the timeframe for implementation;

5.3.1.2 specify the parametric emission(s) that will be affected by the implementation of the improvement;

5.3.1.3 estimate the costs and sources of funding required to implement the improvement including, where appropriate, details of submissions made to the Department of the Environment, Community and Local Government and sanctions received;

5.3.1.4 identify the anticipated improvements in the quality of the receiving waters as a result of the implementation of the improvement.

5.3.2 in the case of the assessment carried out under Condition 5.2.2 (waste water works):

5.3.2.1 identify, evaluate and describe the infrastructural works necessary to implement those works listed under *Schedule C: Specified Improvement Programme*, of this licence;

5.3.2.2 clearly identify and describe the improvement and the timeframe for its implementation;

5.3.2.3 estimate the costs and sources of funding required to implement the improvement including, where appropriate, details of submissions made to the Department of the Environment, Community and Local Government and sanctions received.

5.4 The licensee shall complete the improvements as set out in *Schedule C: Specified Improvement Programme*, of this licence, by the dates specified in order to ensure compliance with the emission limit values as set out in *Schedule A: Discharges and Discharge Monitoring*, of this licence.

5.5 The licensee shall put in place a programme of measures for the gathering, recording and retention of information in relation to the infrastructural components of the waste water works. This information shall be in the form of "As-Constructed" drawings and electronic mapping tools, or in any other format as required by the Agency.

5.6 Uncontrolled spillages in the Curraghalane area

5.6.1 The licensee shall, within six months of the date of grant of licence, investigate the source of uncontrolled spillages from a sewer manhole in the Curraghalane area.

5.6.2 If the source of the uncontrolled spillages is Lifford waste water works, the licensee shall: (1) determine the factors contributing to the uncontrolled spillages, and (2) identify the improvement measures required to eliminate these uncontrolled discharges.

5.6.3 The licensee shall, within nine months of the date of grant of licence, unless otherwise agreed by the Agency, implement all of the appropriate improvement measures identified in Condition 5.6.2.

5.6.4 The licensee shall, within twelve months of the date of grant of licence, unless otherwise agreed by the Agency, submit a report to the Agency on the effectiveness of the implemented improvement measures, in eliminating uncontrolled spillages from the waste water works.

5.7 Within 6 months of the date of grant of licence the licensee shall ensure that there is no unauthorised access to the primary discharge point.

| | |
|---|---|
| *Reason:* | **To provide for the improvement of the waste water works on a planned basis having regard to the need for on-going assessment, recording and reporting of matters affecting the receiving water environment.** |

# Condition 6. Notifications, Records and Reports

6.1 The licensee shall notify the Agency's headquarters in Wexford, or to such other Agency office, as soon as practicable after the occurrence of any incident (as defined in this licence). This notification shall be in such format as specified in Guidance to Licensees/COA holders on the Notification, Management and Communication of Environmental Incidents issued by the Agency and as a minimum shall include the following: the date, time, location, details, nature, cause, extent and ranking of the incident, details on any vulnerable receptors, corrective action taken and plans to prevent a reoccurrence, and the steps taken to minimise any discharges and to carry out any necessary environmental cleanup. The following shall also be notified, as soon as practicable after the occurrence of any incident:

6.1.1 The Loughs Agency, in the case of discharges to receiving waters.

6.2 The licensee shall record all complaints of an environmental nature related to the discharge(s) to waters from the waste water works in accordance with the national environmental complaints procedure. Each such record shall give details of the date and time of the complaint, the name of the complainant (if provided), and the nature of the complaint. A record shall also be kept of the response made in the case of each complaint.

6.3 The licensee shall record all sampling, analyses, measurements, examinations, calibrations and maintenance carried out in accordance with the requirements of this licence.

6.4 The licensee shall as a minimum keep the following documents at the headquarters of the licensee or such office as may be agreed by the Agency:

6.4.1 the licence application and all associated documentation;

6.4.2 the licence(s) relating to the discharge(s) to waters from the waste water works;

6.4.3 the previous year's AER;

6.4.4 records of all risk assessments, sampling, analyses, measurements, examinations, calibrations and maintenance carried out in accordance with the requirements of this licence and guidance produced by the Agency;

6.4.5 relevant correspondence with the Agency;

6.4.6 up to date drawings/plans showing the location of key process and environmental infrastructure, including monitoring locations and discharge points;

6.4.7 up to date operational procedures for all monitoring and control equipment necessary to give effect to this licence.

This documentation shall be available to the Agency for inspection at all reasonable times and shall be submitted to the Agency, as required, in such a format as may be requested, including electronic submittal of the information or a summary of such information.

6.5 The licensee shall, within six months of date of grant of this licence, ensure that a documented Emergency Response Procedure is in place, that addresses any emergency situation that may originate on-site. This procedure shall include provision for minimising the effects of any emergency on the environment. This procedure shall be reviewed annually and updated as necessary.

6.6 The licensee shall establish and maintain a Public Awareness and Communications Programme to ensure that members of the public can obtain, at all reasonable times, environmental information relating to the discharge.

6.7 Unless otherwise agreed by the Agency, all reports and notifications submitted to the Agency shall:

6.7.1 be sent to Administration, Office of Environmental Enforcement (OEE) at the Agency's Headquarters or to such other Agency office agreed by the Agency;

6.7.2 comprise one original and two copies unless additional copies are required by Agency;

6.7.3 be formatted in accordance with any written instruction or guidance issued by the Agency;

6.7.4 include whatever information may be required by the Agency;

6.7.5 be identified by a unique code, indicate any modification or amendment, and be correctly dated to reflect any such modification or amendment;

6.7.6 be accompanied by a written interpretation setting out their significance in the case of all monitoring data; and

6.7.7 be transferred electronically to the Agency's computer system if required by the Agency.

6.8 The licensee shall submit to the Agency, by the 28th February of each year, an AER covering the previous calendar year. This report, which shall be to the satisfaction of the Agency, shall include as a minimum the information specified in *Schedule D: Annual Environmental Report*, of this licence and shall be prepared in accordance with any relevant guidelines issued by the Agency. The content of the AER may be revised subject to the agreement of the Agency.

6.9 All reports shall be certified accurate and representative by the Director of Services or a nominated, suitably qualified and experienced deputy.

6.10 The licensee shall notify the Agency, as soon as is practicable, where a discharge from the waste water works has ceased permanently.

*Reason:* **To provide for the collection and reporting of adequate information on the activity.**

# Condition 7. Financial Charges and Provisions

7.1 Agency Charges

7.1.1 The licensee shall pay to the Agency an annual contribution of €5,238.50 or such sum, as the Agency from time to time determines, having regard to variations in the extent of reporting, auditing, inspection, sampling and analysis or other functions carried out by the Agency, towards the cost of monitoring the discharge as the Agency considers necessary for the performance of its functions under the Waste Water Discharge (Authorisation) Regulations 2007, as amended. The first payment shall be a pro-rata amount for the period from the date of this licence to the 31st day of December, and shall be paid to the Agency within one month from the date of the licence. In subsequent years the licensee shall pay to the Agency such revised annual contribution as the Agency shall from time to time consider necessary to enable performance by the Agency of its relevant functions under the Waste Water Discharge (Authorisation) Regulations 2007, as amended, and all such payments shall be made within one month of the date upon which demanded by the Agency.

7.1.2 In the event that the frequency or extent of monitoring, investigations or other functions carried out by the Agency needs to be increased, the licensee shall contribute such sums as determined by the Agency to defray its costs in regard to items not covered by the said annual contribution.

7.2 Environmental Liabilities

7.2.1 The licensee shall as part of the AER provide an annual statement as to the measures taken or adopted in relation to the prevention of environmental damage, and the financial provisions in place in relation to the underwriting of costs for remedial actions following anticipated events (including closure) or accidents/incidents, as may be associated with discharges or overflows from the waste water works.

*Reason:* **To provide for the adequate financing for monitoring and financial provisions for measures to protect the environment.**

# *SCHEDULE A: DISCHARGES & DISCHARGE MONITORING*

## *A.1: Primary Waste Water Discharge & Monitoring*

*A.1.1 Primary Waste Water Discharge*

| EDEN Code | Licence Code | Discharge Location | | | | Monitoring Location | | | | Receiving Water Name | WFD Code Receiving Water |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TPEFF0600D0352SW001 | SW001 | E | 233791 | N | 398536 | E | 233762 | N | 398589 | Foyle and Faughan estuaries | UKGBN 15NW250010 |

| | Discharges | | | | Monitoring | | |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Parameter | Units | Interim ELV Note 1 & Note 3 | ELV | ELV Commencement Date Note 2 | Monitoring Frequency | Sampling Method | Analysis Method/ Technique |
| pH | *pH units* | - | 6 - 9 | 31/12/2017 | Daily | Composite | pH Meter and recorder |
| cBOD | *mg/l* | 20% reduction | 25 | 31/12/2017 | Bi-monthly | Composite | Standard Method |
| COD | *mg/l* | - | 125 | 31/12/2017 | Bi-monthly | Composite | Standard Method |
| Suspended Solids | *mg/l* | 50% reduction | 25 | 31/12/2017 | Bi-monthly | Composite | Standard Method |
| Ammonia (as N) | *mg/l* | - | 10 | 31/12/2017 | Bi-monthly | Composite | Standard Method |
| Orthophosphate (as P) | *mg/l* | - | 5 | 31/12/2017 | Bi-monthly | Composite | Standard Method |

**Note 1:** **Any specified interim ELV shall apply from the date of grant of licence until the ELV Commencement Date.**

**Note 2:** **Where no ELV Commencement Date is specified, the ELV shall apply from date of grant of licence.**

**Note 3:** **Where a percentage reduction figure is specified, the incoming waste water must be reduced by the percentage specified prior to discharge.**

## *A.2: Secondary Waste Water Discharge(s) & Monitoring*

There shall be no Secondary Waste Water Discharges associated with this agglomeration.

## *A.3: Storm Water Overflows*

**A.3.1 Storm Water Overflows**

| EDEN Code | Licence Code | Discharge Location | | | | Storm Water Overflow Location | | | | Name of Receiving Water | WFD Code Receiving Water |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TPEFF0600D0352SW002 | SW002 | E | 233348 | N | 398301 | E | | N | | River Foyle | NW_250_0100 |
| TPEFF0600D0352SW003 | SW003 | E | 233348 | N | 398301 | E | | N | | River Foyle | NW_250_0100 |

## *A.4 Interpretation of Discharge Monitoring Results*

| A.4 Interpretation of Discharge Monitoring Results | | | |
|---|---|---|---|
| ***No. of Samples taken in any one year*** [Note 1] | ***Max. number of samples which may exceed ELV*** | ***No. of Samples taken in any one year*** [Note 1] | ***Max. number of samples which may exceed ELV*** |
| 4-7 | 1 | 172-187 | 14 |
| 8-16 | 2 | 188-203 | 15 |
| 17-28 | 3 | 204-219 | 16 |
| 29-40 | 4 | 220-235 | 17 |
| 41-53 | 5 | 236-251 | 18 |
| 54-67 | 6 | 252-268 | 19 |
| 68-81 | 7 | 269-284 | 20 |
| 82-95 | 8 | 285-300 | 21 |
| 96-110 | 9 | 301-317 | 22 |
| 111-125 | 10 | 318-334 | 23 |
| 126-140 | 11 | 335-350 | 24 |
| 141-155 | 12 | 351-365 | 25 |
| 156-171 | 13 | | |

**Note 1:** **Where the licensee has taken samples which exceed the number specified in this Schedule, the licensee shall submit to the Agency all results of analysis.**

# *SCHEDULE B: AMBIENT MONITORING*

## *B.1: Groundwater Monitoring*

There is no ground water monitoring required in this licence.

## *B.2: Receiving Water Monitoring*

*B.2.1 Receiving Water Monitoring*

| EDEN Code | Licence Code | Monitoring Location | | | | Point Type | Name of Receiving Water |
|---|---|---|---|---|---|---|---|
| RS01F011400 | SW001 | E | 233468 | N | 398357 | Upstream | Foyle and Faughan estuaries |
| RS01F011500 | SW001 | E | 234105 | N | 398855 | Downstream | Foyle and Faughan estuaries |

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| **Parameter** | **Units** | **Monitoring Frequency** | **Analysis Method / Technique** |
| pH | *pH units* | Quarterly | pH Meter and recorder |
| DO | *% O2* | Quarterly | Standard Method |
| BOD | *mg/l* | Quarterly | Standard Method |
| Orthophosphate (as P) | *mg/l* | Quarterly | Standard Method |
| Total Ammonia | *mg/l* | Quarterly | Standard Method |
| Visual Inspection | *Descriptive* | Quarterly | Standard Method |

# *SCHEDULE C: SPECIFIED IMPROVEMENT PROGRAMME*

## *C.1: Specified Improvement Programme*

| C.1 Specified Improvements Programme | | | |
|---|---|---|---|
| 1 | 2 | 3 | 4 |
| **Location** | **Type** | **Specified Improvement** | **Completion Date** |
| Waste Water Works | Treatment Plant | Provision of secondary waste water treatment plant and ancillary works | 31/12/2017 |
| Waste Water Works | Network | Upgrade of waste water collection network | 31/12/2017 |
| TPEFF0600D0352SW002 | Storm Water Overflow | Cessation or upgrade of storm water overflows to comply with the criteria outlined in the DoECLG 'Procedures and Criteria in relation to Storm Water Overflows' (1995) | 31/12/2017 |
| TPEFF0600D0352SW003 | Storm Water Overflow | Cessation or upgrade of storm water overflows to comply with the criteria outlined in the DoECLG 'Procedures and Criteria in relation to Storm Water Overflows' (1995) | 31/12/2017 |
| Waste Water Works | Network | Any works necessary as a result of Condition 5.2.2.3 | 28/02/2014 |

## *C.2: Discharges to be Discontinued*

No discharge is required to be discontinued in this schedule.

# *SCHEDULE D: ANNUAL ENVIRONMENTAL REPORT*

| **D.1 Annual Environmental Report Content** |
|---|
| Discharges from the agglomeration. |
| Summary report on monthly influent monitoring. |
| Data collection and reporting requirements under the Urban Waste Water Treatment Directive. |
| Complaints summary. |
| Pollutant Release and Transfer Register - report for previous year. |
| Pollutant Release and Transfer Register - proposal for current year. |
| Ambient monitoring summary. |
| Storm water overflow identification and inspection report. |
| Reported incidents summary. |
| Report on progress made and proposals being developed to meet the improvement programme requirements. |
| Development/Infrastructural works summary (completed in previous year or prepared for current year). |
| Risk based assessment to identify possible presence of priority substances. |
| Any other items specified by the Agency. |

**Sealed by the seal of the Agency on this the 01 day of November 2012**

**PRESENT when the seal of the Agency**
**was affixed hereto:**

Frank Clinton
**Director/Authorised Person**

**Appendix 8 Discharge Consents, Strabane**

**From:** DAERA WURG Admin <WURG.Admin@daera-ni.gov.uk>
**Sent:** 26 July 2021 10:24
**To:** Thomas Martin <thomas@mclni.com>
**Subject:** RE: MCL Request_Discharge Consent Strabane WwTW

Good Morning,

I refer to the below request you submitted for Strabane WWTW. Please find attached consent and associated maps.

Strabane WwTW is regulated under the Water (Northern Ireland ) Order 1999 and the Urban Waste Water Treatment Regulations (Northern Ireland) 2007.

Since Northern Ireland Water Ltd was established in 2007, Strabane WwTW has been compliant with the terms of its Water Order Consent and the UWWT Regulations.

If you wish to have a copy of the effluent sample results for Strabane WwTW then a specific written request by letter or email is required.

Due to remote working practices and limited access to our normal resources as a result of Covid-19, all consents/licences are issuing in the attached format. Please be assured that the consent and associated maps remain authentic legal documents.

No hard copy of the consent will issue in the post.

Regards

**David Hayes**
**Water Regulation Team**
**Northern Ireland Environment Agency**
**17 Antrim Road**
**Tonagh**
**Lisburn**
**BT28 3AL**

Department of
Agriculture, Environment and Rural Affairs
www.daera-ni.gov.uk

**From:** Thomas Martin [mailto:thomas@mclni.com]
**Sent:** 20 July 2021 14:26

**To:** DAERA WURG Admin <WURG.Admin@daera-ni.gov.uk>
**Subject:** RE: MCL Request_Discharge Consent Strabane WwTW

**Caution** – This email has been received from outside the NICS network.
Please ensure you can verify the sender's name and email address.
Treat all attachments and links with caution.
If you have any concerns regarding the email please forward to spam@finance-ni.gov.uk.

Good Afternoon,

Concerning my request below;

*Regarding the Discharge Consent at Strabane WwTW, 31 Park Road, Strabane, BT82 8QZ;*

*Is it possible to obtain documents on the Discharge Consent and any non compliances associated with it?*

I had been redirected to the following website; https://www.daera-ni.gov.uk/articles/domestic-consent-public-register This website did not contain any information relating to requested location.

I then proceeded to follow the instructions in the following website; https://www2.dardni.gov.uk/dca However, this relates to applying for a Discharge Consent.

Are you able to advise on how I can obtain the information in the above request please?

Many Thanks

**Regards**

**Thomas Martin**

Land Quality Consultant
MCL Consulting

p:028 9074 7766 | m:07704 156547
e: thomas@mclni.com
w:www.mclni.com
a: Unit 5, Forty Eight North, 48 Duncrue Street,
Belfast, BT3 9BJ
My office hours are 8am to 4pm

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**Consent No: 6606/2007**
**File No: WU 1607/2007**
**Discharger Ref. No: 3223**

**DEPARTMENT OF THE ENVIRONMENT**

**Water (*Northern Ireland*) Order 1999**

**Consent for a Waste Water Treatment Works Discharge**

TO Northern Ireland Water Limited (The Consent Holder)
Head Office
Westland House
40 Old Westland Road
Belfast
BT14 6TE

Source of discharges

**STRABANE WASTE WATER TREATMENT WORKS**

| Nature of discharges | | Name of receiving waterway |
|---|---|---|
| Discharge A: | Secondary treated waste water | River Foyle |
| Discharge B: | Settled storm waste water | River Foyle |
| Discharge C: | Screened storm waste water and screened waste water in an emergency | River Foyle |
| Discharge D: | Screened waste water in an emergency | River Foyle |
| Discharge E: | Settled waste water in an emergency | River Foyle |

***The Department of the Environment in pursuance of the powers conferred on it by the Water (Northern Ireland) Order 1999 HEREBY CONSENTS to your making the discharges stated above to the named receiving waterways in accordance with the application dated 7 July 2005 in respect of discharges from the above named waste water treatment works.***

***SUBJECT TO the following conditions:***

## 1. LOCATION

1.1. The discharge (A) shall consist only of secondary treated waste water from an outlet at grid reference 234130 398920.

1.2. The discharge (B) shall consist only of settled storm waste water from an outlet at grid reference 234130 398920.

1.3. The discharge (C) shall consist only of screened storm waste water in an emergency from an outlet at grid reference 234130 398920.

1.4. The discharge (D) shall consist only of screened waste water in an emergency from an outlet at grid reference 234130 398920.

1.5. The discharge (E) shall consist only of primary settled waste water in an emergency from an outlet at grid reference 234130 398920.

## 2. CONDITIONS

### SECONDARY TREATED WASTE WATER (Discharge A)

2.1. The volume of secondary treated waste water discharged shall not exceed 18144 $m^3$/day.

2.2. The average Daily Dry Weather Flow (DWF) of secondary treated waste water shall not exceed 7171 $m^3$/day.

2.3. Subject to the condition 5.1 spot samples of secondary treated waste water shall comply with the following limits for the parameters stated below. Each parameter shall be considered individually.

| (a) PARAMETER | 95 PERCENTILE LIMIT | UPPER TIER LIMIT |
|---|---|---|
| Biochemical Oxygen Demand in 5 days at 20 °C (nitrification suppressed with allylthiourea) | 30 mg/l $O_2$ | 65 mg/l $O_2$ |
| Suspended Solids (measured after drying at 105 °C) | 50 mg/l | 125 mg/l |
| Ammoniacal Nitrogen (expressed as N) | 10 mg/l N | 40 mg/l N |

(b) In addition to (a):

(i) The pH of the discharge shall not be less than 6.0 nor greater than 9.0.

(ii) The discharge shall not contain more than 40 micrograms per litre of total lead and the total load of this substance discharged in any 12 month period shall not exceed 131 kilograms.

(iii) The discharge shall not contain more than 0.5 micrograms per litre of total mercury and the total load of this substance discharged in any 12 month period shall not exceed 2 kilograms.

(iv) The discharge shall not contain more than 23 micrograms per litre of total copper and the total load of this substance discharged in any 12 month period shall not exceed 76 kilograms.

(v) The discharge shall not contain more than 73 micrograms per litre of total zinc and the total load of this substance discharged in any 12 month period shall not exceed 239 kilograms.

(vi) The discharge shall not contain more than 2 micrograms per litre dichlorovous.

2.4. For the purpose of determining compliance with the conditions in 2.3 (a). and 2.3. (b) (i) the Consent Holder shall take 24 (twenty four) spot samples of the effluent at regular but randomised intervals over a 12 month period in accordance with an agreed sampling programme. Note sampling requirements of informative B.

2.5. For conditions 2.3.(b) (ii) to (vi), 12 (twelve) samples shall be taken at regular but randomised intervals over a 12 month period in accordance with an agreed sampling programme and analysed for the parameters stated in these conditions. Note sampling requirements of informative B.

2.6. Compliance with the 95 percentile limits in condition 2.3(a) will be assessed using the look-up table in Annex 1. The number of samples exceeding the 95 percentile limit for any parameter in any 12 month period shall not exceed the maximum number of permitted exceedences stated in the look-up table, for the given number of samples taken.

2.7. During any period of less than 12 months for which this Consent applies, compliance with the 95 percentile standards in condition 2.3(a) shall be assessed using the number of samples taken within that period.

2.8. No spot sample shall at any time exceed the upper tier limits specified in condition 2.3(a) or the maximum concentration standards contained in condition 2.3(b) excluding standards that are twelve monthly means.

2.9. No sequential set of spot samples in any 12 month period shall exceed the standards contained in condition 2.3(b) (i).

2.10. No sequential set of monthly spot samples in any 12 month period shall exceed the load standards contained in condition 2.3(b) (ii) to (vi).

2.11. The Consent Holder shall forward the analysis results for the parameters stated in condition 2.3(a), and 2.3(b) (i) to Northern Ireland Environment Agency on a monthly basis, within two weeks following the end of month in which the samples were taken and for those parameters stated in 2.3(b) (ii) to (vi), within 4 weeks following the end of the month in which the samples were taken. (See informative B)

2.12. In as far as is reasonably practicable, the works shall be operated so as to prevent the discharge from containing any significant trace of visible oil or grease.

## 3. URBAN WASTE WATER TREATMENT REGULATION REQUIREMENTS

3.1. The Consent Holder shall comply with the Urban Waste Water Treatment Regulations (Northern Ireland) 2007 (hereafter referred to as the "Regulations").

3.2. For the purpose of conditions 3.3 to 3.4, interpretations and references to a numbered regulation or schedule shall have the meaning as in the Regulations, unless otherwise indicated.

3.3. The discharge derives from an agglomeration with a population equivalent between 10,000 and 50,000 discharging to freshwaters.

3.4. The discharge shall be subject to Regulation 7(1) (a) and shall satisfy the requirements of Part I of Schedule 3 and conform to the Total Nitrogen requirements of Table 2 to that Schedule.

3.5. The Consent Holder shall inform Northern Ireland Environment Agency in writing of any change, or proposed change, to the population equivalent such as would make a material change to the application of the Regulations and shall, on request, inform Northern Ireland Environment Agency in writing of the actual population equivalent.

3.6. (a) The Consent Holder shall provide apparatus for the purpose of:

(i) measuring and recording the volume, rate of flow, nature, composition and temperature,

and

(ii) collecting samples of any waste water, as is necessary to ensure compliance with paragraph (b) below.

(b) The Consent Holder shall monitor the discharge in order that Northern Ireland Environment Agency can assess compliance with the requirements of condition 3.4 of this consent, in accordance with the control procedures set out in Part II of Schedule 3 of the Regulations. Note the sampling requirements of informative B.

(c) The Consent Holder shall provide Northern Ireland Environment Agency with the information collected in complying with paragraph (b) above, in a manner agreed with Northern Ireland Environment Agency.

## 4. WORKS OPERATION CONDITION

4.1. The works shall be operated and effluent shall be treated in a manner, which, so far as is reasonably practicable, minimises the polluting effects of the discharge made from the works to the receiving waterway.

4.2. Condition 4.1 does not require:

(a) any higher standard to be achieved in relation to any characteristic of the discharge which is specifically regulated by conditions 2.3(a), 2.3(b) and 3.4 than is required by those conditions;

(b) any alteration of the works or a change in the type of treatment used.

## 5. UNUSUAL WEATHER CONDITIONS

5.1. No sample of secondary treated waste water taken at a time when unusual weather conditions are adversely affecting the operation of the waste water treatment works shall be taken into account in determining compliance with the conditions contained in condition 2.3(a), 2.3(b), and 3.4 of this Consent.

5.2. For the purpose of this condition "unusual weather conditions" shall include:

(i) low ambient temperature as evidenced by effluent temperature of 5°C or less, or by the freezing of mechanical equipment in the works,

(ii) significant snow deposits,

(iii) tidal or fluvial flooding,

(iv) weather conditions causing unforeseen loss of power to the works which could not be ameliorated by the reasonable provision and operation of standby generator facilities.

5.3. On each occasion where unusual weather conditions adversely affect the operation of the waste water treatment works, the Consent Holder shall use its best endeavours to mitigate the adverse effect.

5.4. For an effluent sample to be considered for the purposes of condition 5.1. the Consent Holder shall notify Northern Ireland Environment Agency as soon as unusual weather conditions are known to have adversely affected operations and shall confirm the circumstances in writing as soon as possible thereafter (and in any event within 14 working days of the occurrence of such conditions). The notification shall include a full description of the unusual weather conditions and their impact on the operation of the works. The information shall be entered on the public register.

## 6 DISCHARGE OF SETTLED STORM WASTE WATER (Discharge B)

6.1. The volume of settled storm waste water discharged shall be limited to that which overflows when the storm tanks are full. The discharge of storm waste water to the storm tanks shall only occur when the flow at the storm overflow weir exceeds 210 l/sec due to rainfall and/or snow melt.

6.2. The Consent Holder shall provide, when requested by Northern Ireland Environment Agency, flow monitoring information to verify the flow at which the storm overflow operates.

6.3. The contents of the storm tanks shall be automatically returned for full treatment as soon as practicable after the overflow to the storm tanks has ceased.

6.4. The capacity of the storm tanks shall be at least 1630 $m^3$.

6.5. The discharge shall not contain a significant quantity of solid matter having a size greater than 6 millimetres in one dimension and the discharge shall not be comminuted or macerated to achieve this standard.

## 7. DISCHARGE OF SCREENED STORM WASTE WATER AND/OR SCREENED WASTE WATER IN AN EMERGENCY (Discharge C)

7.1. The inlet pumps shall be capable of passing forward for treatment all flows up to a flow of 18144 $m^3$ per day (210 l/s) and the storm sump pumps shall be capable of passing forward to storm tanks all flows up to a flow of
43026 $m^3$ per day (498 l/s).

7.2. The duty pumps shall automatically reactivate immediately after power is restored following interruption to the supply.

7.3. Stand-by pumps shall automatically activate should the duty pumps become inoperative for reasons other than power failure.

7.4. The discharge shall consist of screened waste water discharged in an emergency, when the inlet pumps are inoperative or when the storm pumps fail to operate during storm conditions as a result of one or more of the following:

(a) electrical power failure not due to the act or default of the Consent Holder;

(b) mechanical breakdown of duty and standby pumps;

and it is not reasonably practicable to contain all the wastewater within the storage available.

7.5. A 24 hour response telemetry alarm system shall be provided to give notification of failure of operation of the pumps. The telemetry alarm system shall be maintained and tested on a regular basis. The Consent Holder shall keep a record of the test results for a period of 2 years and during that time they shall be made available to Northern Ireland Environment Agency on request.

7.6. The Consent Holder shall take all reasonable measures, as soon as is practicable after receipt of warning of failure of the inlet or storm pumps, to prevent or limit any discharge and return the pumps to normal operation.

7.7. The Consent Holder shall notify Northern Ireland Environment Agency as soon as practicable when there is a failure of operation of the inlet or storm pumps.

7.8. The Consent Holder shall keep telemetry records for a minimum of 2 years and supply Northern Ireland Environment Agency with a written report on the operation of the pumps on request.

7.9. The pumps shall be maintained in good working order, and the system shall be designed so that individual pumps can be repaired without interfering with the normal operation of the treatment works.

## 8. DISCHARGE OF SCREENED WASTE WATER IN AN EMERGENCY (Discharge D)

8.1. The inlet foul pumps shall be capable of passing forward for treatment all flows up to 18144 $m^3$/day (210 l/s).

8.2. The duty pumps shall automatically reactivate immediately after power is restored following interruption to the supply.

8.3. Stand-by pumps shall automatically activate should the duty pumps become inoperative for reasons other than power failure.

8.4. The discharge shall consist of waste water discharged in an emergency, when the inlet pumps are inoperative as a result of one or more of the following:

(a) electrical power failure not due to the act or default of the Consent Holder;

(b) mechanical breakdown of duty and standby pumps;

and it is not reasonably practicable to contain all the wastewater within the storage available.

8.5. A 24 hour response telemetry alarm system shall be provided to give notification of failure of operation of the inlet pumps. The telemetry alarm system shall be maintained and tested on a regular basis. The Consent Holder shall keep a record of the test results for a period of 2 years and during that time they shall be made available to Northern Ireland Environment Agency upon request.

8.6. The Consent Holder shall take all reasonable measures, as soon as is practical after receipt of a warning of a failure of the inlet pumps, to prevent or limit any discharge and return the pumps to normal operation.

8.7. The Consent Holder shall notify Northern Ireland Environment Agency as soon as practicable when there is a failure of operation of the inlet pumps.

8.8. The Consent Holder shall keep telemetry records for a minimum of 2 years and supply Northern Ireland Environment Agency with a written report on the operation of the inlet on request.

8.9. The discharge shall not contain a significant quantity of solid matter having a size greater than 6 millimetres in one dimension and the discharge shall not be comminuted or macerated to achieve this standard.

8.10. Where the discharge results in unsatisfactory solid matter being visible in the receiving watercourse or on its banks, the Consent Holder shall take all reasonable steps to collect and remove such matter as soon as practicable after the discharge has taken place.

## 9. DISCHARGE OF PRIMARY SETTLED WASTE WATER IN AN EMERGENCY (Discharge E)

### INTERSTAGE PUMPS

9.1. The interstage pumps shall be capable of passing forward for treatment all flows up to 15552 $m^3$/day (180 l/s).

9.2. The duty pumps shall automatically reactivate immediately after power is restored following interruption to the supply.

9.3. Where installed, stand-by pumps shall automatically activate should the duty pumps become inoperative for reasons other than power failure.

9.4. The discharge shall consist of primary settled waste water only (not containing sludge) discharged in an emergency, when the interstage pumps are inoperative as a result of one or more of the following:

(a) electrical power failure not due to the act or default of the Consent Holder;

(b) mechanical breakdown of duty and standby pumps;

and it is not reasonably practicable to contain all the wastewater within the storage available.

9.5. A 24 hour response telemetry alarm system shall be provided to give notification of failure of operation of any of the interstage pumps. The telemetry alarm system shall be maintained and tested on a regular basis. The Consent Holder shall keep a record of the test results for a

period of 2 years and during that time they shall be made available to Northern Ireland Environment Agency upon request.

9.6. The Consent Holder shall take all reasonable measures, as soon as is practical after receipt of a warning of a failure of the interstage pumps, to prevent any discharge and return the pumps to normal operation.

9.7. The Consent Holder shall keep telemetry records for a minimum of 2 years and supply Northern Ireland Environment Agency with a written report on the operation of the interstage pumps on request.

9.8. All interstage pumps shall be maintained in good working order, and shall be designed so that individual pumps can be repaired without interfering with the operation of the treatment works or causing a discharge of untreated or partially treated waste water to a waterway.

## 10. GENERAL DISCHARGE CONDITIONS

### Power

10.1. A permanent stand-by power generator shall be provided and maintained in good working order. The generator shall activate automatically in the event of a failure of the mains power supply. The generator shall be tested on a regular basis to ensure that it is functioning satisfactorily. Records of tests of the generator should be kept for a minimum of 2 years and made available to Northern Ireland Environment Agency on request.

### Sampling

10.2. Facilities shall be provided, maintained and labelled so that representative samples of the following can be safely obtained at the stated sample point location:

| Type of sample | Easting and Northing |
|---|---|
| Secondary treated waste water before discharge | 234150 398920 |

### Flow Measurement

10.3. Continuous flow recording equipment such that a reading can be readily obtained, shall be provided and operated to enable the daily volume and instantaneous flows as detailed in condition 10.4 to be recorded. See informative D.

10.4. Facilities shall be provided to enable the flow to be measured at the following locations.

| Monitoring location | Easting and Northing |
|---|---|
| Waste water passing forward for treatment | 234230 399080 |
| Final effluent discharge | 234160 398940 |

10.5. Flow readings recorded by the Consent Holder shall be retained for a period of 2 years and made available to Northern Ireland Environment Agency upon request in a format specified.

**Records**

10.6. All records shall be:

- true and accurate;
- comprehensible and legible;
- recorded as soon as practicable after each relevant event;
- amended in such a way, when amendments are necessary, so as to leave the original entry clear and legible and that the person who has made the amendment is identified.

**Access**

10.7. The Consent Holder shall permit duly authorised representatives of Northern Ireland Environment Agency to enter the premises at all reasonable times under article 25 of the Water (NI) Order 1999 in order to undertake the functions conferred on Northern Ireland Environment Agency by the Order and to ensure that the conditions of this consent are complied with.

**Priority Pollutants**

10.8. The Consent Holder shall notify the Northern Ireland Environment Agency in writing if it becomes known that a material change or planned change in the nature of the waste water received has occurred, in respect of discharges from trade premises to the sewerage system, that may increase or introduce into the effluent any 'Priority Pollutant' (as listed in Annex 2 of this Consent and updated from time to time and notified to the Consent Holder in writing), or any other substance considered by the Consent Holder as having or likely to have a significant effect on the receiving waters.

### Substantial Change Condition

10.9. A discharge shall not be made from the works if it would cause a significant increase in the polluting effects of the discharge on the receiving waterway as a result of a new or altered discharge of trade effluent into the works. See informative E.

10.10. An increase in the polluting effects of the discharge on the receiving waterway is not significant for the purposes of condition 10.9 if it relates to any characteristic of the discharge which is specifically regulated by condition 2.3(a), 2.3(b), 2.12 and 3.4 of this consent but it may be significant if it is caused by a change in some other characteristic of the discharge.

### Unauthorised Discharge Condition

10.11. A discharge made from the works shall not contain any poisonous, noxious or polluting matter or solid waste matter which is attributable to any unauthorised discharge into the works.

10.12. A discharge into the works is unauthorised if it is made by a third party and either there is no obligation to receive it, or conditions subject to which there is an obligation to receive it, are not observed.

10.13. Nothing in this, or any other condition of this Consent, prevents anyone from relying on any defence available under the Water and Sewerage Services (Northern Ireland) Order 2006 and any amendment thereof.

### Review of Discharge Conditions

10.14. This consent may be subject to review in line with the conditions in paragraphs 6 (1) to (5) of Schedule1 of The Water (NI) Order 1999 subject to the requirements of paragraphs 5 (1) to (7).

10.15. In respect of condition 10.14. Northern Ireland Environment Agency may alter any of the conditions of this Consent at any time within 4 years of the date of issue for the purposes of meeting the requirements of the Water Framework Directive or any other European Union Directives as implemented into Northern Ireland legislation or where the formally agreed sewerage system upgrade indicates additional requirements at the waste water treatment works.

## CONSENT INFORMATIVES

### A Dry Weather Flow

For the purpose of this Consent Dry Weather Flow shall mean the average daily flow to the treatment works during seven consecutive days without rain (excluding a period which includes public holidays), following seven days during which the rainfall did not exceed 0.25 millimetres on any one day.

### B Sampling

The Consent Holder shall arrange for spot or composite samples to be taken (depending upon the standards to be assessed in the Consent) at regular but randomised intervals over a 12 month period. The sampling days shall be varied across all days of the week and all months during the 12 month period. In the case of spot samples the time of sampling shall be varied across normal working hours. Any failure to take a sample shall be notified to Northern Ireland Environment Agency as soon as practical and confirmed in writing, providing details of the reason for the failure and what action was taken to address the situation.

The Consent Holder shall arrange for the effluent samples to be analysed for the parameters stated in this Consent by laboratories that have been accredited by a nationally recognised quality accreditation body, such as UKAS. The parameter analysis shall employ the methods contained in the appropriate Blue Book (or it's equivalent) and shall be carried out to the accuracy and precision stipulated in the selected method and shall as a minimum comply with the requirements set out in Annex 10 of the Guidance Note to the Urban Waste Water Treatment Directive (August 1999) and the associated appendices.

The Consent Holder shall take into account the requirements of Annex 10 of the Guidance Note to the Urban Waste Water Treatment Regulations (Northern Ireland) 2007 in developing their sampling and analysis programme.

### C Population Equivalent

The Consent Holder shall inform Northern Ireland Environment Agency in writing of any change, or proposed change, to the population equivalent and shall, upon request, inform Northern Ireland Environment Agency in writing of the actual population equivalent.

## D Flow Recording

The Consent Holder shall produce and maintain a quality control manual approved by an independent expert and to the satisfaction of Northern Ireland Environment Agency, specifying procedures for the calibration, operation and maintenance of the flow recording system. The flow recording equipment shall be calibrated, operated and maintained by the Consent Holder in accordance with the provisions of the manual. The Consent Holder shall keep a record of these procedures available for inspection for a minimum period of 24 months and provide a copy to Northern Ireland Environment Agency upon request.

The Consent Holder shall record all failures of the continuous flow recording system and any breaks in the flow record. The reasons for these failures and breaks shall be recorded and all steps taken to prevent a re-occurrence. The Consent Holder shall ensure that as far as possible the recorded remains operational at all times. Any failures shall be remedied as soon as practicable.

The use of portable flow measurement equipment at this works may be acceptable to Northern Ireland Environment Agency by agreement in writing and where the environmental impact is considered low, measurement may be limited to 1 year in three.

The Consent Holder shall take into account the requirements section 4.6 Appendix 10(i) of Annex 10 of the Guidance Note to the Urban Waste Water Treatment Regulations (Northern Ireland) 2007 in meeting the flow requirements.

## E Substantial Change Condition

A discharge of trade effluent into the works is new if:

(a) it is made by the Consent Holder and is of a kind not made into the works by the Consent Holder immediately before the date this consent takes effect; or

(b) it is made by a third party and the discharge is authorised on or after that date.

A discharge of trade effluent into the works is altered if:

(a) it is made by the Consent Holder and its composition or quantity changes significantly on or after the date of this consent; or

(b) it is made by a third party and the alteration of the discharge is authorised on or after that date.
For the purposes of this condition "trade effluent" means:

(a) any discharge by the Consent Holder other than:

(i) domestic waste water from premises connected directly or indirectly to the works; or

(ii) surface water run-off;

(b)any discharge by a third party which is only accepted as a result of an authorisation by the Sewerage Undertaker.

## F Additional Informatives

Any transfer of waste to or from this works by tanker shall comply with the requirements of The Controlled Waste (Duty of Care) Regulations (Northern Ireland) 2002.

The Department considers that bunds should be provided around oil storage or bulk chemical storage tanks and that any chemical should be stored safely in order to reduce the risk of pollution of neighbouring watercourses and groundwater from accidental spillage or leakage.

The drainage of the site should be designed so as to contain any spillages within the site and not discharge such spillages direct to a watercourse.

## G Sewerage Undertaker

For the purposes of this Consent, Sewerage Undertaker shall mean Northern Ireland Water Limited.

**COMMENCEMENT DATE**

**This Consent is effective from the 1st day of January 2016**

First issued on the 30th day of March 2007, the 12th day of May 2010 the 1st day of January 2013, and the 8th day of July 2014.

[Re issued on this 5th day of April 2016].

..... Authorised Officer

**ANNEX 1**

## Urban Waste Water Treatment Directive Look-up Table

| Number of samples taken in any twelve month period | Maximum number of allowed exceedences for any parameter |
|---|---|
| **4-7** | **1** |
| **8-16** | **2** |
| **17-28** | **3** |
| **29-40** | **4** |
| **41-53** | **5** |
| **54-67** | **6** |
| **68-81** | **7** |
| **82-95** | **8** |
| **96-110** | **9** |
| **111-125** | **10** |
| **126-140** | **11** |
| **141-155** | **12** |
| **156-171** | **13** |
| **172-187** | **14** |
| **188-203** | **15** |
| **204-219** | **16** |
| **220-235** | **17** |
| **236-251** | **18** |
| **252-268** | **19** |
| **269-284** | **20** |
| **285-300** | **21** |
| **301-317** | **22** |
| **318-334** | **23** |
| **335-350** | **24** |
| **351-365** | **25** |

Water (Northern Ireland) Order 1999
Consent for a Waste Water Treatment Works Discharge

**Annex 2**

## Priority Pollutant Listing

| | DANGEROUS SUBSTANCES LIST I |
|---|---|
| 1 | Cadmium (total and dissolved) and its compounds |
| 2 | Carbon Tetrachloride (CTC) |
| 3 | Chloroform (CF) (Trichloromethane) |
| 4 | DDT Isomers (pp-DDE, pp-TDE, op-DDT, pp-DDT) |
| 5 | The 'Drins' (Aldrin, Diedrin, Endrin, Isodrin) |
| 6 | 1,2-Dichloroethane (EDC) |
| 7 | Hexachlorobenzene (HCB) |
| 8 | Hexachlorobutadiene (HCBD) |
| 9 | hexachlorocyclohexane (a-HCH, b-HCH, g-HCH (Lindane)) |
| 10 | Mercury (total and dissolved) and its compounds |
| 11 | Pentachlorophenol (PCP) |
| 12 | Tetrachloroethene (PER) |
| 13 | Trichlorobenzene (1,2,3-TCB, 1,2,4-TCB, 1,3,5-TCB) |
| 14 | Trichloroethene (TRI) |
| | |
| | **DANGEROUS SUBSTANCES LIST II** |
| 15 | Boron (total) |
| 16 | Chromium (total and dissolved) |
| 17 | Copper (total and dissolved) |
| 18 | Cyanide |
| 19 | Cyfluthrin |
| 20 | Iron (total and dissolved) |
| 21 | Lead (total and dissolved) |
| 22 | Nickel (total and dissolved) |
| 23 | Permethrin |
| 24 | Vanadium |
| 25 | Zinc (total and dissolved) |
| 26 | pH (if <5.5 and >9.0) |
| 27 | PCSD |
| 28 | Sulcofuron |
| 29 | Flucofuron |
| 30 | Azinphos-ethyl |
| 31 | Azinphos-methyl |
| 32 | Dichlorovos |
| 33 | Endosulphan |
| 34 | Fenitrothion |
| 35 | Fenthion |
| 36 | Malathion |
| 37 | Parathion (including parathion Methyl) |
| 38 | Simazine |
| 39 | Tributyltin |
| 40 | Trifuralin |
| 41 | Triphenyltin Acetate (Fentin Acetate) |
| 42 | Triphenyltin Chloride (Fentin Chloride) |
| 43 | Triphenyltin Hydroxide (Fentin Hydroxide) |
| 44 | Atrazine |
| 45 | 2-Amino-4-Chlorophenol |
| 46 | Anthracene |

Water (Northern Ireland) Order 1999
Consent for a Waste Water Treatment Works Discharge

## Annex 2

| | |
|---|---|
| **47** | Arsenic and its mineral compounds |
| **48** | Benzene |
| **49** | Benzidine |
| **50** | Benzylchloride (Alpha-chlorotoluene) |
| **51** | Benzylidenechloride (Alpha,alpha-dichlorotoluene) |
| **52** | Biphenyl |
| **53** | Chloral Hydrate |
| **54** | Clordane |
| **55** | Chloroacetic Acid |
| **56** | 2-Chloroaniline |
| **57** | 3-Chloroaniline |
| **58** | 4-Chloroaniline |
| **59** | Mono-Chlorobenzene |
| **60** | 1-Chloro-2,4-Dinitrobenzene |
| **61** | 2-Chloroethanol |
| **62** | 4-Chloro-3-Methylphenol |
| **63** | 1-Chloronapthalene |
| **64** | Chloronapthalenes (technical mixture) |
| **65** | 4-Chloronitroaniline |
| **66** | 1-Chloro-2-Nitrobenzene |
| **67** | 1-Chloro-3-Nitrobenzene |
| **68** | 1-Chloro-4-Nitrobenzene |
| **69** | 4-Chloro-2-Nitrotoluene |
| **70** | Chloronitrotoluenes (other than 4-Chloro-2-Nitrotoluene) |
| **71** | 2-Chlorophenol |
| **72** | 3-Chlorophenol |
| **73** | 4-Chlorophenol |
| **74** | Chloroprene (2-Chloro-1,3-Butadiene) |
| **75** | 3-Chloropropene (Allylchloride) |
| **76** | 2-Chlorotoluene |
| **77** | 3-Chlorotoluene |
| **78** | 4-Chlorotoluene |
| **79** | 2-Chloro-p-Toluidine |
| **80** | Chlorotoluidines (Other than 2-Chloro-p-Toluidine) |
| **81** | Coumaphos . |
| **82** | Cyanuric Chloride (2,4,6-Trichloro-1,3,5-Triazine) |
| **83** | 2,4,D (Including 2,4-D Salts and 2,4-D Esters) |
| **84** | Demeton (Including D-O, D-S, D-S-Methyl & D-S-Methyl Sulphone) |
| **85** | 1,2-Dibromoethane |
| **86** | Dibutyltin Dichloride |
| **87** | Dibutyltin Oxide |
| **88** | Dibutyltin Salts (Other than Dibutyltin Dichloride & Dibutyltin Oxide) |
| **89** | Dichloroanilines |
| **90** | 1,2-Dichlorobenzene |
| **91** | 1,3-Dichlorobenzene |
| **92** | 1,4-Dichlorobenzene |
| **93** | Dichlorobenzidines |
| **94** | Dichloro-Di-Isopropyl Ether |
| **95** | 1,1-Dichloroethane |
| **96** | 1,1-Dichloroethylene (Vinylidene Chloride) |
| **97** | 1,2-Dichloroethylene |

Water (Northern Ireland) Order 1999
Consent for a Waste Water Treatment Works Discharge

**Annex 2**

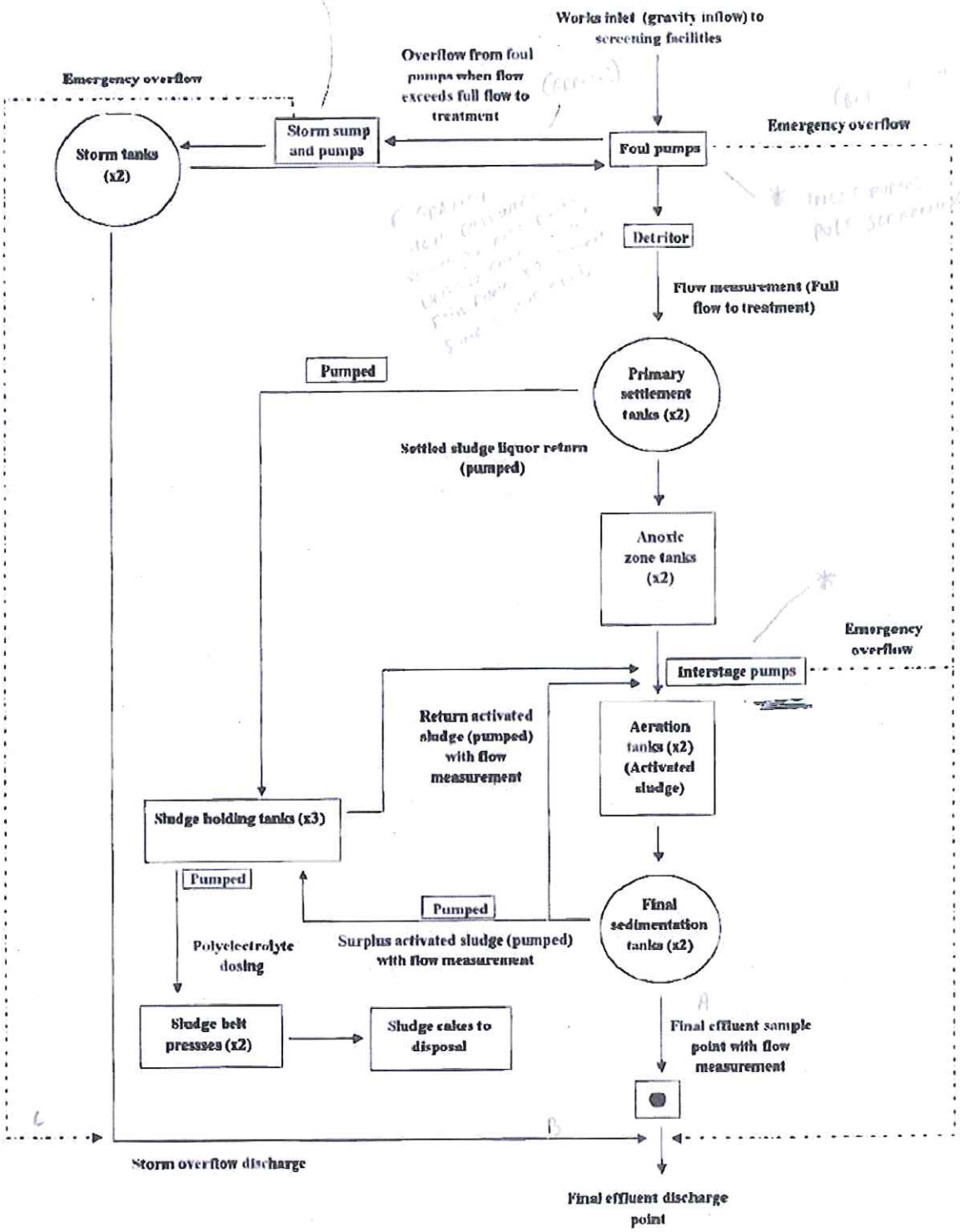
| | |
|---|---|
| **98** | Dichloromethane |
| **99** | Dichloronitrobenzenes |
| **100** | 2,4-Dichlorophenol |
| **101** | 1,2-Dichloropropane |
| **102** | 1,3-Dichloropropan-2-ol |
| **103** | 1,3-Dichloropropene |
| **104** | 2,3-Dichloropropene |
| **105** | Dichlorprop |
| **106** | Diethylamine |
| **107** | Dimethoate |
| **108** | Dimethylamine |
| **109** | Disulfoton |
| **110** | Epichlorohydrin |
| **111** | Ethylbenzene |
| **112** | Heptaclor (Including Heptachlorepoxide) |
| **113** | Hexachloroethane |
| **114** | Isoproplyl Benzene |
| **115** | Linuron |
| **116** | MCPA |
| **117** | Mecoprop |
| **118** | Methamidophos |
| **119** | Mevinphos |
| **120** | Monolinuron |
| **121** | Napthalene |
| **122** | Omethoate |
| **123** | Oxy-Demeton-Methyl |
| **124** | PAH (With special ref to 3,4-Benzopyrene & 3,4-Benzofluoranthene) |
| **125** | PCB (Including PCT) |
| **126** | Phoxime |
| **127** | Propanil |
| **128** | Pyrazon |
| **129** | 2,4,5-T (Including 2,4,5-T Salts & 2,4,5-T Esters) |
| **130** | Tetrabutyltin |
| **131** | 1,2,4,S-Tetrachlorobenzene |
| **132** | 1,1,2,2- Tetrachloroethane |
| **133** | Toluene |
| **134** | Triazophos |
| **135** | Tributyl Phosphate |
| **136** | Trichlorfon |
| **137** | 1,1,1-Trichloroethane |
| **138** | 1,1,2-Trichloroethane |
| **139** | Trichlorophenols |
| **140** | 1,1,2-Tri-Chloro-Tri-Fluoro-Ethane |
| **141** | Vinyl Chloride (Chloroethylene) |
| **142** | Xylenes (Technical Mixture of Isomers) |
| **143** | Bentazone |
| | |
| | **Water Framework Directive 2000/60/EC Annex X** |
| | **(Other than those pollutants on List I & II above)** |
| **144** | Alachlor |
| **145** | BDEs: Pentabromodiphenylether |

Water (Northern Ireland) Order 1999
Consent for a Waste Water Treatment Works Discharge

**Annex 2**

| | |
|---|---|
| **146** | BDEs: Octabromodiphenylether |
| **147** | BDEs: Decabromodiphenylether |
| **148** | C1O-C13-Chloroalkanes |
| **149** | Chloropyrifos |
| **150** | Di-(2-ethylhexyl) Phthalate (DEHP) |
| **151** | Diuron |
| **152** | Isoproturon |
| **153** | Nonylphenols: 4-(para)-nonylphenol |
| **154** | Octylphenols: Para-tert-Octylphenol |
| **155** | PAH: Fluoroanthene |
| **156** | PAH: Benzo(a)pyrene |
| **157** | PAH: Benzo(b)fluoroanthene |
| **158** | PAH: Benzo(g,h,i)perylene |
| **159** | PAH: Benzo(k)fluoroanthene |
| **160** | PAH: Indeno(1,2,3-cd)pyrene |
| **161** | Chlorfenvinfos |
| **162** | Diazinon |
| **163** | Propetamphos |
| **164** | Pentachlorobenzene |
| | |
| | **Metals/Metaloids DSD 76/464/EEC** |
| | **(Other than those pollutants on List I &II above)** |
| **165** | Selenium |
| **166** | Antimony |
| **167** | Molybdenum |
| **168** | Titanium |
| **169** | Barium |
| **170** | Beryllium |
| **171** | Uranium |
| **172** | Cobalt |
| **173** | Thallium |
| **174** | Tellurium |
| **175** | Silver |
| | |
| | |
| | |
| | |
| | |

This list is applicable as at the 1st August 2004 and will be updated as and when changes to the requirements of the relevant legislation occur.

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**Strabane WWTW**

# STRABANE WWTW

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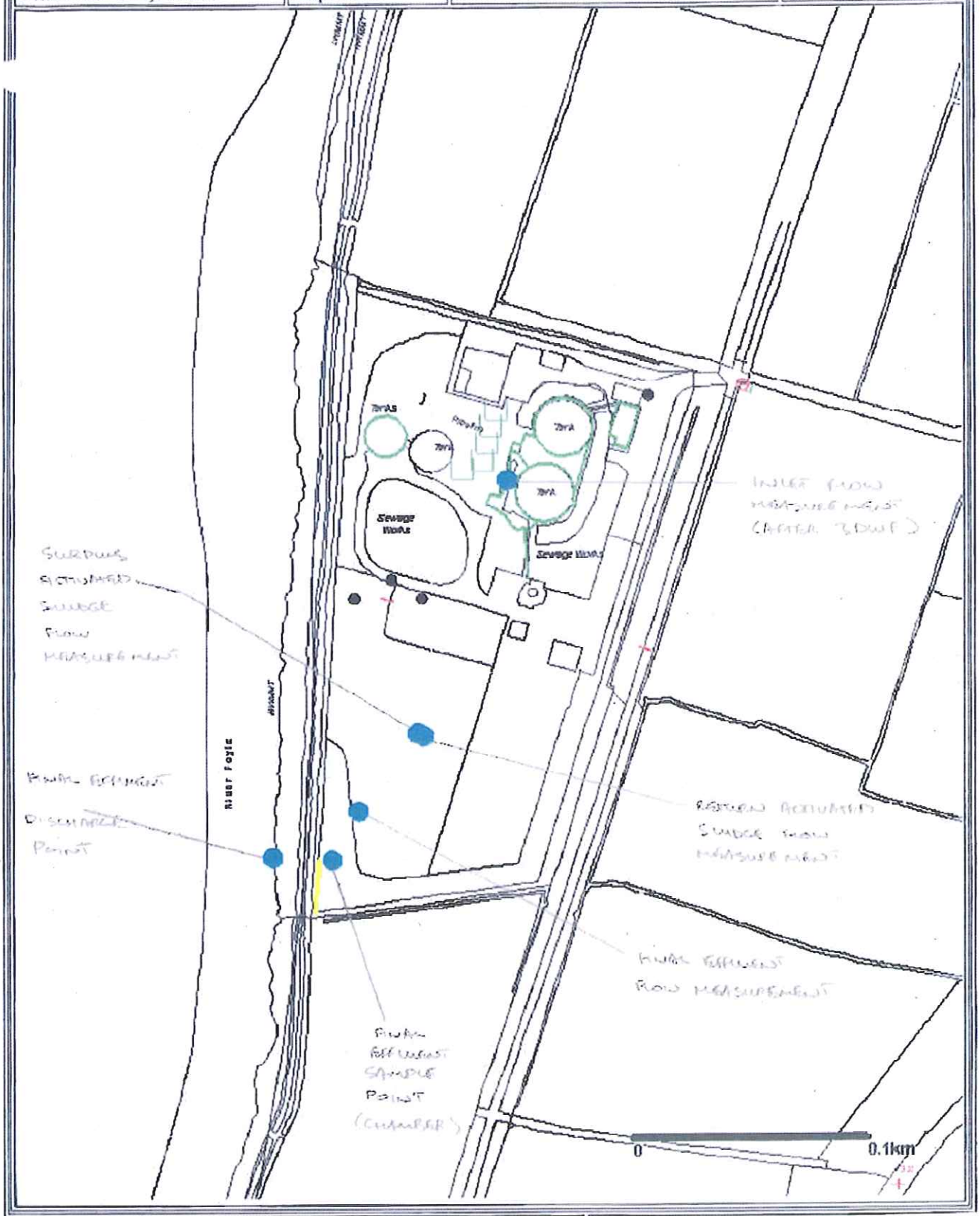
|---|---|---|---|

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File WU 1607/2007

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Signed Robyn Stewart

Authorised Officer

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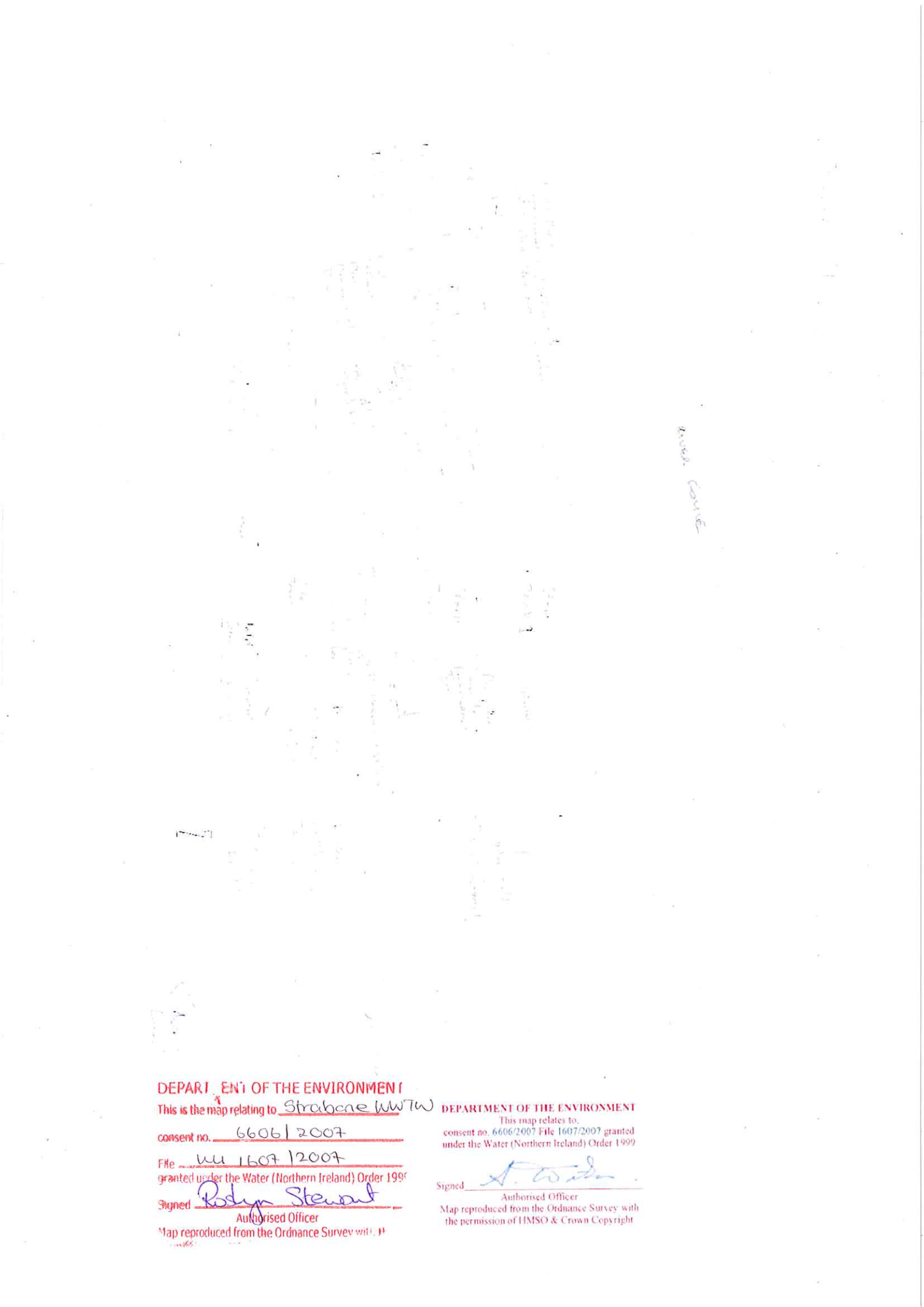

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**Appendix 9 Field Chemistry**

| 24.06.2021 | pH | DO | Electrical Conductivity | TDS | Salinity | Temperature | Ammonia |
|---|---|---|---|---|---|---|---|
| *Units* | - | *mg/l* | *µ S/cm* | *mg/l* | *psu* | *o C* | *mg/l NH3-N* |
| ***Strabane Watercourse Field Chemistry*** | | | | | | | |
| **WCS 01** | 7.84 | 76 | 622 | - | - | 13.71 | 0 |
| **WCS 02** | 8.6 | 111.1 | 185 | 92 | 0.09 | 13.13 | 0 |
| **WCS 04** | 7.94 | 106 | 218 | 109 | 0.10 | 15.70 | 0 |
| **WCS 05** | 7.73 | 109.5 | 203 | 95 | 0.11 | 15.81 | 0 |
| ***Strabane Pond Field Chemistry*** | | | | | | | |
| **WCS 03 (Pond 2)** | 7.70 | 94 | - | - | - | 14.26 | 0 |
| **WCS 06 (Pond 1)** | 7.89 | 92.5 | 453 | 211 | 0.07 | 15.25 | 0 |
| ***Lifford Watercourse Field Chemistry*** | | | | | | | |
| **WCS 07** | 7.02 | 120.3 | 136 | 67 | 0.06 | 14.25 | 0 |
| **WCS 08** | 8.37 | 146 | 112 | - | - | 14.7 | 0 |
| **WCS 09** | 7.85 | 73.3 | 428 | 214 | 0.21 | 14.49 | 0 |
| **WCS 10** | 7.36 | 110.4 | 411 | 198 | 0.16 | 14.78 | 0 |

| Lifford 24.06.2021 | pH | DO | Electrical Conductivity | TDS | Salinity | Temperature | Ammonia |
|---|---|---|---|---|---|---|---|
| *Units* | - | *mg/l* | *µ S/cm* | *mg/l* | *psu* | *o C* | *mg/l NH3-N* |
| **LHS1.1** | 7.42 | 84.1 | 409 | 201 | 0.19 | 14.58 | 0 |
| **LHS1.2** | 7.69 | 73.6 | 334 | 174 | 0.08 | 13.85 | 0 |
| **LHS1.3** | 8.06 | 95.7 | 569 | 195 | 0.15 | 14.12 | 0 |
| **LHS1.4** | 7.84 | 103.9 | 584 | 85 | 0.11 | 14.35 | 0 |
| **LHS1.5** | 7.94 | 92.4 | 428 | 111 | 0.21 | 14.09 | 0 |
| **LHS2.1** | 7.62 | 78.4 | 483 | 187 | 0.09 | 13.79 | 0 |
| **LHS2.2** | 7.76 | 81.7 | 415 | 226 | 0.17 | 14.08 | 0 |
| **LHS2.3** | 7.83 | 92.6 | 587 | 249 | 0.12 | 13.94 | 0 |

| Strabane 24.06.2021 | pH | DO | Electrical Conductivity | TDS | Salinity | Temperature | Ammonia |
|---|---|---|---|---|---|---|---|
| *Units* | - | *mg/l* | *µ S/cm* | *mg/l* | *psu* | *o C* | *mg/l NH3-N* |
| **SHS3.1** | 7.73 | 87.5 | 504 | 291 | 0.28 | 14.48 | 0 |
| **SHS3.2** | 7.62 | 93.4 | 347 | 274 | 0.11 | 14.25 | 0 |
| **SHS3.3** | 8.3 | 110.1 | 135 | 168 | 0.06 | 15.2 | 0 |
| **SHS3.4** | 8.11 | 97.5 | 402 | 198 | 0.09 | 14.97 | 0 |
| **SHS3.5** | 7.84 | 76 | 522 | - | - | 13.71 | 0 |
| **SHS3.6** | 7.79 | 75.6 | 234 | 117 | 0.11 | 13.7 | 0.6 |
| **SHS3.7** | 7.83 | 92.7 | 307 | 176 | 0.18 | 14.26 | 0 |
| **SHS3.8** | 7.54 | 84.9 | 249 | 189 | 0.06 | 13.86 | 0 |
| **SHS3.9** | 8.01 | 103.6 | 334 | 136 | 0.08 | 14.02 | 0 |
| **SHS4.1** | 7.98 | 87.6 | 379 | 212 | 0.15 | 13.67 | 0 |
| **SHS4.2** | 7.67 | 97.4 | 408 | 267 | 0.09 | 14.05 | 0 |
| **SHS4.3** | 7.84 | 102.3 | 457 | 243 | 0.17 | 13.85 | 0 |
| **SHS6.1** | 7.97 | 103.2 | 429 | 214 | 0.21 | 14.36 | 0 |
| **SHS6.2** | 8.13 | 87.1 | 368 | 184 | 0.18 | 13.95 | 0 |
| **SHS6.3** | 7.86 | 112.6 | 334 | 208 | 0.12 | 14.12 | 0 |
| **SHS7.1** | 8.13 | 106 | 195 | 97 | 0.09 | 13.89 | 0 |
| **SHS7.2** | 7.85 | 75.8 | 209 | 102 | 0.12 | 13.76 | 0 |
| **SHS7.3** | 7.98 | 82.7 | 184 | 88 | 0.04 | 13.90 | 0 |
| **SHS7.4** | 8.06 | 90.5 | 257 | 84 | 0.06 | 14.10 | 0 |
| **SHS7.5** | 7.54 | 101.7 | 174 | 92 | 0.10 | 14.04 | 0 |
| **SHS9.1** | 6.97 | 157.1 | 183 | 99 | 0.09 | 13 | 0.02 |
| **SHS9.2** | 7.9 | 153.5 | 293 | 108 | 0.04 | 12.90 | 0 |

**Appendix 10 Laboratory Certificates, Surface Waters & Groundwaters**

Element Materials Technology
Unit 3 Deeside Point
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Deeside
CH5 2UA

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MCL Consulting
Unit 5
Forty Eight North
Duncrue Street
Belfast
Northern Ireland
BT3 9LA

| | |
|---|---|
| **Attention :** | Thomas Martin |
| **Date :** | 11th June, 2021 |
| **Your reference :** | P2288 |
| **Our reference :** | Test Report 21/8216 Batch 1 |
| **Location :** | Riverine |
| **Date samples received :** | 1st June, 2021 |
| **Status :** | Final report |
| **Issue :** | 1 |

Fifteen samples were received for analysis on 1st June, 2021 of which fifteen 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**

Please include all sections of this report if it is reproduced

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin
**EMT Job No:** 21/8216

**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. | 1-4 | 5-8 | 9-12 | 13-16 | 17-20 | 21-24 | 25-28 | 29-32 | 33-36 | 37-41 | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | WS02 | WS06 | WS07 | WS09 | WS10 | WS11 | WS12 | WS13 | WS14 | SW1 | | | |
| Depth | | | | | | | | | | | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V P G | V P G | V P G | V P G | V P G | V P G | V P G | V P G | V P G | V P BOD G | | | |
| Sample Date | 27/05/2021 | 27/05/2021 | 26/05/2021 | 26/05/2021 | 26/05/2021 | 26/05/2021 | 26/05/2021 | 26/05/2021 | 26/05/2021 | 26/05/2021 | | | |
| Sample Type | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Surface Water | | | |
| Batch Number | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| Date of Receipt | 01/06/2021 | 01/06/2021 | 01/06/2021 | 01/06/2021 | 01/06/2021 | 01/06/2021 | 01/06/2021 | 01/06/2021 | 01/06/2021 | 01/06/2021 | | | |
| Dissolved Arsenic # | 32.4 | 19.2 | 1.3 | 2.3 | 2.4 | 2.7 | 1.5 | 3.8 | 5.1 | 1.0 | <0.9 | ug/l | TM170/PM14 |
| Dissolved Barium # | 130.6 | 103.0 | 47.3 | 16.5 | 215.1 | 95.5 | 98.9 | 111.3 | 133.0 | 74.6 | <1.8 | ug/l | TM170/PM14 |
| Dissolved Beryllium # | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | ug/l | TM170/PM14 |
| Dissolved Boron # | 14 | <12 | 27 | 26 | 69 | 44 | 49 | 23 | 35 | 59 | <12 | ug/l | TM170/PM14 |
| Dissolved Cadmium # | 0.06 | <0.03 | <0.03 | 0.03 | <0.03 | <0.03 | 0.13 | 0.13 | <0.03 | <0.03 | <0.03 | ug/l | TM170/PM14 |
| Total Dissolved Chromium # | 0.4 | <0.2 | 1.6 | 8.9 | 0.6 | <0.2 | <0.2 | 1.3 | 1.2 | 0.3 | <0.2 | ug/l | TM170/PM14 |
| Dissolved Copper # | <1 | <1 | 3 | 12 | <1 | <1 | 5 | 18 | <1 | 5 | <1 | ug/l | TM170/PM14 |
| Dissolved Lead # | <0.4 | <0.4 | 0.4 | 2.1 | <0.4 | 0.6 | 20.5 | 12.6 | 0.4 | <0.4 | <0.4 | ug/l | TM170/PM14 |
| Dissolved Mercury # | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | ug/l | TM170/PM14 |
| Dissolved Nickel # | 97.9 | 34.2 | 4.3 | 7.6 | 3.6 | 2.2 | 4.2 | 9.1 | 7.9 | 8.7 | <0.2 | ug/l | TM170/PM14 |
| Dissolved Selenium # | <1.2 | <1.2 | <1.2 | 1.3 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | ug/l | TM170/PM14 |
| Dissolved Vanadium # | 2.9 | <0.6 | 3.1 | 4.1 | <0.6 | 0.8 | 8.1 | 0.6 | 1.0 | <0.6 | <0.6 | ug/l | TM170/PM14 |
| Dissolved Zinc # | 103.6 | 16.5 | 8.1 | 24.9 | 4.0 | 2.2 | 23.7 | 134.7 | 14.0 | 29.1 | <1.5 | ug/l | TM170/PM14 |
| | | | | | | | | | | | | | |
| Total Hardness Dissolved (as CaCO3) | 114 | 58 | 133 | 34 | 300 | 321 | 489 | 192 | 153 | 244 | <1 | mg/l | TM30/PM14 |
| | | | | | | | | | | | | | |
| PAH MS | | | | | | | | | | | | | |
| Naphthalene # | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | ug/l | TM4/PM30 |
| Acenaphthylene # | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | ug/l | TM4/PM30 |
| Acenaphthene # | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | 0.014 | <0.013 | <0.013 | ug/l | TM4/PM30 |
| Fluorene # | <0.014 | <0.014 | <0.014 | <0.014 | <0.014 | <0.014 | <0.014 | <0.014 | <0.014 | <0.014 | <0.014 | ug/l | TM4/PM30 |
| Phenanthrene # | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | 0.021 | <0.011 | 0.036 | 0.012 | <0.011 | ug/l | TM4/PM30 |
| Anthracene # | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | 0.031 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | ug/l | TM4/PM30 |
| Fluoranthene # | <0.012 | <0.012 | <0.012 | <0.012 | <0.012 | 0.045 | 0.051 | <0.012 | 0.061 | 0.047 | <0.012 | ug/l | TM4/PM30 |
| Pyrene # | 0.030 | <0.013 | <0.013 | <0.013 | <0.013 | 0.053 | 0.051 | <0.013 | 0.072 | 0.153 | <0.013 | ug/l | TM4/PM30 |
| Benzo(a)anthracene # | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 | 0.023 | 0.027 | <0.015 | 0.027 | 0.020 | <0.015 | ug/l | TM4/PM30 |
| Chrysene # | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | 0.032 | 0.027 | <0.011 | 0.036 | 0.046 | <0.011 | ug/l | TM4/PM30 |
| Benzo(bk)fluoranthene # | <0.018 | <0.018 | <0.018 | <0.018 | <0.018 | 0.063 | 0.069 | <0.018 | 0.031 | 0.077 | <0.018 | ug/l | TM4/PM30 |
| Benzo(a)pyrene # | <0.016 | <0.016 | <0.016 | <0.016 | <0.016 | 0.029 | 0.035 | <0.016 | <0.016 | 0.025 | <0.016 | ug/l | TM4/PM30 |
| Indeno(123cd)pyrene # | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | 0.016 | 0.022 | <0.011 | <0.011 | 0.024 | <0.011 | ug/l | TM4/PM30 |
| Dibenzo(ah)anthracene # | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | ug/l | TM4/PM30 |
| Benzo(ghi)perylene # | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | 0.016 | 0.027 | <0.011 | <0.011 | 0.034 | <0.011 | ug/l | TM4/PM30 |
| PAH 16 Total # | <0.195 | <0.195 | <0.195 | <0.195 | <0.195 | 0.308 | 0.330 | <0.195 | 0.277 | 0.438 | <0.195 | ug/l | TM4/PM30 |
| Benzo(b)fluoranthene | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.05 | 0.05 | <0.01 | 0.02 | 0.06 | <0.01 | ug/l | TM4/PM30 |
| Benzo(k)fluoranthene | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.02 | 0.02 | <0.01 | <0.01 | 0.02 | <0.01 | ug/l | TM4/PM30 |
| PAH Surrogate % Recovery | 86 | 87 | 85 | 97 | 85 | 81 | 82 | 82 | 83 | 91 | <0 | % | TM4/PM30 |
| | | | | | | | | | | | | | |
| MTBE # | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | ug/l | TM36/PM12 |
| Benzene # | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | ug/l | TM36/PM12 |
| Toluene # | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | ug/l | TM36/PM12 |
| Ethylbenzene # | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | ug/l | TM36/PM12 |
| m/p-Xylene # | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | ug/l | TM36/PM12 |
| o-Xylene # | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | ug/l | TM36/PM12 |

Please see attached notes for all abbreviations and acronyms

## Element Materials Technology

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin
**EMT Job No:** 21/8216

**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. | 1-4 | 5-8 | 9-12 | 13-16 | 17-20 | 21-24 | 25-28 | 29-32 | 33-36 | 37-41 | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | WS02 | WS06 | WS07 | WS09 | WS10 | WS11 | WS12 | WS13 | WS14 | SW1 | | | |
| Depth | | | | | | | | | | | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V P G | V P G | V P G | V P G | V P G | V P G | V P G | V P G | V P G | V P BOD G | | | |
| Sample Date | 27/05/2021 | 27/05/2021 | 26/05/2021 | 26/05/2021 | 26/05/2021 | 26/05/2021 | 26/05/2021 | 26/05/2021 | 26/05/2021 | 26/05/2021 | | | |
| Sample Type | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Surface Water | | | |
| Batch Number | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| Date of Receipt | 01/06/2021 | 01/06/2021 | 01/06/2021 | 01/06/2021 | 01/06/2021 | 01/06/2021 | 01/06/2021 | 01/06/2021 | 01/06/2021 | 01/06/2021 | | | |
| EPH (C8-C40) # | - | - | - | - | - | - | - | - | - | - | <10 | ug/l | TM5/PM30 |
| TPH CWG | | | | | | | | | | | | | |
| **Aliphatics** | | | | | | | | | | | | | |
| >C5-C6 # | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | ug/l | TM36/PM12 |
| >C6-C8 # | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | ug/l | TM36/PM12 |
| >C8-C10 # | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | ug/l | TM36/PM12 |
| >C10-C12 # | <5 | <5 | <5 | <10 AA | <5 | <5 | <5 | <5 | <5 | <5 | <5 | ug/l | TM5/PM16/PM30 |
| >C12-C16 # | <10 | <10 | <10 | <20 AA | <10 | <10 | <10 | <10 | <10 | <10 | <10 | ug/l | TM5/PM16/PM30 |
| >C16-C21 # | <10 | <10 | <10 | <20 AA | <10 | <10 | <10 | <10 | <10 | <10 | <10 | ug/l | TM5/PM16/PM30 |
| >C21-C35 # | <10 | <10 | <10 | <20 AA | <10 | <10 | <10 | <10 | <10 | <10 | <10 | ug/l | TM5/PM16/PM30 |
| Total aliphatics C5-35 # | <10 | <10 | <10 | <20 AA | <10 | <10 | <10 | <10 | <10 | <10 | <10 | ug/l | TM5/TM36/PM12/PM16/PM30 |
| **Aromatics** | | | | | | | | | | | | | |
| >C5-EC7 # | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | ug/l | TM36/PM12 |
| >EC7-EC8 # | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | ug/l | TM36/PM12 |
| >EC8-EC10 # | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | ug/l | TM36/PM12 |
| >EC10-EC12 # | <5 | <5 | <5 | <10 AA | <5 | <5 | <5 | <5 | <5 | <5 | <5 | ug/l | TM5/PM16/PM30 |
| >EC12-EC16 # | <10 | <10 | <10 | <20 AA | <10 | <10 | <10 | <10 | <10 | <10 | <10 | ug/l | TM5/PM16/PM30 |
| >EC16-EC21 # | <10 | <10 | <10 | <20 AA | <10 | <10 | <10 | <10 | <10 | <10 | <10 | ug/l | TM5/PM16/PM30 |
| >EC21-EC35 # | <10 | <10 | <10 | <20 AA | <10 | <10 | <10 | <10 | <10 | <10 | <10 | ug/l | TM5/PM16/PM30 |
| Total aromatics C5-35 # | <10 | <10 | <10 | <20 AA | <10 | <10 | <10 | <10 | <10 | <10 | <10 | ug/l | TM5/TM36/PM12/PM16/PM30 |
| Total aliphatics and aromatics(C5-35) # | <10 | <10 | <10 | <20 AA | <10 | <10 | <10 | <10 | <10 | <10 | <10 | ug/l | TM5/TM36/PM12/PM16/PM30 |
| Sulphate as SO4 # | 99.0 | 35.1 | 7.1 | <0.5 | 81.0 | 94.0 | 29.3 | <0.5 | 3.6 | 58.1 | <0.5 | mg/l | TM38/PM0 |
| Free Cyanide # | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | mg/l | TM89/PM0 |
| Total Cyanide # | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | mg/l | TM89/PM0 |
| Hexavalent Chromium | <6 | <6 | <6 | <6 | <6 | <6 | <6 | <6 | <6 | <6 | <6 | ug/l | TM38/PM0 |
| Total Dissolved Chromium III | <6 | <6 | <6 | 9 | <6 | <6 | <6 | <6 | <6 | <6 | <6 | ug/l | NONE/NONE |
| Thiocyanate | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | 0.06 | 0.05 | <0.02 | <0.02 | mg/l | TM107/PM0 |
| BOD (Settled) # | - | - | - | - | - | - | - | - | - | <1 | <1 | mg/l | TM58/PM0 |
| Electrical Conductivity @25C # | 329 | 164 | 439 | 142 | 790 | 664 | 844 | 542 | 522 | 687 | <2 | uS/cm | TM76/PM0 |
| pH # | 5.61 | 5.80 | 6.50 | 5.77 | 7.02 | 7.34 | 7.65 | 6.60 | 6.53 | 7.59 | <0.01 | pH units | TM73/PM0 |
| Total Suspended Solids # | 33200 | 21848 | 5948 | 9232 | 11272 | 21386 | 14598 | 1636 | 38748 | 505 | <10 | mg/l | TM37/PM0 |

Please see attached notes for all abbreviations and acronyms



Please include all sections of this report if it is reproduced

All solid results are expressed on a dry weight basis unless stated otherwise.

## Element Materials Technology

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin
**EMT Job No:** 21/8216

**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. | 42-46 | 47-51 | 52-56 | 57-61 | 62-64 | | | | | | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | SW2 | SW3 | SW4 | SW5 | HA08 | | | | | | | | |
| Depth | | | | | | | | | | | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V P BOD G | V P BOD G | V P BOD G | V P BOD G | V P | | | | | | | | |
| Sample Date | 26/05/2021 | 26/05/2021 | 27/05/2021 | 27/05/2021 | 27/05/2021 | | | | | | | | |
| Sample Type | Surface Water | Surface Water | Surface Water | Surface Water | Ground Water | | | | | | | | |
| Batch Number | 1 | 1 | 1 | 1 | 1 | | | | | | | | |
| Date of Receipt | 01/06/2021 | 01/06/2021 | 01/06/2021 | 01/06/2021 | 01/06/2021 | | | | | | | | |
| Dissolved Arsenic # | <0.9 | <0.9 | <0.9 | <0.9 | 2.6 | | | | | | <0.9 | ug/l | TM170/PM14 |
| Dissolved Barium # | 71.0 | 37.4 | 19.1 | 21.0 | 285.3 | | | | | | <1.8 | ug/l | TM170/PM14 |
| Dissolved Beryllium # | <0.5 | <0.5 | <0.5 | <0.5 | 0.9 | | | | | | <0.5 | ug/l | TM170/PM14 |
| Dissolved Boron # | 27 | <12 | 20 | 20 | 26 | | | | | | <12 | ug/l | TM170/PM14 |
| Dissolved Cadmium # | <0.03 | <0.03 | <0.03 | <0.03 | 0.66 | | | | | | <0.03 | ug/l | TM170/PM14 |
| Total Dissolved Chromium # | <0.2 | 2.4 | 0.4 | 0.4 | 1.6 | | | | | | <0.2 | ug/l | TM170/PM14 |
| Dissolved Copper # | 3 | 3 | 3 | 2 | 3 | | | | | | <1 | ug/l | TM170/PM14 |
| Dissolved Lead # | <0.4 | <0.4 | <0.4 | <0.4 | 2.1 | | | | | | <0.4 | ug/l | TM170/PM14 |
| Dissolved Mercury # | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | | | | | | <0.5 | ug/l | TM170/PM14 |
| Dissolved Nickel # | 3.4 | 1.2 | 2.5 | 3.5 | 76.5 | | | | | | <0.2 | ug/l | TM170/PM14 |
| Dissolved Selenium # | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | | | | | | <1.2 | ug/l | TM170/PM14 |
| Dissolved Vanadium # | <0.6 | 1.3 | <0.6 | <0.6 | <0.6 | | | | | | <0.6 | ug/l | TM170/PM14 |
| Dissolved Zinc # | 3.8 | 7.1 | 9.9 | 7.4 | 533.1 AC | | | | | | <1.5 | ug/l | TM170/PM14 |
| Total Hardness Dissolved (as CaCO3) | 208 | 54 | 174 | 168 | - | | | | | | <1 | mg/l | TM30/PM14 |
| PAH MS | | | | | | | | | | | | | |
| Naphthalene # | <0.1 | <0.1 | <0.1 | <0.1 | - | | | | | | <0.1 | ug/l | TM4/PM30 |
| Acenaphthylene # | <0.013 | <0.013 | <0.013 | <0.013 | - | | | | | | <0.013 | ug/l | TM4/PM30 |
| Acenaphthene # | <0.013 | <0.013 | <0.013 | <0.013 | - | | | | | | <0.013 | ug/l | TM4/PM30 |
| Fluorene # | <0.014 | <0.014 | <0.014 | <0.014 | - | | | | | | <0.014 | ug/l | TM4/PM30 |
| Phenanthrene # | <0.011 | <0.011 | <0.011 | <0.011 | - | | | | | | <0.011 | ug/l | TM4/PM30 |
| Anthracene # | <0.013 | <0.013 | <0.013 | <0.013 | - | | | | | | <0.013 | ug/l | TM4/PM30 |
| Fluoranthene # | 0.016 | <0.012 | <0.012 | 0.048 | - | | | | | | <0.012 | ug/l | TM4/PM30 |
| Pyrene # | 0.022 | <0.013 | <0.013 | 0.082 | - | | | | | | <0.013 | ug/l | TM4/PM30 |
| Benzo(a)anthracene # | <0.015 | <0.015 | <0.015 | 0.023 | - | | | | | | <0.015 | ug/l | TM4/PM30 |
| Chrysene # | <0.011 | <0.011 | <0.011 | 0.032 | - | | | | | | <0.011 | ug/l | TM4/PM30 |
| Benzo(bk)fluoranthene # | <0.018 | <0.018 | <0.018 | 0.049 | - | | | | | | <0.018 | ug/l | TM4/PM30 |
| Benzo(a)pyrene # | <0.016 | <0.016 | <0.016 | 0.016 | - | | | | | | <0.016 | ug/l | TM4/PM30 |
| Indeno(123cd)pyrene # | <0.011 | <0.011 | <0.011 | <0.011 | - | | | | | | <0.011 | ug/l | TM4/PM30 |
| Dibenzo(ah)anthracene # | <0.01 | <0.01 | <0.01 | <0.01 | - | | | | | | <0.01 | ug/l | TM4/PM30 |
| Benzo(ghi)perylene # | <0.011 | <0.011 | <0.011 | <0.011 | - | | | | | | <0.011 | ug/l | TM4/PM30 |
| PAH 16 Total # | <0.195 | <0.195 | <0.195 | 0.250 | - | | | | | | <0.195 | ug/l | TM4/PM30 |
| Benzo(b)fluoranthene | <0.01 | <0.01 | <0.01 | 0.04 | - | | | | | | <0.01 | ug/l | TM4/PM30 |
| Benzo(k)fluoranthene | <0.01 | <0.01 | <0.01 | 0.01 | - | | | | | | <0.01 | ug/l | TM4/PM30 |
| PAH Surrogate % Recovery | 79 | 84 | 79 | 76 | - | | | | | | <0 | % | TM4/PM30 |
| MTBE # | <5 | <5 | <5 | <5 | - | | | | | | <5 | ug/l | TM36/PM12 |
| Benzene # | <5 | <5 | <5 | <5 | - | | | | | | <5 | ug/l | TM36/PM12 |
| Toluene # | <5 | <5 | <5 | <5 | - | | | | | | <5 | ug/l | TM36/PM12 |
| Ethylbenzene # | <5 | <5 | <5 | <5 | - | | | | | | <5 | ug/l | TM36/PM12 |
| m/p-Xylene # | <5 | <5 | <5 | <5 | - | | | | | | <5 | ug/l | TM36/PM12 |
| o-Xylene # | <5 | <5 | <5 | <5 | - | | | | | | <5 | ug/l | TM36/PM12 |

Please see attached notes for all abbreviations and acronyms

## Element Materials Technology

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin
**EMT Job No:** 21/8216

**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. | 42-46 | 47-51 | 52-56 | 57-61 | 62-64 | | | | | | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | SW2 | SW3 | SW4 | SW5 | HA08 | | | | | | | | |
| Depth | | | | | | | | | | | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V P BOD G | V P BOD G | V P BOD G | V P BOD G | V P | | | | | | | | |
| Sample Date | 26/05/2021 | 26/05/2021 | 27/05/2021 | 27/05/2021 | 27/05/2021 | | | | | | | | |
| Sample Type | Surface Water | Surface Water | Surface Water | Surface Water | Ground Water | | | | | | | | |
| Batch Number | 1 | 1 | 1 | 1 | 1 | | | | | | | | |
| Date of Receipt | 01/06/2021 | 01/06/2021 | 01/06/2021 | 01/06/2021 | 01/06/2021 | | | | | | | | |
| EPH (C8-C40) # | - | - | - | - | <30 AB | | | | | | <10 | ug/l | TM5/PM30 |
| TPH CWG | | | | | | | | | | | | | |
| **Aliphatics** | | | | | | | | | | | | | |
| >C5-C6 # | <10 | <10 | <10 | <10 | - | | | | | | <10 | ug/l | TM36/PM12 |
| >C6-C8 # | <10 | <10 | <10 | <10 | - | | | | | | <10 | ug/l | TM36/PM12 |
| >C8-C10 # | <10 | <10 | <10 | <10 | - | | | | | | <10 | ug/l | TM36/PM12 |
| >C10-C12 # | <5 | <5 | <5 | <5 | - | | | | | | <5 | ug/l | TM5/PM16/PM30 |
| >C12-C16 # | <10 | <10 | <10 | <10 | - | | | | | | <10 | ug/l | TM5/PM16/PM30 |
| >C16-C21 # | <10 | <10 | <10 | <10 | - | | | | | | <10 | ug/l | TM5/PM16/PM30 |
| >C21-C35 # | <10 | <10 | <10 | <10 | - | | | | | | <10 | ug/l | TM5/PM16/PM30 |
| Total aliphatics C5-35 # | <10 | <10 | <10 | <10 | - | | | | | | <10 | ug/l | TM5/TM36/PM12/PM16/PM30 |
| **Aromatics** | | | | | | | | | | | | | |
| >C5-EC7 # | <10 | <10 | <10 | <10 | - | | | | | | <10 | ug/l | TM36/PM12 |
| >EC7-EC8 # | <10 | <10 | <10 | <10 | - | | | | | | <10 | ug/l | TM36/PM12 |
| >EC8-EC10 # | <10 | <10 | <10 | <10 | - | | | | | | <10 | ug/l | TM36/PM12 |
| >EC10-EC12 # | <5 | <5 | <5 | <5 | - | | | | | | <5 | ug/l | TM5/PM16/PM30 |
| >EC12-EC16 # | <10 | <10 | <10 | <10 | - | | | | | | <10 | ug/l | TM5/PM16/PM30 |
| >EC16-EC21 # | <10 | <10 | <10 | <10 | - | | | | | | <10 | ug/l | TM5/PM16/PM30 |
| >EC21-EC35 # | <10 | <10 | <10 | <10 | - | | | | | | <10 | ug/l | TM5/PM16/PM30 |
| Total aromatics C5-35 # | <10 | <10 | <10 | <10 | - | | | | | | <10 | ug/l | TM5/TM36/PM12/PM16/PM30 |
| Total aliphatics and aromatics(C5-35) # | <10 | <10 | <10 | <10 | - | | | | | | <10 | ug/l | TM5/TM36/PM12/PM16/PM30 |
| Sulphate as SO4 # | 29.6 | 5.2 | 14.5 | 15.2 | - | | | | | | <0.5 | mg/l | TM38/PM0 |
| Free Cyanide # | <0.01 | <0.01 | <0.01 | <0.01 | - | | | | | | <0.01 | mg/l | TM89/PM0 |
| Total Cyanide # | <0.01 | <0.01 | <0.01 | <0.01 | - | | | | | | <0.01 | mg/l | TM89/PM0 |
| Hexavalent Chromium | <6 | <6 | <6 | <6 | - | | | | | | <6 | ug/l | TM38/PM0 |
| Total Dissolved Chromium III | <6 | <6 | <6 | <6 | - | | | | | | <6 | ug/l | NONE/NONE |
| Thiocyanate | <0.02 | <0.02 | <0.02 | <0.02 | - | | | | | | <0.02 | mg/l | TM107/PM0 |
| BOD (Settled) # | <1 | <1 | 1 | 2 | - | | | | | | <1 | mg/l | TM58/PM0 |
| Electrical Conductivity @25C # | 510 | 155 | 614 | 610 | - | | | | | | <2 | uS/cm | TM76/PM0 |
| pH # | 7.98 | 7.61 | 7.69 | 7.52 | - | | | | | | <0.01 | pH units | TM73/PM0 |
| Total Suspended Solids # | 22 | 55 | 14 | 725 | - | | | | | | <10 | mg/l | TM37/PM0 |

Please see attached notes for all abbreviations and acronyms



Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

**Client Name:** MCL Consulting

**Reference:** P2288

**Location:** Riverine

**Contact:** Thomas Martin

**Matrix : Liquid**

| EMT Job No. | Batch | Sample ID | Depth | EMT Sample No. | Analysis | Reason |
|---|---|---|---|---|---|---|
| 21/8216 | 1 | SW1 | | 37-41 | BOD | Sample holding time exceeded |
| 21/8216 | 1 | SW2 | | 42-46 | BOD | Sample holding time exceeded |
| 21/8216 | 1 | SW3 | | 47-51 | BOD | Sample holding time exceeded |
| 21/8216 | 1 | SW4 | | 52-56 | BOD | Sample holding time exceeded |
| 21/8216 | 1 | SW5 | | 57-61 | BOD | 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.**



Please include all sections of this report if it is reproduced

# NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

***EMT Job No.:*** 21/8216

**SOILS**

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

**WATERS**

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

**DEVIATING SAMPLES**

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

**SURROGATES**

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

**DILUTIONS**

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

**BLANKS**

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

**NOTE**

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

**REPORTS FROM THE SOUTH AFRICA LABORATORY**

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

**Measurement Uncertainty**

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

**ABBREVIATIONS and ACRONYMS USED**

| | |
|---|---|
| # | ISO17025 (UKAS Ref No. 4225) accredited - UK. |
| SA | ISO17025 (SANAS Ref No.T0729) accredited - South Africa |
| B | Indicates analyte found in associated method blank. |
| DR | Dilution required. |
| M | MCERTS accredited. |
| NA | Not applicable |
| NAD | No Asbestos Detected. |
| ND | None Detected (usually refers to VOC and/SVOC TICs). |
| NDP | No Determination Possible |
| SS | Calibrated against a single substance |
| SV | Surrogate recovery outside performance criteria. This may be due to a matrix effect. |
| W | Results expressed on as received basis. |
| + | AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page. |
| >> | Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher, this result is not accredited. |
| * | Analysis subcontracted to an Element Materials Technology approved laboratory. |
| AD | Samples are dried at 35°C ±5°C |
| CO | Suspected carry over |
| LOD/LOR | Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS |
| ME | Matrix Effect |
| NFD | No Fibres Detected |
| BS | AQC Sample |
| LB | Blank Sample |
| N | Client Sample |
| TB | Trip Blank Sample |

| | |
|---|---|
| OC | Outside Calibration Range |
| AA | x2 Dilution |
| AB | x3 Dilution |
| AC | x5 Dilution |

**EMT Job No:** 21/8216

| 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 |
|---|---|---|---|---|---|---|---|
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM30 | Water samples are extracted with solvent using a magnetic stirrer to create a vortex. | | | | |
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM30 | Water samples are extracted with solvent using a magnetic stirrer to create a vortex. | Yes | | | |
| TM5 | Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present. | PM16/PM30 | Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE/Water samples are extracted with solvent using a magnetic stirrer to create a vortex. | Yes | | | |
| TM5 | Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present. | PM30 | Water samples are extracted with solvent using a magnetic stirrer to create a vortex. | Yes | | | |
| TM5/TM36 | please refer to TM5 and TM36 for method details | PM12/PM16/PM30 | please refer to PM16/PM30 and PM12 for method details | Yes | | | |
| TM30 | Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 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 | | | | |
| TM36 | Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested. | PM12 | Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis. | Yes | | | |
| TM37 | Modified methods - TSS: USEPA 160.2 (1983), EN872:2005 and APHA SMEWW 2540D:1999 22nd Edition; VSS: USEPA 1684 (Jan 2001), USEPA 160.4 (1971) and SMEWW 2540E:1999 22nd Edition. Gravimetric determination of Total Suspended Solids (TSS) and Volatile Suspended Solids (VSS). Sample is filtered through a 1.5um pore size glass fibre filter and the resulting residue is dried and weighed at 105°C for TSS and 550°C for VSS. | PM0 | No preparation is required. | 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 | | | |

**EMT Job No:** 21/8216

| 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 |
|---|---|---|---|---|---|---|---|
| TM58 | APHA SMEWW 5210B:1999 22nd Edition. Comparible with ISO 5815:1989. Measurement of Biochemical Oxygen Demand. When cBOD (Carbonaceous BOD) is requested a nitrification inhibitor is added which prevents the oxidation of reduced forms of nitrogen, such as am | 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 | | | |
| TM76 | Modified US EPA method 120.1 (1982). Determination of Specific Conductance by Metrohm automated probe analyser. | PM0 | No preparation is required. | Yes | | | |
| TM89 | Modified USEPA method OIA-1667 (1999). Determination of cyanide by Flow Injection Analyser. Where WAD cyanides are required a Ligand displacement step is carried out before analysis. | PM0 | No preparation is required. | Yes | | | |
| TM107 | Determination of Sulphide/Thiocyanate by Skalar Continuous Flow Analyser | PM0 | No preparation is required. | | | | |
| TM170 | Determination of Trace Metals by ICP-MS (Inductively Coupled Plasma – Mass Spectrometry): Modified USEPA Method 200.8, Rev. 5.4, 1994; Modified EPA Method 6020A, Rev.1, Feb 2007; Modified BS EN ISO 17294-2:2016 | 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 | | | |
| NONE | No Method Code | NONE | No Method Code | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

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Duncrue Street
Belfast
Northern Ireland
BT3 9LA

| | |
|---|---|
| **Attention :** | Thomas Martin |
| **Date :** | 12th August, 2021 |
| **Your reference :** | P2288 |
| **Our reference :** | Test Report 21/11994 Batch 1 |
| **Location :** | Riverine |
| **Date samples received :** | 6th August, 2021 |
| **Status :** | Final Report |
| **Issue :** | 1 |

One sample was received for analysis on 6th August, 2021 and was 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**

Please include all sections of this report if it is reproduced

Element Materials Technology Environmental UK Limited
Registered in England and Wales
Registered Office: 10 Lower Grosvenor Place, London, SW1W 0EN
Company Registration No: 11371415

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin
**EMT Job No:** 21/11994

**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.** | 1-4 | | | | | | | | | | Please see attached notes for all abbreviations and acronyms | | |
| **Sample ID** | CGBH(S) | | | | | | | | | | | | |
| **Depth** | | | | | | | | | | | | | |
| **COC No / misc** | | | | | | | | | | | | | |
| **Containers** | V P G | | | | | | | | | | | | |
| **Sample Date** | 04/08/2021 | | | | | | | | | | | | |
| **Sample Type** | Ground Water | | | | | | | | | | | | |
| **Batch Number** | 1 | | | | | | | | | | LOD/LOR | Units | Method No. |
| **Date of Receipt** | 06/08/2021 | | | | | | | | | | | | |
| Dissolved Arsenic # | <2.5 | | | | | | | | | | <2.5 | ug/l | TM30/PM14 |
| Dissolved Barium # | 128 | | | | | | | | | | <3 | ug/l | TM30/PM14 |
| Dissolved Beryllium | <0.5 | | | | | | | | | | <0.5 | ug/l | TM30/PM14 |
| Dissolved Boron | 46 | | | | | | | | | | <12 | ug/l | TM30/PM14 |
| Dissolved Cadmium # | <0.5 | | | | | | | | | | <0.5 | ug/l | TM30/PM14 |
| Total Dissolved Chromium # | <1.5 | | | | | | | | | | <1.5 | ug/l | TM30/PM14 |
| Dissolved Copper # | <7 | | | | | | | | | | <7 | ug/l | TM30/PM14 |
| Dissolved Lead # | <5 | | | | | | | | | | <5 | ug/l | TM30/PM14 |
| Dissolved Mercury # | <1 | | | | | | | | | | <1 | ug/l | TM30/PM14 |
| Dissolved Nickel # | <2 | | | | | | | | | | <2 | ug/l | TM30/PM14 |
| Dissolved Selenium # | <3 | | | | | | | | | | <3 | ug/l | TM30/PM14 |
| Dissolved Vanadium # | <1.5 | | | | | | | | | | <1.5 | ug/l | TM30/PM14 |
| Dissolved Zinc # | 8 | | | | | | | | | | <3 | ug/l | TM30/PM14 |
| Total Hardness Dissolved (as CaCO3) | 251 | | | | | | | | | | <1 | mg/l | TM30/PM14 |
| | | | | | | | | | | | | | |
| PAH MS | | | | | | | | | | | | | |
| Naphthalene # | <0.1 | | | | | | | | | | <0.1 | ug/l | TM4/PM30 |
| Acenaphthylene # | <0.013 | | | | | | | | | | <0.013 | ug/l | TM4/PM30 |
| Acenaphthene # | <0.013 | | | | | | | | | | <0.013 | ug/l | TM4/PM30 |
| Fluorene # | <0.014 | | | | | | | | | | <0.014 | ug/l | TM4/PM30 |
| Phenanthrene # | <0.011 | | | | | | | | | | <0.011 | ug/l | TM4/PM30 |
| Anthracene # | <0.013 | | | | | | | | | | <0.013 | ug/l | TM4/PM30 |
| Fluoranthene # | <0.012 | | | | | | | | | | <0.012 | ug/l | TM4/PM30 |
| Pyrene # | <0.013 | | | | | | | | | | <0.013 | ug/l | TM4/PM30 |
| Benzo(a)anthracene # | <0.015 | | | | | | | | | | <0.015 | ug/l | TM4/PM30 |
| Chrysene # | <0.011 | | | | | | | | | | <0.011 | ug/l | TM4/PM30 |
| Benzo(bk)fluoranthene # | <0.018 | | | | | | | | | | <0.018 | ug/l | TM4/PM30 |
| Benzo(a)pyrene # | <0.016 | | | | | | | | | | <0.016 | ug/l | TM4/PM30 |
| Indeno(123cd)pyrene # | <0.011 | | | | | | | | | | <0.011 | ug/l | TM4/PM30 |
| Dibenzo(ah)anthracene # | <0.01 | | | | | | | | | | <0.01 | ug/l | TM4/PM30 |
| Benzo(ghi)perylene # | <0.011 | | | | | | | | | | <0.011 | ug/l | TM4/PM30 |
| PAH 16 Total # | <0.195 | | | | | | | | | | <0.195 | ug/l | TM4/PM30 |
| Benzo(b)fluoranthene | <0.01 | | | | | | | | | | <0.01 | ug/l | TM4/PM30 |
| Benzo(k)fluoranthene | <0.01 | | | | | | | | | | <0.01 | ug/l | TM4/PM30 |
| PAH Surrogate % Recovery | 82 | | | | | | | | | | <0 | % | TM4/PM30 |
| | | | | | | | | | | | | | |
| MTBE # | <5 | | | | | | | | | | <5 | ug/l | TM36/PM12 |
| Benzene # | <5 | | | | | | | | | | <5 | ug/l | TM36/PM12 |
| Toluene # | <5 | | | | | | | | | | <5 | ug/l | TM36/PM12 |
| Ethylbenzene # | <5 | | | | | | | | | | <5 | ug/l | TM36/PM12 |
| m/p-Xylene # | <5 | | | | | | | | | | <5 | ug/l | TM36/PM12 |
| o-Xylene # | <5 | | | | | | | | | | <5 | ug/l | TM36/PM12 |

## Element Materials Technology

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin
**EMT Job No:** 21/11994

**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. | 1-4 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | CGBH(S) | | | | | | | | | | | | |
| Depth | | | | | | | | | | | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V P G | | | | | | | | | | | | |
| Sample Date | 04/08/2021 | | | | | | | | | | | | |
| Sample Type | Ground Water | | | | | | | | | | | | |
| Batch Number | 1 | | | | | | | | | | | | |
| Date of Receipt | 06/08/2021 | | | | | | | | | | | | |

Please see attached notes for all abbreviations and acronyms

| | | | | | | | | | | | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TPH CWG | | | | | | | | | | | | | |
| **Aliphatics** | | | | | | | | | | | | | |
| >C5-C6 # | <10 | | | | | | | | | | <10 | ug/l | TM36/PM12 |
| >C6-C8 # | <10 | | | | | | | | | | <10 | ug/l | TM36/PM12 |
| >C8-C10 # | <10 | | | | | | | | | | <10 | ug/l | TM36/PM12 |
| >C10-C12 # | <5 | | | | | | | | | | <5 | ug/l | TM5/PM16/PM30 |
| >C12-C16 # | <10 | | | | | | | | | | <10 | ug/l | TM5/PM16/PM30 |
| >C16-C21 # | <10 | | | | | | | | | | <10 | ug/l | TM5/PM16/PM30 |
| >C21-C35 # | <10 | | | | | | | | | | <10 | ug/l | TM5/PM16/PM30 |
| Total aliphatics C5-35 # | <10 | | | | | | | | | | <10 | ug/l | TM5/TM36/PM12/PM16/PM30 |
| **Aromatics** | | | | | | | | | | | | | |
| >C5-EC7 # | <10 | | | | | | | | | | <10 | ug/l | TM36/PM12 |
| >EC7-EC8 # | <10 | | | | | | | | | | <10 | ug/l | TM36/PM12 |
| >EC8-EC10 # | <10 | | | | | | | | | | <10 | ug/l | TM36/PM12 |
| >EC10-EC12 # | <5 | | | | | | | | | | <5 | ug/l | TM5/PM16/PM30 |
| >EC12-EC16 # | <10 | | | | | | | | | | <10 | ug/l | TM5/PM16/PM30 |
| >EC16-EC21 # | <10 | | | | | | | | | | <10 | ug/l | TM5/PM16/PM30 |
| >EC21-EC35 # | <10 | | | | | | | | | | <10 | ug/l | TM5/PM16/PM30 |
| Total aromatics C5-35 # | <10 | | | | | | | | | | <10 | ug/l | TM5/TM36/PM12/PM16/PM30 |
| Total aliphatics and aromatics(C5-35) # | <10 | | | | | | | | | | <10 | ug/l | TM5/TM36/PM12/PM16/PM30 |
| Sulphate as SO4 # | 57.3 | | | | | | | | | | <0.5 | mg/l | TM38/PM0 |
| Free Cyanide # | <0.01 | | | | | | | | | | <0.01 | mg/l | TM89/PM0 |
| Total Cyanide # | <0.01 | | | | | | | | | | <0.01 | mg/l | TM89/PM0 |
| Hexavalent Chromium | <6 | | | | | | | | | | <6 | ug/l | TM38/PM0 |
| Total Dissolved Chromium III | <6 | | | | | | | | | | <6 | ug/l | TM0/PM0 |
| Thiocyanate | <0.02 | | | | | | | | | | <0.02 | mg/l | TM107/PM0 |
| Electrical Conductivity @25C # | 636 | | | | | | | | | | <2 | uS/cm | TM76/PM0 |
| pH # | 7.49 | | | | | | | | | | <0.01 | pH units | TM73/PM0 |
| Total Suspended Solids # | 1431 | | | | | | | | | | <10 | mg/l | TM37/PM0 |

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin

| EMT Job No. | Batch | Sample ID | Depth | EMT Sample No. | Analysis | Reason |
|---|---|---|---|---|---|---|
| No deviating sample report results for job 21/11994 | | | | | | |

**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.**


Please include all sections of this report if it is reproduced

# NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

***EMT Job No.:*** 21/11994

**SOILS**

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

**WATERS**

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

**DEVIATING SAMPLES**

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

**SURROGATES**

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

**DILUTIONS**

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

**BLANKS**

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

**NOTE**

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

**REPORTS FROM THE SOUTH AFRICA LABORATORY**

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

**Measurement Uncertainty**

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

**ABBREVIATIONS and ACRONYMS USED**

| | |
|---|---|
| # | ISO17025 (UKAS Ref No. 4225) accredited - UK. |
| SA | ISO17025 (SANAS Ref No.T0729) accredited - South Africa |
| B | Indicates analyte found in associated method blank. |
| DR | Dilution required. |
| M | MCERTS accredited. |
| NA | Not applicable |
| NAD | No Asbestos Detected. |
| ND | None Detected (usually refers to VOC and/SVOC TICs). |
| NDP | No Determination Possible |
| SS | Calibrated against a single substance |
| SV | Surrogate recovery outside performance criteria. This may be due to a matrix effect. |
| W | Results expressed on as received basis. |
| + | AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page. |
| >> | Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher. |
| * | Analysis subcontracted to an Element Materials Technology approved laboratory. |
| AD | Samples are dried at 35°C ±5°C |
| CO | Suspected carry over |
| LOD/LOR | Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS |
| ME | Matrix Effect |
| NFD | No Fibres Detected |
| BS | AQC Sample |
| LB | Blank Sample |
| N | Client Sample |
| TB | Trip Blank Sample |
| OC | Outside Calibration Range |

**EMT Job No:** 21/11994

| 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 |
|---|---|---|---|---|---|---|---|
| TM0 | Not available | PM0 | No preparation is required. | | | | |
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM30 | Water samples are extracted with solvent using a magnetic stirrer to create a vortex. | | | | |
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM30 | Water samples are extracted with solvent using a magnetic stirrer to create a vortex. | Yes | | | |
| TM5 | Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present. | PM16/PM30 | Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE/Water samples are extracted with solvent using a magnetic stirrer to create a vortex. | Yes | | | |
| TM5/TM36 | please refer to TM5 and TM36 for method details | PM12/PM16/PM30 | please refer to PM16/PM30 and PM12 for method details | Yes | | | |
| TM30 | Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 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 | | | | |
| 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 | | | |
| TM36 | Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested. | PM12 | Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis. | Yes | | | |
| TM37 | Modified methods - TSS: USEPA 160.2 (1985), EN872:2005 and APHA SMEWW 2540D:1999 22nd Edition; VSS: USEPA 1684 (Jan 2001), USEPA 160.4 (1971) and SMEWW 2540E:1999 22nd Edition. Gravimetric determination of Total Suspended Solids (TSS) and Volatile Suspended Solids (VSS). Sample is filtered through a 1.5um pore size glass fibre filter and the resulting residue is dried and weighed at 105°C for TSS and 550°C for VSS. | PM0 | No preparation is required. | 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: 2013I | PM0 | No preparation is required. | | | | |

**EMT Job No:** 21/11994

| 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 |
|---|---|---|---|---|---|---|---|
| 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 | | | |
| TM76 | Modified US EPA method 120.1 (1982). Determination of Specific Conductance by Metrohm automated probe analyser. | PM0 | No preparation is required. | Yes | | | |
| TM89 | Modified USEPA method OIA-1667 (1999). Determination of cyanide by Flow Injection Analyser. Where WAD cyanides are required a Ligand displacement step is carried out before analysis. | PM0 | No preparation is required. | Yes | | | |
| TM107 | Determination of Sulphide/Thiocyanate by Skalar Continuous Flow Analyser | PM0 | No preparation is required. | | | | |
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| | |
|---|---|
| **Attention :** | Thomas Martin |
| **Date :** | 14th July, 2021 |
| **Your reference :** | P2288 |
| **Our reference :** | Test Report 21/10245 Batch 1 |
| **Location :** | Riverine |
| **Date samples received :** | 6th July, 2021 |
| **Status :** | Final report |
| **Issue :** | 1 |

Five samples were received for analysis on 6th July, 2021 of which five 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:**

**Bruce Leslie**
**Project Manager**

Please include all sections of this report if it is reproduced

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin
**EMT Job No:** 21/10245

**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. | 1-5 | 6-10 | 11-15 | 16-20 | 21-25 | | | | | | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | WS15 | WS16 | WS17 | WS19 | WS20 | | | | | | | | |
| Depth | | | | | | | | | | | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V P G | V P G | V P G | V P G | V P G | | | | | | | | |
| Sample Date | 02/07/2021 10:00 | 02/07/2021 10:20 | 02/07/2021 10:40 | 02/07/2021 11:00 | 02/07/2021 11:20 | | | | | | | | |
| Sample Type | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | | | | | | | | |
| Batch Number | 1 | 1 | 1 | 1 | 1 | | | | | | | | |
| Date of Receipt | 06/07/2021 | 06/07/2021 | 06/07/2021 | 06/07/2021 | 06/07/2021 | | | | | | | | |
| Dissolved Arsenic # | 13.5 | 3.6 | 7.5 | 2.5 | 6.6 | | | | | | <0.9 | ug/l | TM170/PM14 |
| Dissolved Barium # | 489.0 | 56.3 | 242.8 | 149.1 | 227.0 | | | | | | <1.8 | ug/l | TM170/PM14 |
| Dissolved Beryllium # | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | | | | | | <0.5 | ug/l | TM170/PM14 |
| Dissolved Boron # | 212 | 18 | 117 | 24 | 300 | | | | | | <12 | ug/l | TM170/PM14 |
| Dissolved Cadmium # | <0.03 | <0.03 | <0.03 | 0.07 | <0.03 | | | | | | <0.03 | ug/l | TM170/PM14 |
| Total Dissolved Chromium # | <0.2 | <0.2 | <0.2 | 0.8 | <0.2 | | | | | | <0.2 | ug/l | TM170/PM14 |
| Dissolved Copper # | <1 | <1 | <1 | 15 | <1 | | | | | | <1 | ug/l | TM170/PM14 |
| Dissolved Lead # | <0.4 | <0.4 | <0.4 | 1.5 | <0.4 | | | | | | <0.4 | ug/l | TM170/PM14 |
| Dissolved Mercury # | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | | | | | | <0.5 | ug/l | TM170/PM14 |
| Dissolved Nickel # | 5.5 | 3.8 | 9.5 | 9.8 | 4.1 | | | | | | <0.2 | ug/l | TM170/PM14 |
| Dissolved Selenium # | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | | | | | | <1.2 | ug/l | TM170/PM14 |
| Dissolved Vanadium # | <0.6 | <0.6 | 1.3 | 1.4 | 1.6 | | | | | | <0.6 | ug/l | TM170/PM14 |
| Dissolved Zinc # | <1.5 | 6.0 | 29.6 | 18.4 | 2.7 | | | | | | <1.5 | ug/l | TM170/PM14 |
| Total Hardness Dissolved (as CaCO3) | 375 | 73 | 482 | 148 | $841_{AA}$ | | | | | | <1 | mg/l | TM30/PM14 |
| PAH MS | | | | | | | | | | | | | |
| Naphthalene # | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | | | | | | <0.1 | ug/l | TM4/PM30 |
| Acenaphthylene # | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | | | | | | <0.013 | ug/l | TM4/PM30 |
| Acenaphthene # | <0.013 | 0.078 | 0.041 | <0.013 | 0.028 | | | | | | <0.013 | ug/l | TM4/PM30 |
| Fluorene # | <0.014 | 0.037 | 0.028 | <0.014 | 0.014 | | | | | | <0.014 | ug/l | TM4/PM30 |
| Phenanthrene # | <0.011 | 0.037 | 0.168 | <0.011 | 0.027 | | | | | | <0.011 | ug/l | TM4/PM30 |
| Anthracene # | <0.013 | <0.013 | 0.032 | <0.013 | <0.013 | | | | | | <0.013 | ug/l | TM4/PM30 |
| Fluoranthene # | <0.012 | 0.024 | 0.280 | <0.012 | 0.111 | | | | | | <0.012 | ug/l | TM4/PM30 |
| Pyrene # | <0.013 | 0.018 | 0.231 | <0.013 | 0.097 | | | | | | <0.013 | ug/l | TM4/PM30 |
| Benzo(a)anthracene # | <0.015 | <0.015 | 0.114 | <0.015 | 0.032 | | | | | | <0.015 | ug/l | TM4/PM30 |
| Chrysene # | <0.011 | <0.011 | 0.122 | <0.011 | 0.027 | | | | | | <0.011 | ug/l | TM4/PM30 |
| Benzo(bk)fluoranthene # | <0.018 | <0.018 | 0.185 | <0.018 | 0.036 | | | | | | <0.018 | ug/l | TM4/PM30 |
| Benzo(a)pyrene # | <0.016 | <0.016 | 0.100 | <0.016 | 0.019 | | | | | | <0.016 | ug/l | TM4/PM30 |
| Indeno(123cd)pyrene # | <0.011 | <0.011 | 0.055 | <0.011 | <0.011 | | | | | | <0.011 | ug/l | TM4/PM30 |
| Dibenzo(ah)anthracene # | <0.01 | <0.01 | 0.01 | <0.01 | <0.01 | | | | | | <0.01 | ug/l | TM4/PM30 |
| Benzo(ghi)perylene # | <0.011 | <0.011 | 0.045 | <0.011 | <0.011 | | | | | | <0.011 | ug/l | TM4/PM30 |
| PAH 16 Total # | <0.195 | <0.195 | 1.411 | <0.195 | 0.391 | | | | | | <0.195 | ug/l | TM4/PM30 |
| Benzo(b)fluoranthene | <0.01 | <0.01 | 0.13 | <0.01 | 0.03 | | | | | | <0.01 | ug/l | TM4/PM30 |
| Benzo(k)fluoranthene | <0.01 | <0.01 | 0.05 | <0.01 | 0.01 | | | | | | <0.01 | ug/l | TM4/PM30 |
| PAH Surrogate % Recovery | 80 | 83 | 87 | 84 | 86 | | | | | | <0 | % | TM4/PM30 |
| MTBE # | <5 | <5 | <5 | <5 | <5 | | | | | | <5 | ug/l | TM36/PM12 |
| Benzene # | <5 | <5 | <5 | <5 | <5 | | | | | | <5 | ug/l | TM36/PM12 |
| Toluene # | <5 | <5 | <5 | <5 | <5 | | | | | | <5 | ug/l | TM36/PM12 |
| Ethylbenzene # | <5 | <5 | <5 | <5 | <5 | | | | | | <5 | ug/l | TM36/PM12 |
| m/p-Xylene # | <5 | <5 | <5 | <5 | <5 | | | | | | <5 | ug/l | TM36/PM12 |
| o-Xylene # | <5 | <5 | <5 | <5 | <5 | | | | | | <5 | ug/l | TM36/PM12 |



Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin
**EMT Job No:** 21/10245

**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. | 1-5 | 6-10 | 11-15 | 16-20 | 21-25 | | | | | | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | WS15 | WS16 | WS17 | WS19 | WS20 | | | | | | | | |
| Depth | | | | | | | | | | | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V P G | V P G | V P G | V P G | V P G | | | | | | | | |
| Sample Date | 02/07/2021 10:00 | 02/07/2021 10:20 | 02/07/2021 10:40 | 02/07/2021 11:00 | 02/07/2021 11:20 | | | | | | | | |
| Sample Type | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | | | | | | | | |
| Batch Number | 1 | 1 | 1 | 1 | 1 | | | | | | | | |
| Date of Receipt | 06/07/2021 | 06/07/2021 | 06/07/2021 | 06/07/2021 | 06/07/2021 | | | | | | | | |
| TPH CWG | | | | | | | | | | | | | |
| **Aliphatics** | | | | | | | | | | | | | |
| >C5-C6 # | <10 | <10 | <10 | <10 | <10 | | | | | | <10 | ug/l | TM36/PM12 |
| >C6-C8 # | <10 | <10 | <10 | <10 | <10 | | | | | | <10 | ug/l | TM36/PM12 |
| >C8-C10 # | <10 | <10 | <10 | <10 | <10 | | | | | | <10 | ug/l | TM36/PM12 |
| >C10-C12 # | <5 | <5 | <5 | <5 | <5 | | | | | | <5 | ug/l | TM5/PM16/PM30 |
| >C12-C16 # | <10 | <10 | <10 | <10 | <10 | | | | | | <10 | ug/l | TM5/PM16/PM30 |
| >C16-C21 # | <10 | <10 | <10 | <10 | <10 | | | | | | <10 | ug/l | TM5/PM16/PM30 |
| >C21-C35 # | <10 | <10 | <10 | <10 | <10 | | | | | | <10 | ug/l | TM5/PM16/PM30 |
| Total aliphatics C5-35 # | <10 | <10 | <10 | <10 | <10 | | | | | | <10 | ug/l | TM5/TM36/PM12/PM16/PM30 |
| **Aromatics** | | | | | | | | | | | | | |
| >C5-EC7 # | <10 | <10 | <10 | <10 | <10 | | | | | | <10 | ug/l | TM36/PM12 |
| >EC7-EC8 # | <10 | <10 | <10 | <10 | <10 | | | | | | <10 | ug/l | TM36/PM12 |
| >EC8-EC10 # | <10 | <10 | <10 | <10 | <10 | | | | | | <10 | ug/l | TM36/PM12 |
| >EC10-EC12 # | <5 | <5 | <5 | <5 | <5 | | | | | | <5 | ug/l | TM5/PM16/PM30 |
| >EC12-EC16 # | <10 | <10 | <10 | <10 | <10 | | | | | | <10 | ug/l | TM5/PM16/PM30 |
| >EC16-EC21 # | <10 | <10 | <10 | <10 | <10 | | | | | | <10 | ug/l | TM5/PM16/PM30 |
| >EC21-EC35 # | <10 | <10 | <10 | <10 | <10 | | | | | | <10 | ug/l | TM5/PM16/PM30 |
| Total aromatics C5-35 # | <10 | <10 | <10 | <10 | <10 | | | | | | <10 | ug/l | TM5/TM36/PM12/PM16/PM30 |
| Total aliphatics and aromatics(C5-35) # | <10 | <10 | <10 | <10 | <10 | | | | | | <10 | ug/l | TM5/TM36/PM12/PM16/PM30 |
| Sulphate as SO4 # | 10.7 | 6.6 | 20.9 | 15.7 | 73.3 | | | | | | <0.5 | mg/l | TM38/PM0 |
| Free Cyanide # | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | | | | | <0.01 | mg/l | TM89/PM0 |
| Total Cyanide # | <0.01 | <0.01 | 0.01 | 0.02 | <0.01 | | | | | | <0.01 | mg/l | TM89/PM0 |
| Hexavalent Chromium | <6 | <6 | <6 | <6 | <6 | | | | | | <6 | ug/l | TM38/PM0 |
| Total Dissolved Chromium III | <6 | <6 | <6 | <6 | <6 | | | | | | <6 | ug/l | NONE/NONE |
| Thiocyanate | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | | | | | | <0.02 | mg/l | TM107/PM0 |
| Electrical Conductivity @25C # | 792 | 212 | 843 | 480 | 1339 | | | | | | <2 | uS/cm | TM76/PM0 |
| pH # | 6.90 | 6.37 | 6.94 | 6.37 | 7.11 | | | | | | <0.01 | pH units | TM73/PM0 |
| Total Suspended Solids # | 10508 | 15064 | 10884 | 1467 | 9294 | | | | | | <10 | mg/l | TM37/PM0 |

Please see attached notes for all abbreviations and acronyms



Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin

| EMT Job No. | Batch | Sample ID | Depth | EMT Sample No. | Analysis | Reason |
|---|---|---|---|---|---|---|
| No deviating sample report results for job 21/10245 | | | | | | |

**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.:*** 21/10245

**SOILS**

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

**WATERS**

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

**DEVIATING SAMPLES**

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

**SURROGATES**

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

**DILUTIONS**

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

**BLANKS**

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

**NOTE**

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

**REPORTS FROM THE SOUTH AFRICA LABORATORY**

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

**Measurement Uncertainty**

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

**ABBREVIATIONS and ACRONYMS USED**

| | |
|---|---|
| # | ISO17025 (UKAS Ref No. 4225) accredited - UK. |
| SA | ISO17025 (SANAS Ref No.T0729) accredited - South Africa |
| B | Indicates analyte found in associated method blank. |
| DR | Dilution required. |
| M | MCERTS accredited. |
| NA | Not applicable |
| NAD | No Asbestos Detected. |
| ND | None Detected (usually refers to VOC and/SVOC TICs). |
| NDP | No Determination Possible |
| SS | Calibrated against a single substance |
| SV | Surrogate recovery outside performance criteria. This may be due to a matrix effect. |
| W | Results expressed on as received basis. |
| + | AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page. |
| >> | Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher, this result is not accredited. |
| * | Analysis subcontracted to an Element Materials Technology approved laboratory. |
| AD | Samples are dried at 35°C ±5°C |
| CO | Suspected carry over |
| LOD/LOR | Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS |
| ME | Matrix Effect |
| NFD | No Fibres Detected |
| BS | AQC Sample |
| LB | Blank Sample |
| N | Client Sample |
| TB | Trip Blank Sample |
| OC | Outside Calibration Range |
| AA | x5 Dilution |

**EMT Job No:** 21/10245

| 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 |
|---|---|---|---|---|---|---|---|
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM30 | Water samples are extracted with solvent using a magnetic stirrer to create a vortex. | | | | |
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM30 | Water samples are extracted with solvent using a magnetic stirrer to create a vortex. | Yes | | | |
| TM5 | Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present. | PM16/PM30 | Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE/Water samples are extracted with solvent using a magnetic stirrer to create a vortex. | Yes | | | |
| TM5/TM36 | please refer to TM5 and TM36 for method details | PM12/PM16/PM30 | please refer to PM16/PM30 and PM12 for method details | Yes | | | |
| TM30 | Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 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 | | | | |
| TM36 | Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested. | PM12 | Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis. | Yes | | | |
| TM37 | Modified methods - TSS: USEPA 160.2 (1985), EN872:2005 and APHA SMEWW 2540D:1999 22nd Edition; VSS: USEPA 1684 (Jan 2001), USEPA 160.4 (1971) and SMEWW 2540E:1999 22nd Edition. Gravimetric determination of Total Suspended Solids (TSS) and Volatile Suspended Solids (VSS). Sample is filtered through a 1.5um pore size glass fibre filter and the resulting residue is dried and weighed at 105°C for TSS and 550°C for VSS. | PM0 | No preparation is required. | 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 | | | |

**EMT Job No:** 21/10245

| 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 |
|---|---|---|---|---|---|---|---|
| TM76 | Modified US EPA method 120.1 (1982). Determination of Specific Conductance by Metrohm automated probe analyser. | PM0 | No preparation is required. | Yes | | | |
| TM89 | Modified USEPA method OIA-1667 (1999). Determination of cyanide by Flow Injection Analyser. Where WAD cyanides are required a Ligand displacement step is carried out before analysis. | PM0 | No preparation is required. | Yes | | | |
| TM107 | Determination of Sulphide/Thiocyanate by Skalar Continuous Flow Analyser | PM0 | No preparation is required. | | | | |
| TM170 | Determination of Trace Metals by ICP-MS (Inductively Coupled Plasma – Mass Spectrometry): Modified USEPA Method 200.8, Rev. 5.4, 1994; Modified EPA Method 6020A, Rev.1, Feb 2007; Modified BS EN ISO 17294-2:2016 | 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 | | | |
| NONE | No Method Code | NONE | No Method Code | | | | |
| | | | | | | | |
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| | |
|---|---|
| **Attention :** | Thomas Martin |
| **Date :** | 6th July, 2021 |
| **Your reference :** | P2288 |
| **Our reference :** | Test Report 21/9738 Batch 1 |
| **Location :** | Riverine |
| **Date samples received :** | 28th June, 2021 |
| **Status :** | Final report |
| **Issue :** | 1 |

Ten samples were received for analysis on 28th June, 2021 of which ten were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

**Authorised By:**

**Phil Sommerton BSc**
**Senior Project Manager**

Please include all sections of this report if it is reproduced

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin
**EMT Job No:** 21/9738

**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. | 1-8 | 9-16 | 17-23 | 24-31 | 32-39 | 40-47 | 48-55 | 56-63 | 64-71 | 72-79 | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | WSC01 | WSC02 | WSC03 | WSC04 | WSC05 | WSC06 | WSC07 | WSC08 | WSC09 | WSC10 | | | |
| Depth | | | | | | | | | | | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V H HNUF P BOD G | V H HNUF P BOD G | V H HNUF P BOD G | V H HN P BOD G | V H HN P BOD G | V H HNUF P BOD G | V H HN P BOD G | V H HNUF P BOD G | V H HNUF P BOD G | V H HNUF P BOD G | | | |
| Sample Date | 24/06/2021 | 24/06/2021 | 24/06/2021 | 24/06/2021 | 24/06/2021 | 24/06/2021 | 24/06/2021 | 24/06/2021 | 24/06/2021 | 24/06/2021 | | | |
| Sample Type | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | | | |
| Batch Number | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| Date of Receipt | 28/06/2021 | 28/06/2021 | 28/06/2021 | 28/06/2021 | 28/06/2021 | 28/06/2021 | 28/06/2021 | 28/06/2021 | 28/06/2021 | 28/06/2021 | | | |
| Dissolved Arsenic # | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | ug/l | TM30/PM14 |
| Dissolved Barium # | 59 | 46 | 8 | 47 | 44 | 109 | 44 | 37 | 10 | 12 | <3 | ug/l | TM30/PM14 |
| Dissolved Beryllium | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | ug/l | TM30/PM14 |
| Dissolved Boron | 55 | 15 | <12 | <12 | <12 | 22 | <12 | <12 | <12 | <12 | <12 | ug/l | TM30/PM14 |
| Dissolved Cadmium # | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | ug/l | TM30/PM14 |
| Total Dissolved Chromium # | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | ug/l | TM30/PM14 |
| Dissolved Copper # | <7 | <7 | <7 | <7 | <7 | <7 | <7 | <7 | <7 | <7 | <7 | ug/l | TM30/PM14 |
| Dissolved Lead # | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | ug/l | TM30/PM14 |
| Dissolved Mercury # | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | ug/l | TM30/PM14 |
| Dissolved Nickel # | <2 | 4 | <2 | <2 | <2 | <2 | <2 | <2 | <2 | <2 | <2 | ug/l | TM30/PM14 |
| Dissolved Selenium # | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | ug/l | TM30/PM14 |
| Dissolved Vanadium # | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | ug/l | TM30/PM14 |
| Dissolved Zinc # | <3 | <3 | 3 | 69 | 5 | <3 | <3 | 3 | 43 | 38 | <3 | ug/l | TM30/PM14 |
| Total Hardness Dissolved (as CaCO3) | 164 | 170 | 31 | 89 | 93 | 361 | 88 | 95 | 84 | 85 | <1 | mg/l | TM30/PM14 |
| | | | | | | | | | | | | | |
| PAH MS | | | | | | | | | | | | | |
| Naphthalene # | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 0.1 | 0.1 | <0.1 | ug/l | TM4/PM30 |
| Acenaphthylene # | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | ug/l | TM4/PM30 |
| Acenaphthene # | 0.018 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | ug/l | TM4/PM30 |
| Fluorene # | 0.051 | <0.014 | <0.014 | <0.014 | <0.014 | <0.014 | <0.014 | <0.014 | 0.018 | 0.017 | <0.014 | ug/l | TM4/PM30 |
| Phenanthrene # | 0.175 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | 0.018 | 0.016 | <0.011 | ug/l | TM4/PM30 |
| Anthracene # | 0.029 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | ug/l | TM4/PM30 |
| Fluoranthene # | 0.410 | 0.018 | <0.012 | <0.012 | <0.012 | <0.012 | <0.012 | <0.012 | <0.012 | <0.012 | <0.012 | ug/l | TM4/PM30 |
| Pyrene # | 0.649 | 0.018 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | 0.019 | 0.021 | <0.013 | ug/l | TM4/PM30 |
| Benzo(a)anthracene # | 0.115 | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 | ug/l | TM4/PM30 |
| Chrysene # | 0.225 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | ug/l | TM4/PM30 |
| Benzo(bk)fluoranthene # | 0.266 | <0.018 | <0.018 | <0.018 | <0.018 | <0.018 | <0.018 | <0.018 | <0.018 | <0.018 | <0.018 | ug/l | TM4/PM30 |
| Benzo(a)pyrene # | 0.130 | <0.016 | <0.016 | <0.016 | <0.016 | <0.016 | <0.016 | <0.016 | <0.016 | <0.016 | <0.016 | ug/l | TM4/PM30 |
| Indeno(123cd)pyrene # | 0.069 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | ug/l | TM4/PM30 |
| Dibenzo(ah)anthracene # | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | ug/l | TM4/PM30 |
| Benzo(ghi)perylene # | 0.126 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | ug/l | TM4/PM30 |
| PAH 16 Total # | 2.273 | <0.195 | <0.195 | <0.195 | <0.195 | <0.195 | <0.195 | <0.195 | <0.195 | <0.195 | <0.195 | ug/l | TM4/PM30 |
| Benzo(b)fluoranthene | 0.19 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | ug/l | TM4/PM30 |
| Benzo(k)fluoranthene | 0.07 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | ug/l | TM4/PM30 |
| PAH Surrogate % Recovery | 70 | 58 SV | 81 | 86 | 79 | 71 | 76 | 79 | 80 | 79 | <0 | % | TM4/PM30 |
| | | | | | | | | | | | | | |
| EPH (C8-C40) # | 3230 | <10 | 200 AA | <10 | <10 | 110 | <10 | <10 | <10 | <10 | <10 | ug/l | TM5/PM30 |
| | | | | | | | | | | | | | |
| Sulphate as SO4 # | 19.9 | 23.1 | 2.3 | 9.7 | 18.3 | <0.5 | 9.8 | 12.0 | 34.1 | 34.6 | <0.5 | mg/l | TM38/PM0 |
| Chloride # | 38.4 | 23.5 | 20.4 | 15.7 | 23.2 | 10.8 | 16.1 | 17.4 | 195.2 | 194.2 | <0.3 | mg/l | TM38/PM0 |
| Nitrate as NO3 # | <0.2 | 17.3 | <0.2 | 4.2 | 6.3 | <0.2 | 3.9 | 3.3 | <0.2 | <0.2 | <0.2 | mg/l | TM38/PM0 |
| | | | | | | | | | | | | | |
| Free Cyanide # | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | mg/l | TM89/PM0 |
| Total Cyanide # | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.02 | 0.02 | <0.01 | mg/l | TM89/PM0 |

Please see attached notes for all abbreviations and acronyms



Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

## Element Materials Technology

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin
**EMT Job No:** 21/9738

**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. | 1-8 | 9-16 | 17-23 | 24-31 | 32-39 | 40-47 | 48-55 | 56-63 | 64-71 | 72-79 | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | WSC01 | WSC02 | WSC03 | WSC04 | WSC05 | WSC06 | WSC07 | WSC08 | WSC09 | WSC10 | | | |
| Depth | | | | | | | | | | | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V H HNUF P BOD G | V H HNUF P BOD G | V H HNUF P BOD G | V H HN P BOD G | V H HN P BOD G | V H HNUF P BOD G | V H HN P BOD G | V H HNUF P BOD G | V H HNUF P BOD G | V H HNUF P BOD G | | | |
| Sample Date | 24/06/2021 | 24/06/2021 | 24/06/2021 | 24/06/2021 | 24/06/2021 | 24/06/2021 | 24/06/2021 | 24/06/2021 | 24/06/2021 | 24/06/2021 | | | |
| Sample Type | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | | | |
| Batch Number | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| Date of Receipt | 28/06/2021 | 28/06/2021 | 28/06/2021 | 28/06/2021 | 28/06/2021 | 28/06/2021 | 28/06/2021 | 28/06/2021 | 28/06/2021 | 28/06/2021 | | | |
| Ammoniacal Nitrogen as N # | 1.19 | 0.75 | 0.06 | 0.05 | 0.05 | 0.55 | 0.13 | 0.74 | 7.40 | 7.38 | <0.03 | mg/l | TM38/PM0 |
| Hexavalent Chromium | <6 | <6 | <6 | <6 | <6 | <6 | <6 | <6 | <6 | <6 | <6 | ug/l | TM38/PM0 |
| Total Dissolved Chromium III | <6 | <6 | <6 | <6 | <6 | <6 | <6 | <6 | <6 | <6 | <6 | ug/l | TM0/PM0 |
| Thiocyanate | 0.03 | <0.02 | <0.02 | <0.02 | <0.02 | 0.03 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | mg/l | TM107/PM0 |
| Electrical Conductivity @25C # | 455 | 433 | 140 | 235 | 292 | 707 | 230 | 272 | 918 | 914 | <2 | uS/cm | TM76/PM0 |
| pH # | 7.35 | 7.76 | 6.63 | 7.90 | 7.66 | 7.50 | 7.92 | 7.92 | 7.32 | 7.35 | <0.01 | pH units | TM73/PM0 |
| Total Organic Carbon # | 10 | 3 | 16 | 7 | 5 | 32 | 7 | 5 | 14 | 11 | <2 | mg/l | TM60/PM0 |
| Total Suspended Solids # | 588 | 73 | 28 | 11 | 17 | 707 | <10 | 51 | 41 | 77 | <10 | mg/l | TM37/PM0 |
| True Colour | 499 | 34 | 230 | 55 | 72 | 46 | 58 | 51 | 107 | 67 | <15 | mg/l PtCo | TM35/PM0 |

Please see attached notes for all abbreviations and acronyms

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin

| EMT Job No. | Batch | Sample ID | Depth | EMT Sample No. | Analysis | Reason |
|---|---|---|---|---|---|---|
| No deviating sample report results for job 21/9738 | | | | | | |

**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.:*** 21/9738

**SOILS**

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

**WATERS**

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

**DEVIATING SAMPLES**

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

**SURROGATES**

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

**DILUTIONS**

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

**BLANKS**

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

**NOTE**

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

**REPORTS FROM THE SOUTH AFRICA LABORATORY**

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

**Measurement Uncertainty**

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

**ABBREVIATIONS and ACRONYMS USED**

| | |
|---|---|
| # | ISO17025 (UKAS Ref No. 4225) accredited - UK. |
| SA | ISO17025 (SANAS Ref No.T0729) accredited - South Africa |
| B | Indicates analyte found in associated method blank. |
| DR | Dilution required. |
| M | MCERTS accredited. |
| NA | Not applicable |
| NAD | No Asbestos Detected. |
| ND | None Detected (usually refers to VOC and/SVOC TICs). |
| NDP | No Determination Possible |
| SS | Calibrated against a single substance |
| SV | Surrogate recovery outside performance criteria. This may be due to a matrix effect. |
| W | Results expressed on as received basis. |
| + | AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page. |
| >> | Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher, this result is not accredited. |
| * | Analysis subcontracted to an Element Materials Technology approved laboratory. |
| AD | Samples are dried at 35°C ±5°C |
| CO | Suspected carry over |
| LOD/LOR | Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS |
| ME | Matrix Effect |
| NFD | No Fibres Detected |
| BS | AQC Sample |
| LB | Blank Sample |
| N | Client Sample |
| TB | Trip Blank Sample |
| OC | Outside Calibration Range |
| AA | x2 Dilution |

**EMT Job No:** 21/9738

| 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 |
|---|---|---|---|---|---|---|---|
| TM0 | Not available | PM0 | No preparation is required. | | | | |
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM30 | Water samples are extracted with solvent using a magnetic stirrer to create a vortex. | | | | |
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM30 | Water samples are extracted with solvent using a magnetic stirrer to create a vortex. | Yes | | | |
| TM5 | Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present. | PM30 | Water samples are extracted with solvent using a magnetic stirrer to create a vortex. | Yes | | | |
| TM30 | Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 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 | | | | |
| 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 | | | |
| TM35 | True and apparent colour by Hach Lange DR3800 spectrophotometer. Apparent colour includes dissolved and suspended matter. True colour is determinined after filtration of the sample. | PM0 | No preparation is required. | | | | |
| TM37 | Modified methods - TSS: USEPA 160.2 (1985), EN872:2005 and APHA SMEWW 2540D:1999 22nd Edition; VSS: USEPA 1684 (Jan 2001), USEPA 160.4 (1971) and SMEWW 2540E:1999 22nd Edition. Gravimetric determination of Total Suspended Solids (TSS) and Volatile Suspended Solids (VSS). Sample is filtered through a 1.5um pore size glass fibre filter and the resulting residue is dried and weighed at 105°C for TSS and 550°C for VSS. | PM0 | No preparation is required. | 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 | | | |

**EMT Job No:** 21/9738

| 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 |
|---|---|---|---|---|---|---|---|
| TM60 | TC/TOC analysis of Waters by High Temperature Combustion followed by NDIR detection. Based on the following modified standard methods: USEPA 9060A (2002), APHA SMEWW 5310B:1999 22nd Edition, ASTM D 7573, and USEPA 415.1. | PM0 | No preparation is required. | 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 | | | |
| TM76 | Modified US EPA method 120.1 (1982). Determination of Specific Conductance by Metrohm automated probe analyser. | PM0 | No preparation is required. | Yes | | | |
| TM89 | Modified USEPA method OIA-1667 (1999). Determination of cyanide by Flow Injection Analyser. Where WAD cyanides are required a Ligand displacement step is carried out before analysis. | PM0 | No preparation is required. | Yes | | | |
| TM107 | Determination of Sulphide/Thiocyanate by Skalar Continuous Flow Analyser | PM0 | No preparation is required. | | | | |
| | | | | | | | |
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## Appendix 9-5

### Preliminary Risk Assessment / Preliminary Sources Study Report

**APPENDIX 9-5**

# Preliminary Risk Assessment and Preliminary Sources Study Report (Stage 1)

**Riverine Community Park**
**Lifford-Strabane**

**Client: McAdam**

**Issued: July 2021**

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# CONTENTS


1.0 INTRODUCTION (STAGE 1) 2

1.1 Report Brief 2
1.2 Methodology and Scope of Works 2

2.0 SITE LOCATION AND DESCRIPTION 4

2.1 Site Location 4

3.0 SITE HISTORY 6

3.1 Lifford Historical Review 6
3.1 Strabane Historical Review 7

4.0 SITE VISIT OBSERVATIONS 11

4.1 Lifford Side 11
4.2 Strabane Observations 17

5.0 FURTHER DATA GATHERING 28

5.1 Regulatory Searches 28
5.2 Geology 33
5.3 Hydrogeology and Hydrology 36
5.4 Protected Areas 39

6.0 PRELIMINARY ENVIRONMENTAL RISK ASSESSMENT 41

6.1 Introduction to Initial Conceptual Model 41
6.2 Screening of Sources 41
6.3 Receptors 42
6.4 Initial Conceptual Site Model 42

7.0 PRELIMINARY ASSESSMENT OF LAND QUALITY AND GEOTECHNICAL RISKS 48

8.0 SUMMARY AND RECOMMENDATIONS 54

Appendices

APPENDIX A: Utility Information from Free Providers

# 1.0 INTRODUCTION (STAGE 1)

## 1.1 Report Brief

MCL Consulting Ltd (MCL) was appointed by McAdam to undertake a Tier 1 Preliminary Risk Assessment (PRA) and Preliminary Sources Study Report (PSSR) on the lands for a proposed cross community park known as Riverine, which is straddling the River Foyle between the eastern area of Lifford Town, County Donegal, Republic of Ireland and the western area of the town of Strabane in County Tyrone, Northern Ireland.

The project will comprise the creation of new community park infrastructure in excess of twenty-three hectares either side of the border connected through the creation of a new pedestrian and cycle bridge between Lifford and Strabane. The park on the Lifford site will be a designed landscape incorporating indoor and outdoor recreational features, smaller meeting & events spaces for programmed activity, complemented by the use of the naturalised flood plain environment on the Strabane site for informal recreation and environmental education/conservation activities.

## 1.2 Methodology and Scope of Works

The objective of this PRA and PSSR is to determine the previous uses of the land under consideration or land nearby or adjacent to the site, and to identify potential contaminated ground and/or geotechnical constraints which are relevant to the suitability of the site for any redevelopment in the future. Any relevant issues identified can also be used to inform the potential site investigation requirements, development requirements and associated costs which can be used to inform the selection of the site from available options. The PRA will identify potential sources of contamination, receptors and pathways using available datasets and local knowledge. This information is used to develop an initial site conceptual model to determine the potential risk to the environment and / or human health.

The PRA has been prepared following the guidelines set out in Environment Agency *Land Contamination: Risk Management* guidance (LCRM, Published October 2020) which is the current UK technical framework, which NIEA recommend the application of. Guidelines stated in the EPA *Guidance on the Management of Contaminated Land and Groundwater at EPA Licenced Sites* have also been followed in preparing the PRA.

This report has also considered the DAERA *Environmental Advice for Planning Practice Guide Redeveloping Land Affected by Contamination A Developers Guide to Planning*

*Considerations and Environmental Responsibilities* (April 2019) which has yet to be updated to reflect the formal withdrawal of *'Model Procedures for the Management of Land Contamination – Contaminated Land Report (CLR) 11'*.

This PRA and PSSR comprised the following scope of works:

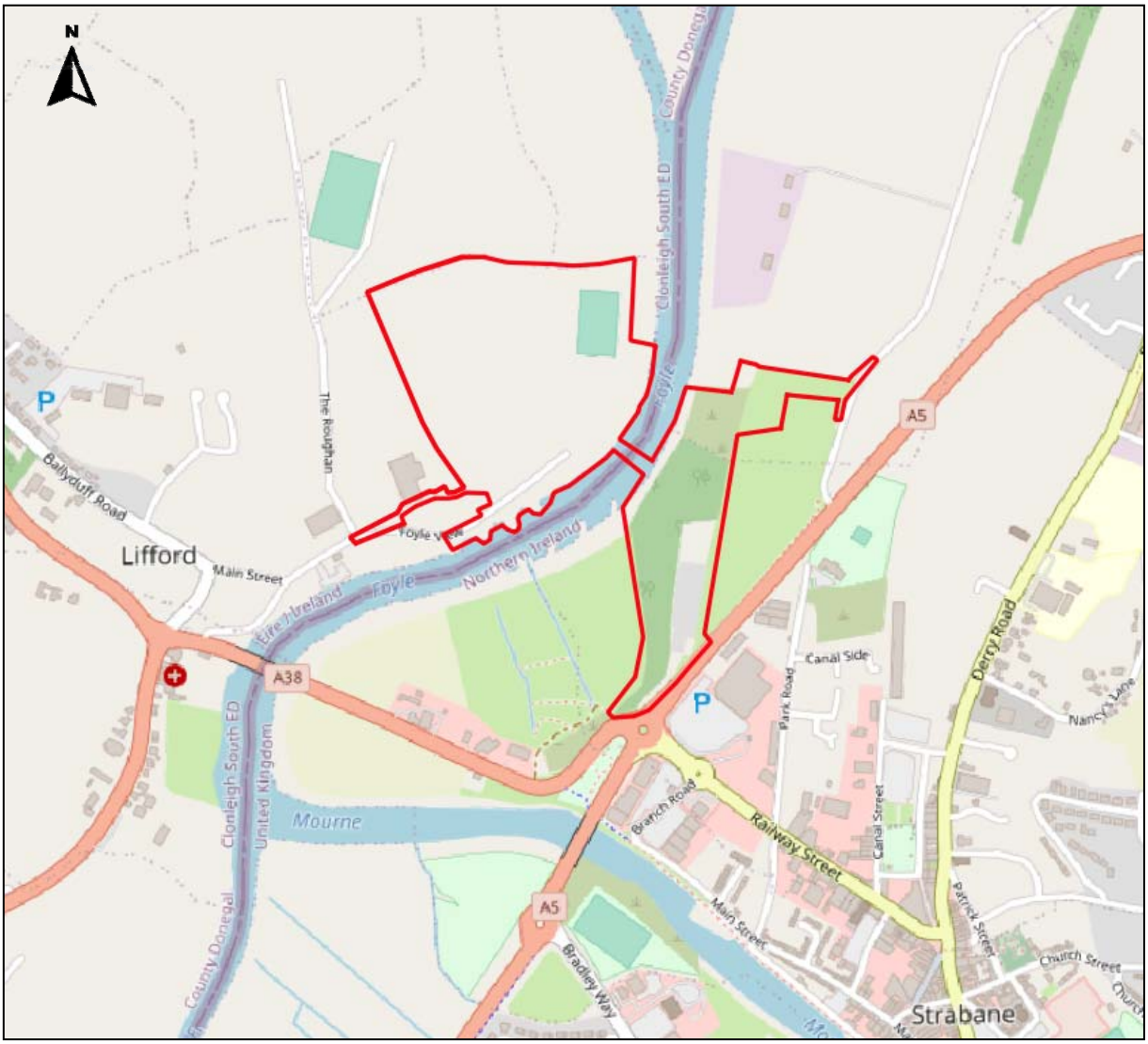
- A site walkover;
- A review of current and historical Ordnance Survey (OS) maps and google aerial photography;
- A review of the environmental setting of the site to include discussion on geology, hydrogeology, hydrology and groundwater vulnerability;
- Review of existing and proposed topography and existing buildings/structures
- Regulator searches including: NIEA Waste and Contaminated Land Database, NIEA Abstraction Licence Database and NIEA Discharge Consent Database for Northern Ireland
- Regulator searches including: GSI, OSI, EPA (Ireland),
- Development of an initial Conceptual Site Model (iCSM) in consideration to sources, pathways and receptors
- and recommendations, where necessary under LCRM guidance.

# 2.0 SITE LOCATION AND DESCRIPTION

## 2.1 Site Location

The **Lifford** site is situated to on lands to the west of Station Road in the Town of Lifford, County Donegal, (IGR 233882, 398765). The **Strabane** site is situated at Barnhill Road, in the north western area of Strabane, County Tyrone, BT82 0AN (IGR 234119, 398597). The overall site is shown on Figure 1.

**Figure 1: Site Location**




The surrounding land use is detailed in Table 1 and Table 2 below.

**Table 1: Summary of Lifford Adjacent Land Use**

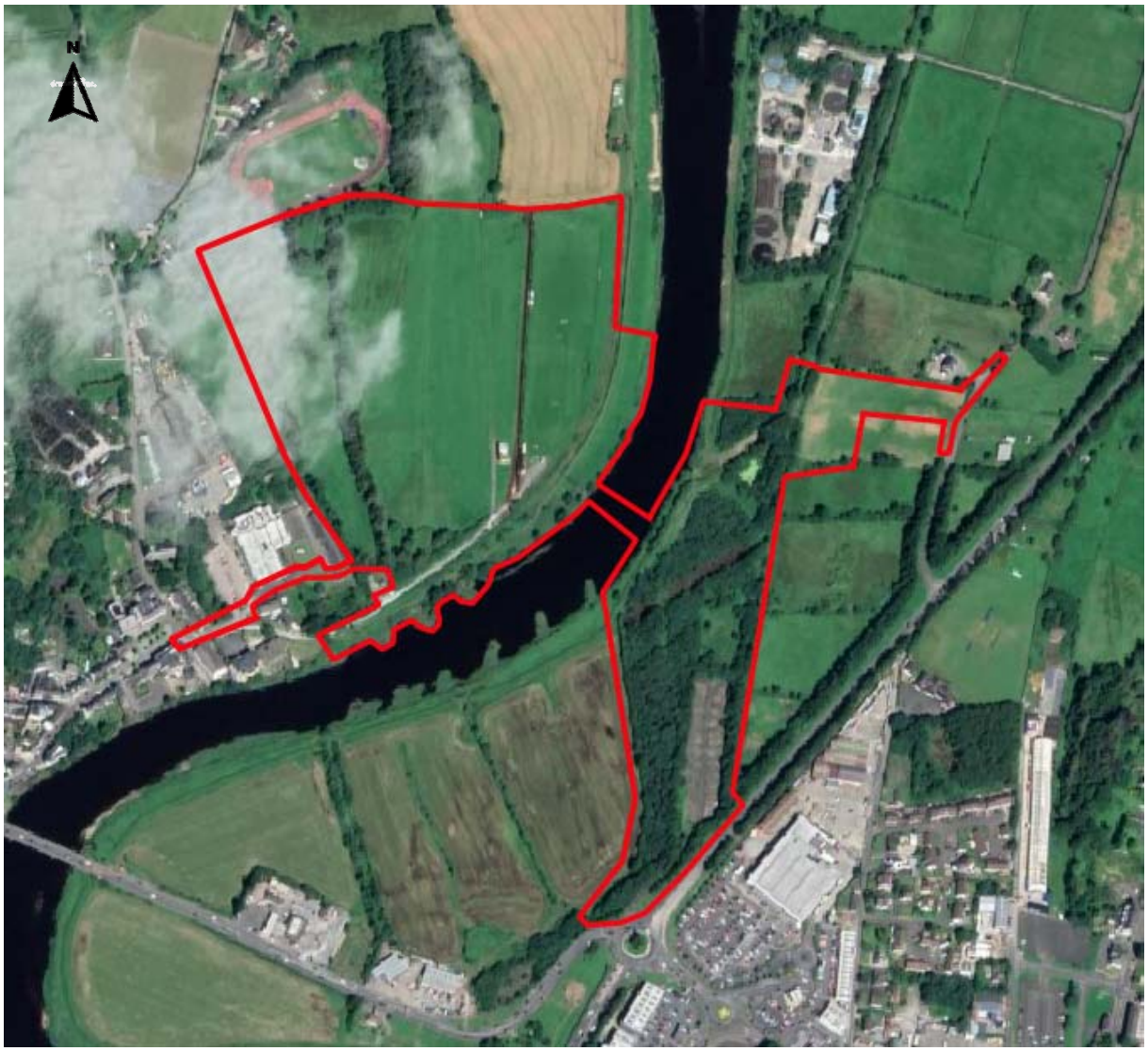
| Orientation from Site | Neighbouring Property/ Land Use beyond Site Boundaries |
|---|---|
| North | Lifford Strabane Athletics Club, crop field and wooded area |
| South | River Foyle, Strabane (NI) located across the river. |
| East | River Foyle, Strabane WwTW across the river. |
| West | Lifford Town, commercial and residential development |

**Table 2: Summary of Strabane Adjacent Land Use**

| Orientation from Site | Neighbouring Property/ Land Use beyond Site Boundaries |
|---|---|
| North | Strabane WwTW and grass fields |
| South | Commercial properties |
| East | Barnhill Road and Park Road with a mixture of grass fields and commercial and industrial land use. |
| West | River Foyle, Lifford (ROI) located across the river, and agricultural land. |

The existing site layout is shown on the Google Aerial presented as Figure 2 below. A site walkover was carried out on 5th and 13th May 2021 by MCL Consulting and is detailed in Section 3.

**Figure 2: Existing Google Aerial**

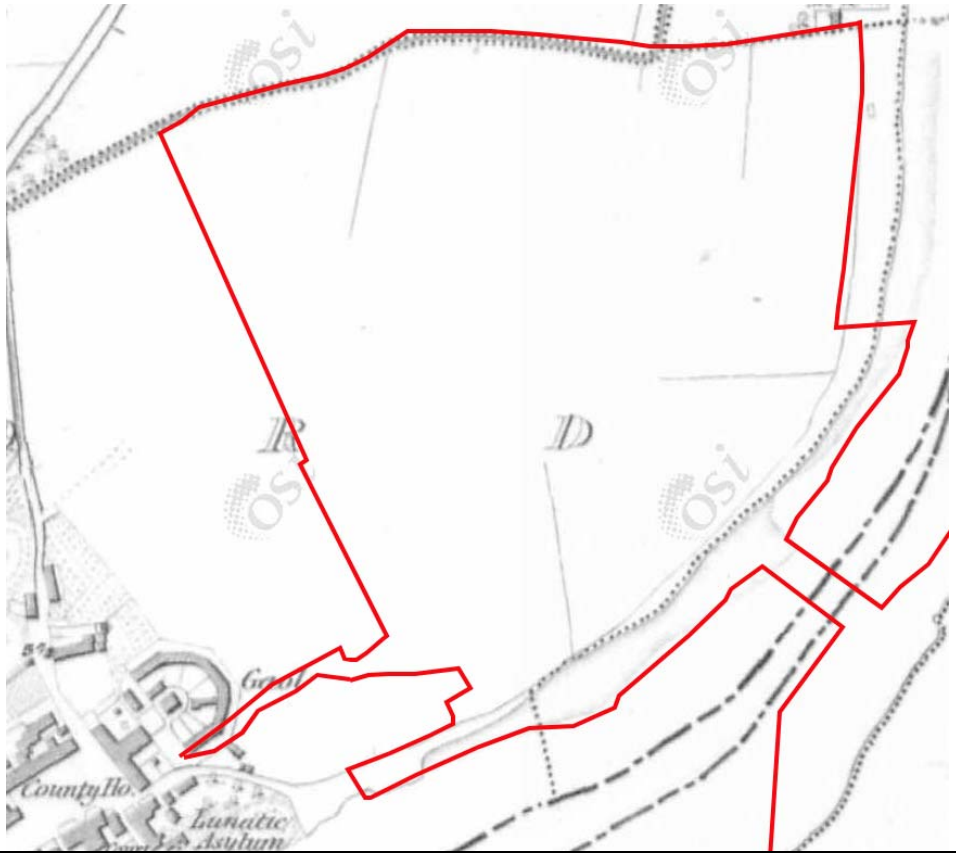


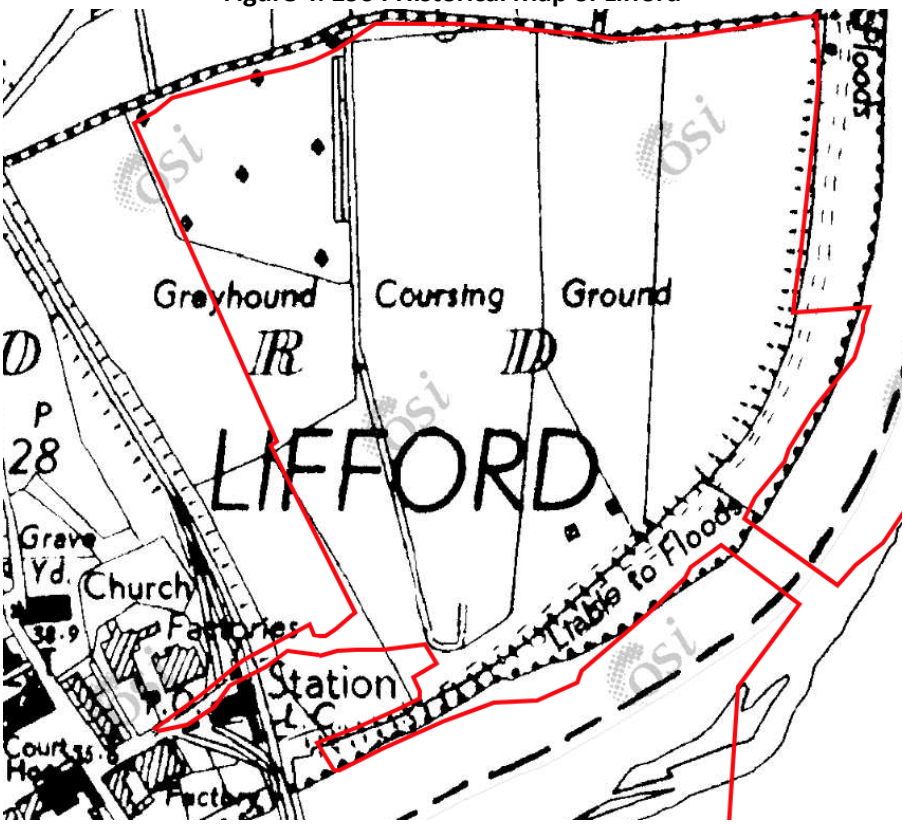
# 3.0 SITE HISTORY

Information relating to the development history of the site was determined by the review of the available historical maps published by the Ordnance Survey of Northern Ireland (OSNI), the National Townland and Historical Map Viewer and publicly available aerial photography available via Google Earth aerial photography. Distances have been taken from the site boundaries.

## 3.1 Lifford Historical Review

**Table 3: Lifford Summary of Historical Development Review**

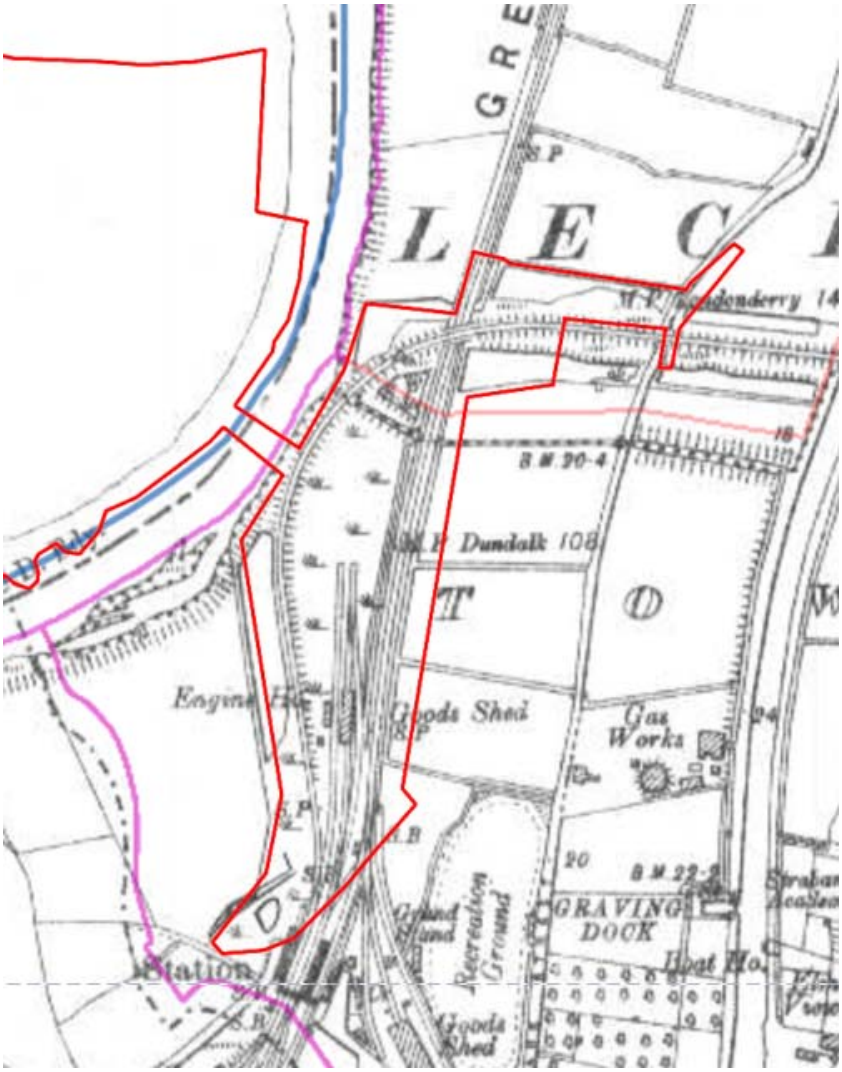
| Source | Description |
|---|---|
| OSI (1837 – 1842) | Site area unspecified. Lifford in west is developed, with a Gaol and Lunatic Asylum located on the southwest boundary. Raised flood embankment is evident along the river with change of slope indicated either side. Watercourse traverses the site in the north, flowing west to east and then north.<br>**Figure 3: 1837-1842 Historical Map of Lifford**<br>  |
| OSI (1888 – 1913) | No other additional notable changes. |
| OSI (1904) | *Greyhound Coursing Grounds* are first evident across the central area of the site, with a road/track running north/south in the central area of the site. The southern area of the site adjacent to the River Foyle is labelled '*Liable to Floods*'.<br>Addition of a railway line, crossing the proposed access road, and railway station beyond the southwest boundary. The *Gaol* has been demolised to make way for a railway station southwest of the site adjacent to the River Foyle, and a railway line running from the station northwest |

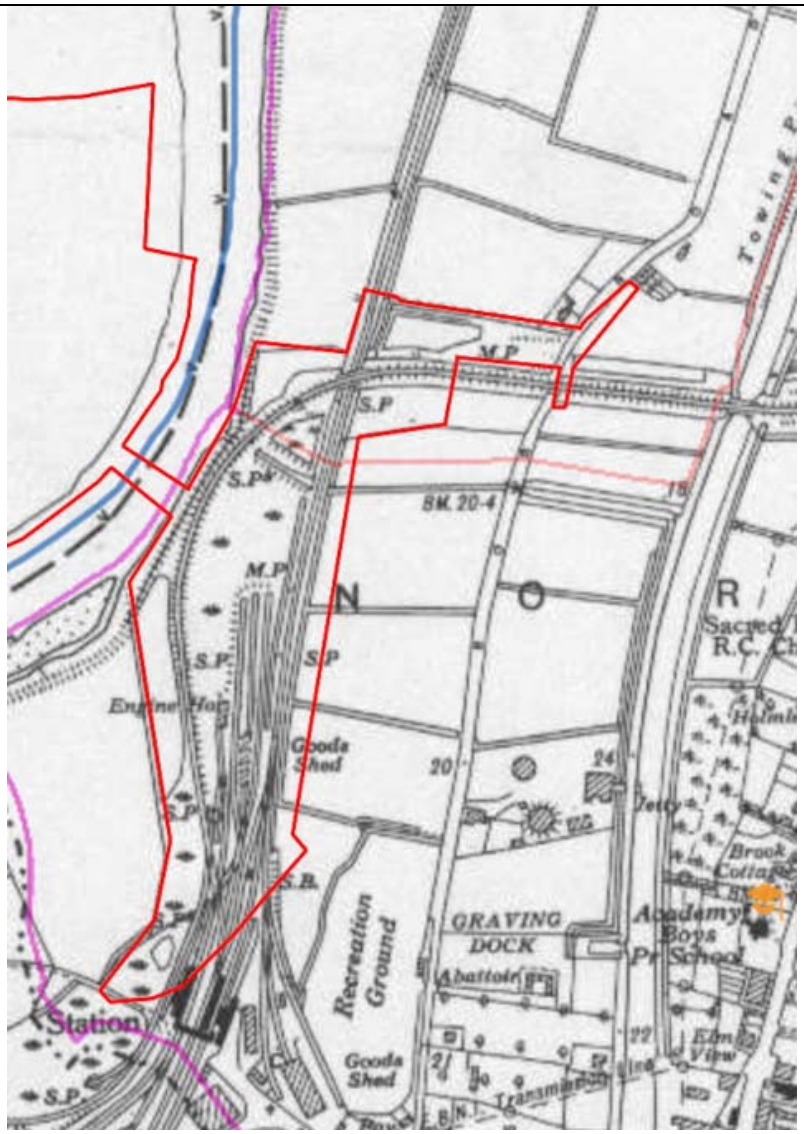
| | |
|---|---|
| | **Figure 4: 1904 Historical Map of Lifford**<br>  <br><br>. |
| Google Earth 2001 | Site as present day. Minor buildings in the south-eastern area of the site around the coursing ground. |
| Google Earth 2008 | Site as present day. |
| Google Earth 2020 | Site as present day. |

## 3.1 Strabane Historical Review

**Table 4: Strabane Historical Development Review**

| Source | Description |
|---|---|
| OSNI 1832 – 1846 | Site and surrounding area are underdeveloped. A watercourse is located in the northern area of the site, flowing west across the site to discharge into the River Foyle. |
| OSNI 1846 – 1862 | Map Unavailable. |
| OSNI 1900 – 1907 | As shown Figure 6 a railway line and sidings ran through the site, including along the western and eastern boundaries and through the north and northeast of the site on embankments (imported materials inferred), possible ponds/open water features in northern area to the north and south of railway embankment.<br>*Engine House* and *Goods Shed* labelled, at the two buildings visible on site with a main railway station with associated buildings and infrastructure located immediately to the south of the site.<br>A large area of bog exists in the central area of the site, with several ponds in the north, north east, and along the western boundary. |

| | |
|---|---|
| | **Figure 6: PRONI 1900-1907 Historical Map of Strabane**<br>  <br><br>Several ditches to the east of the site feed into a ditch that crosses the northern area of the site, flowing into the River Foyle. Railway lines on site shown to traverse over the ditches. Triangle shaped pond located in part of the northern area, to the south of the railway line. *Gas Works* is present 150m east. *Strabane Railway Station* 50m south. |
| OSNI 1905 – 1957 | Minor layout changes in the central area with siding added. Some ponds in the north of the site no longer shown (inferred infilled). No significant changes in the surrounding area.<br>**Figure 7: PRONI 1905-1957 Historic Map for Strabane** |

| | |
|---|---|
| |  |
| OSNI 1919 – 1963 | Map Unavailable. |
| OSNI 1952 – 1967 | Map Unavailable. |
| OSNI 1957 – 1986 | Railway lines no longer shown on site and railway siding to south no longer present, however embankments still indicated with changes of slope. *Platform* (likely bus related) labelled in the southern portion of the site with elongated structures. The majority of the site is shown as Marsh land, with the triangle shaped *Pond* present in the north. Previously indicated ponds in the north east of the site no longer present.<br>Strabane Railway Station replaced by a *Bus Depot*. The *Gas Works* 150m east still present. *Refuse Tip* 180m east of the site, north of the *Gas Works*. *Abbatoir* c.75m to south of *Gas Works*. |

| | |
|---|---|
| |  |
| Google Earth 2010 | Evidence of vehicles parked on site (camper vans) within the area of hard standing. It is known that members of the traveller community used this site as accommodation. |
| Google Earth 2011 | More vehicles present on the area of hard standing. No other significant changes. |
| Google Earth 2013 | No significant changes. |
| Google Earth 2014 | Evidence of stones across the width of the hard standing (east to west). |
| Google Earth 2015, 2016 | No significant changes. |
| Google Earth 2017 | Vehicles no longer present on the hard standing. |
| Google Earth 2019 | Markings evident on the hard standing. |
| Google Earth 2020 | Markings no longer evident on the hard standing. Site as present day. |

# 4.0 SITE VISIT OBSERVATIONS

The existing site conditions are discussed below. A site walkover was carried out on 5th and 19th May 2021. The purpose of the site walkover was to undertake a general inspection of the site to identify any potential contamination sources on and nearby. The Lifford and Strabane observations are discussed in separate sections.

## 4.1 Lifford Side

For the purposes of discussing the Lifford side, the site has been divided into 3 main areas: Western, Central and Eastern as marked on Figure 8 below.

**Figure 8: Lifford Areas**




### 4.1.1 Western

At the site entrance in the south-western corner, Lifford WWTP is present. The Final Treated Effluent Outfall was observed in the bank of the River Foyle. Around this area of the site the utility drawings identify the outfall pipe and gravity sewer to the WWTP.

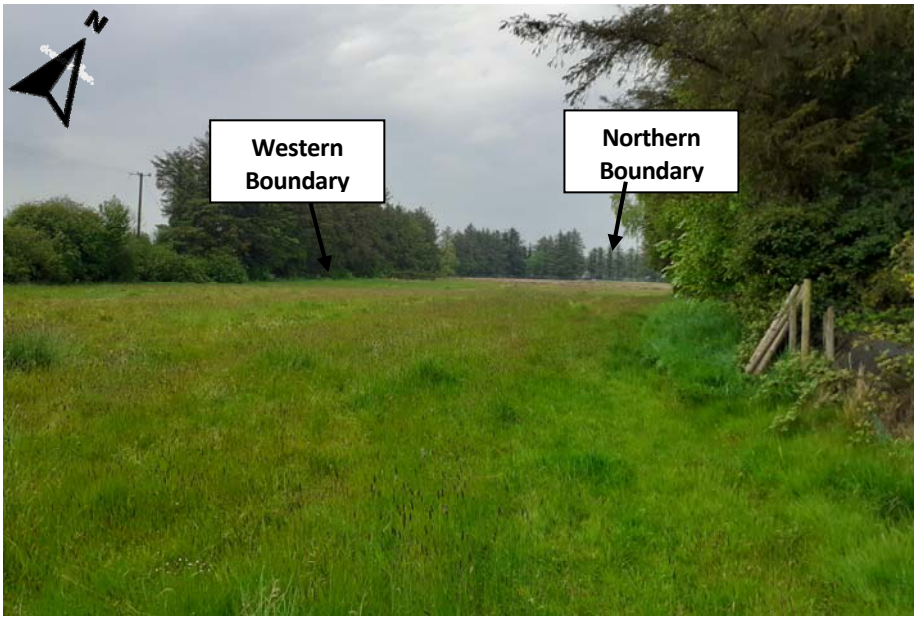
Electricity cables will be located in the vicinity of the Works, with the utility drawings identifying cables to the north.

**Figure 9: Lifford WWTP Discharge into River Foyle**




The remainder of the western Section of the Lifford is one large field which has two distinctively separate areas. The southern area is maintained grass, typical site conditions shown in Figure 10. Overhead electricity cables also run through the site along the western boundary, which is also flanked by mature trees.

**Figure 10: Southern Area**




There northern area is characterised by marshland vegetation including reeds, with areas of waterlogged soils, evident in Figure 11. The historical mapping implies this area of the site has not been subject to any significant development. Ground levels in the proposed development will not change and the site will remain as soft landscaping.

**Figure 11: Marshland vegetation in Northeastern area of site in western field**




### 4.1.2 Central

Mature trees are located along the western and southern boundaries; as such there may be some desiccated soils in these areas. In the proposed development plan the majority of the northern trees will be removed to allow relocation of the coursing ground.

The eastern boundary is fenced by a metal fence. This area is mostly flat and level at c.3mOD, with a small, elevated area c.5mOD in the south as annotated on Figure 12 below.

**Figure 12: Elevated Southern Area: Bing Aerial Annotated with Topographic Survey Elevations**




**Figure 13: Area of raised infilled land in the south of central field**




The elevated area is used for Greyhound Coursing activities. From conversations on site with current grounds keeper this area of the site was raise as part of the coursing activities however, the composition and source of the land raise material is unknown. The raised area and the typical conditions across the Central Lifford area are shown in the above photograph. The final development elevations in this area of the site, at the location of the community building will be within 1m of existing ground levels.

The northern most area this central section (outcropped area of the site) contains a small outbuilding and metal container. Both of these are used for Greyhound Coursing Activities,

shown in Figure 14. The ground surfacing is generally flat and level and maintained by the coursing club. Review of the development drawings indicates the area will remain predominantly unchanged.

The northern and western boundary of this northern outcrop is confined by trees and hedgerows. A watercourse is located adjacent the concrete building and in part, separates the northern section of land from the remainder of the central area. The watercourse is initially culverted as it crosses the site. It then changes to an open in a section in the eastern area as shown in Figure 15. As the watercourse leaves the site it enters a culvert and turns northerly.

**Figure 14: Northern Outcrop of site showing the building and container**




**Figure 15: Open Section Watercourse Next to Concrete Building, Flowing East**



In the south-eastern of the central area a spectator stand is situated, comprised of concrete and corrugated iron. Behind the stand is a narrow Greyhound Coursing Gallop running north, and fenced by a metal fence on the west, and a tall hedge on the right. There is also evidence of burnt material containing cans, glass, and plastic adjacent northeast of the stand, which is likely to be rubbish from the Spector stands.

**Figure 16: Spectator Stand in the South-eastern area**



To the rear of the stand a single storey is building is situated which, is used for changing rooms. The building also contains a materials store (paint gas, cylinders). It is understood a septic tank is located in this area.

**Figure 17: Single Storey Building**



The development plan indicates ground levels in this area will be raised by over a metre, with a toddler play area to be situated to the south of this existing building. The embankment along the southern boundary with the River Lifford will be regraded in places 1:12 and 1:52 slopes to allow for slipway access and pedestrians.

### 4.1.3 Eastern Football Pitches

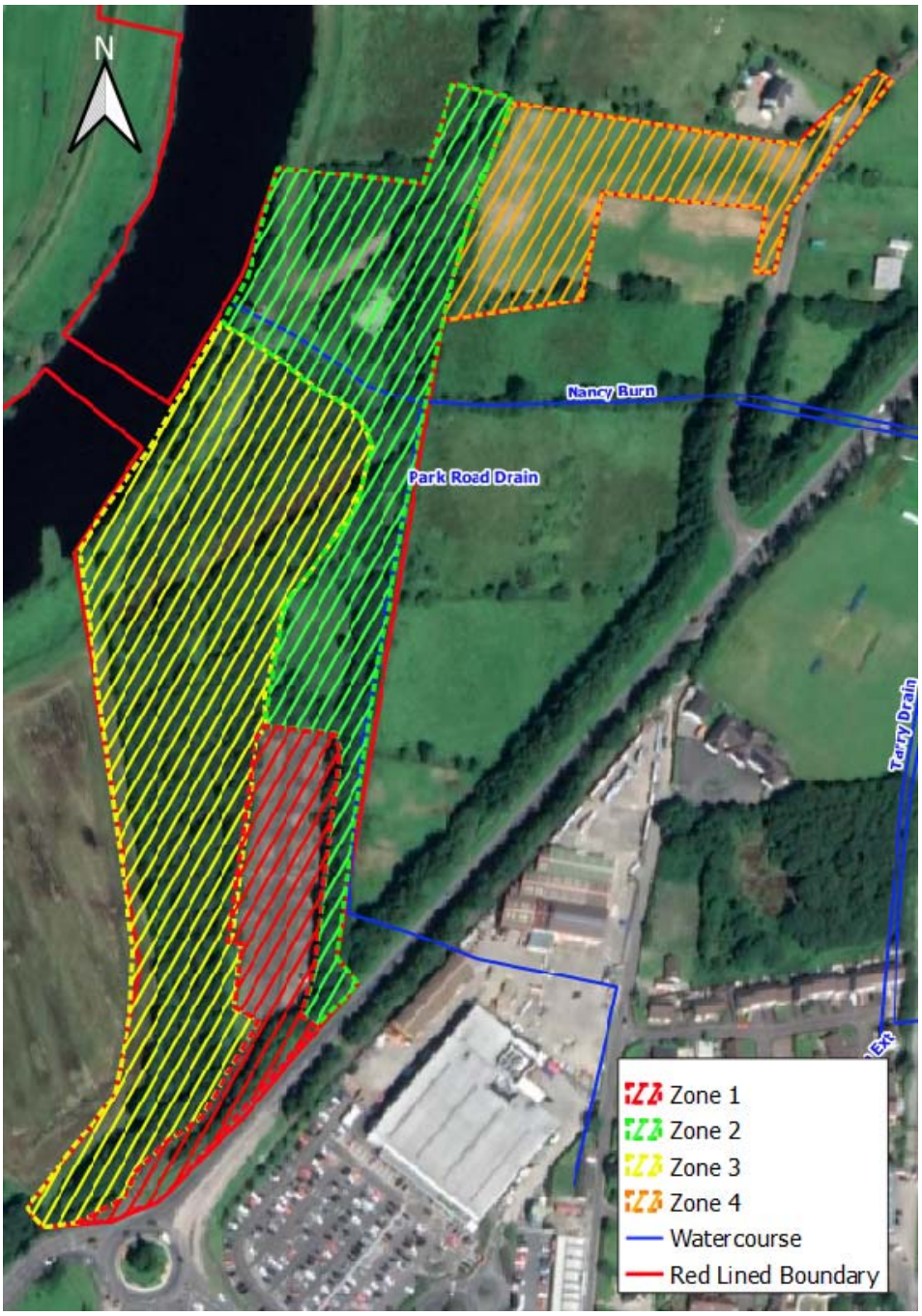
The eastern Section of the Lifford site comprises two football fields, with ground levels ranging from c.2.20mOD in the northern area and rising to between 2.50 to 3.10mOD across the football pitches. The development drawings indicate levels across the southern pitch will be relatively unchanged with a junior play area to be constructed.

A raised flood defence embankment is present along the eastern boundary, similarly to the flood embankment on the Strabane site, with an elevation of between c.5.6 to 5.8mOD on the top of the embankment. To the east of the embankment ground levels reduce to c.2.9mOD on approach to the river. These will remain unchanged in the proposed development in this area.

## 4.2 Strabane Observations

For the purposes of describing the Strabane side, the site has been zoned into 4 different zones in consideration of historical use and proposed development.

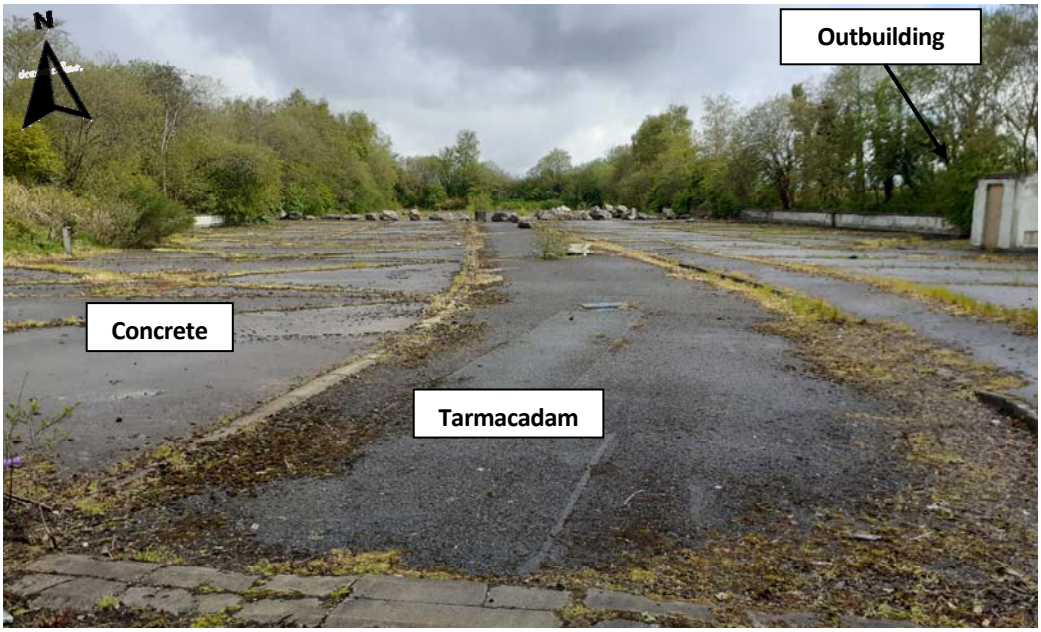
**Figure 18: Strabane Zones**




### 4.2.1 Zone 1: Existing Hardstanding

Zone 1 is currently hardstanding land located in the south-eastern area of the Strabane side. This is the main access to the southern area of the site, which at the time of the walkover was restricted with concrete blocks. The site entrances open into a large hard standing area of tarmacadam and concrete, typical of that shown in Figure 19 below. This was formerly a traveller's community rest.

**Figure 19: Hard standing area in the southeast of the Strabane site**




This area of the site is relatively flat, and level c.3.6 to 4mOD, and a wall c.0.50m high surrounding the hard standing area as visible in Figure 19 above. As part of the proposed development, the hardstanding in this area will be removed and the land re-instated as a wildflower meadow/open grassland as part of the development proposal. Review of the existing topographic elevations and the final car park development levels indicates no significant changes in elevations will occur as part of the development.

Embankments are situated beyond the perimeter wall surrounding the hardstanding area on the northern, eastern, and western boundaries. The embankments are covered with mature trees and are discussed in Zone 2 and Zone 3 observations Sections 4.1.2 and 4.1.3. These are considered to be the former railway embankments shown on the historical mapping. As discussed later in the historical mapping this area of the site was covered in railway sidings, with a *Goods Shed* in the eastern area and an *Engine House* in the western area.

Multiple manholes are located across the hardstanding area. These comprise redundant foul sewage, storm, running water and electricity services. No service maps exist for this infrastructure, which will be excavated and removed as part of the proposed development, with the land re-instated as wildflower meadow/open grassland. A small outbuilding (previous usage unknown) is located on the eastern margin of the hardstanding area. NIE

drawings (Appendix A) also so a low voltage cable entering the site in the south-eastern corner.

A small area of burnt waste fly tipped material including tins, cans, and other household waste was observed and other minor areas of domestic waste were observed across the site. Japanese knotweed was observed in the south-western corner of the Zone and along the north-western boundary.

### 4.2.2 Zone 2

Zone 2 covers the eastern boundary and northern central area. This area is characterised by a raised overgrown embankment that runs along the eastern boundary of the site, with a stagnant pond and the Nancy Burn flowing through the northern section.

The raised railway embankment along the eastern boundary is c.5mOD with ground levels reducing to c.3.8mOD to the west into the hardstanding area of Zone 1.

**Figure 20: Raised embankment along the eastern boundary of the Strabane site**




At the toe of embankment to the east, the northerly flowing Park Road Drain is present. Agricultural grasslands are situated beyond the eastern boundary c.3mOD. Mature trees/hedgerows are present either side of the embankment, however many have recently been cut back to allow better access to the site as visible in Figure 20, above.

The site topographic survey identified a *Storm Flap* at c.234141, 398392 in the southern section of the embankment flowing into the Park Road Drain. The Park Road Drain flows northerly, parallel to the eastern boundary, at the toe of the embankment. It discharges

into the Nancy Burn which flows westerly through the Zone. Drainage is discussed further in section 5.3 of this report and is mapped in Figure 39.

**Figure 21: Park Road Drain**



To the north of the hard standing area the site opens into a grassed area as visible in Figure 22 below, which is orientated east-west. An elongate embankment is present in the area of the former *Engine House*. An exposure of the embankment is present, allowing inspection of the make-up which appears to be primarily Silt and Clay. This ground surface is hummocky and uneven grass with dense vegetation beyond. Ground levels are relatively flat across this area c.5mOD, then slopes down to the north to c.3.3mOD. Some areas of Japanese Knotweed are present in this area.

**Figure 22: Area north of Hard standing area, and west of the eastern embankment**




The former railway embankment traverses on a north-south orientation, through Zone 2 to the north of the grassland area. This is currently serving as an informal pedestrian access track leading to the banks of the River Foyle.

The Park Road Drain flows into the Nancy Burn in the north-eastern corner of the Zone. The Nancy Burn flows west, through the site to the outfall in the River Foyle. Along the Nancy Burn several areas of Japanese Knotweed are present.

**Figure 23: Nancy Burn Drain flowing west into the River Foyle**



**Figure 24: Outflow from the Nancy Burn Drain into the River Foyle**




**Figure 25: Western embankment, dense vegetation in Zone 3, and the River Foyle**



**Figure 26: Embankment along northwest boundary**




A stagnate 'triangle shaped' pond is located the northern area of the Zone, with typical eutrophication conditions shown in Figure 27 below. No inflows were observed into the pond, however a outflow channel was observed, which was dry at the time of the walkover. Areas of Japanese Knotweed were recorded around the pond.

**Figure 27: Stagnate Pond southwest of the Western Embankment**




To the north of the pond a flood defence embankment runs parallel to the bank of the River Foyle. Giant Hogweed was observed at several locations along the riverbank.

### 4.2.3 Zone 3

Zone 3 comprises the western portion of the Strabane site. This area comprises an area of wooded marshland with standing water, traversed by the former railway embankment which now comprises a grassed and wooded embankment. Marshland/standing water areas were especially inaccessible, with access only possible along the railway embankment and along the bank of the River Foyle, where a separate flood embankment runs parallel to the river. A thin sloping strip of woodland is also accessible extending along the margin of the wetland immediately to the west of the hardstanding area of Zone 1.

**Figure 28: Woodland waterbody located in the middle of the Strabane site**



It is noted that the development plans for this area identify *wetland* with a board walk for public access.

**Figure 29: Extent of dense vegetation in Zone 3 that is to be retained, from western embankment**




Ground levels across the existing sweeping embankment will not significantly change in the final development. A footbridge will be constructed, bridging over theRiver Foyle to the Lifford side, with the landing site tieing into the former railway embankment.

Overhead electricity cables cross this area of the site, however these are not located within the vicinity of the footbridge site. A badger sett was observed in this area of the site as shown in Figure 30 below.

**Figure 30: A badger sett located in Zone 3, dug into the western embankment**



### 4.2.4 Zone 4

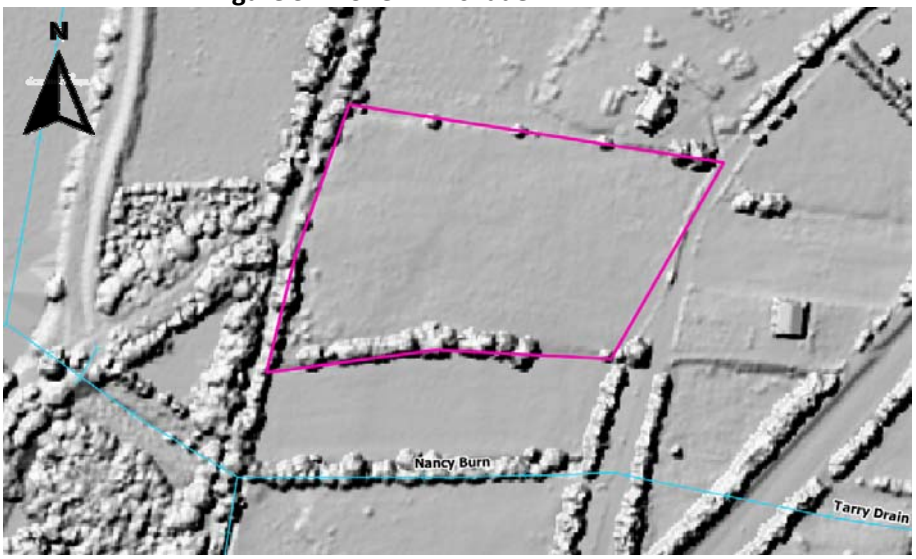
During the site walkover days, no access was available to Zone 4. Figure 19 taken from the eastern perimeter fence shows the Zone characterized by grass and occasional reeds and areas of soft mud. The site is relatively flat at c.4mOD.

**Figure 31: Zone 4 characterised by agricultural land**



A review of Hillshade produced from LiDAR, presented as Figure 32 below shows a relatively featureless site in compassion to the historical mapping, which indicated a railway embankment with ponds either side.

**Figure 32: Zone 4 Hillshade LiDAR**



# 5.0 FURTHER DATA GATHERING

## 5.1 Regulatory Searches

The following datasets were reviewed:

***Republic of Ireland***

- Heritage Maps Ireland,
- Ordnance Survey Ireland (OSI); National Townland and Historical Map Viewer,
- Environment Protection Agency (EPA) Ireland,
- Geologial Survey Ireland (GSI); Geology and Public Data Viewer Series.

***Northern Ireland***

- NIEA Waste and Contaminated Land Database (WCLDB) & Historic Environment Map Viewer and Industrial Heritage records.
- NIEA WMU Information Viewer (Abstraction Licence Database, industrial consents) and
- Drinking Water Inspectorate (private supplies).

### 5.1.1 Abstractions

**Lifford:** A review of GSI informs there are no abstraction licences within 1km of the site, the closest is located 1.3km east. No Source Protection Areas were identified within 1km of the site.

**Strabane:** A review of the Drinking Water Inspectorate (DWI) Private Water Supplies online viewer indicates there are no registered abstractions within 1km of the site.

A review of the NIEA Water Information Request Viewer informs there are no Groundwater Authorisation sites within 1km of the site.

A review of the NIEA water abstraction licence applications (09/06/2020 database updated) indicates there are no PWS within 1km of the site. The closest is located 4km northeast.

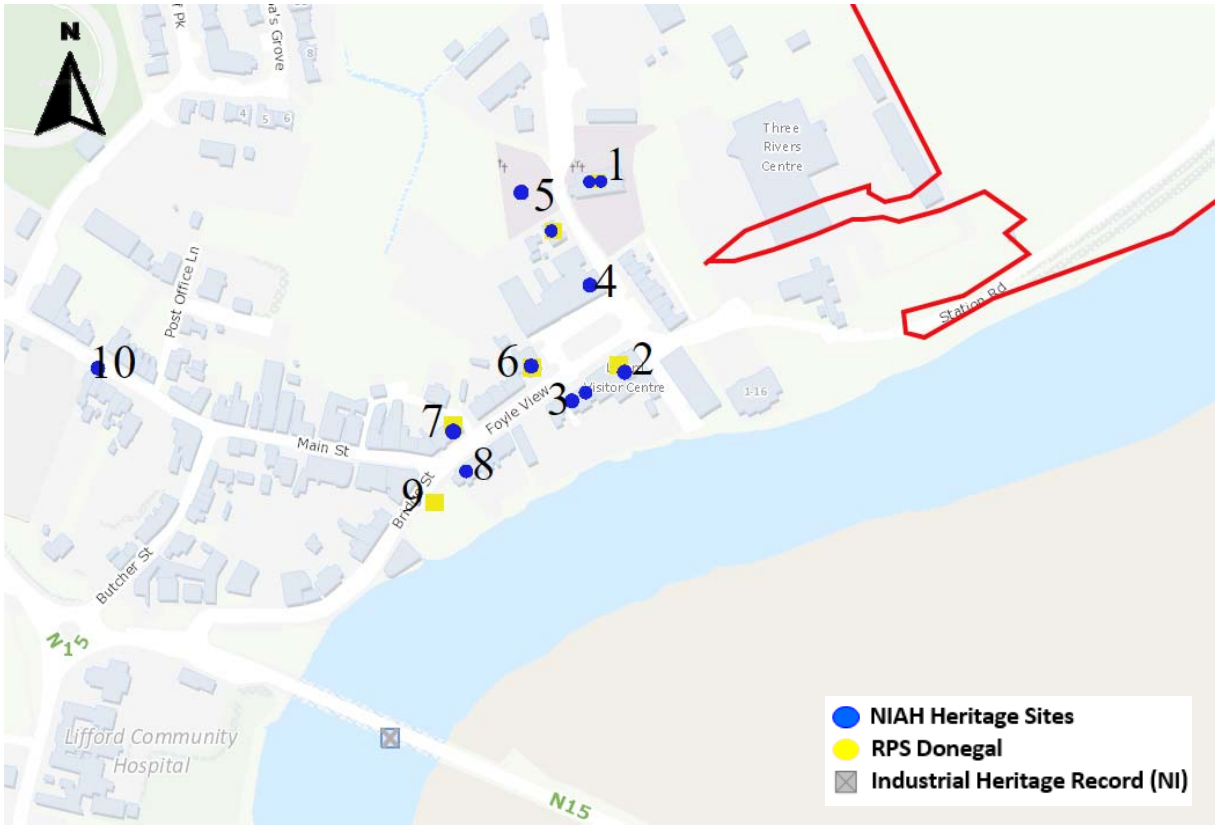
### 5.1.2 Industrial Heritage Records and Historical Land Use records

**Lifford:** Heritage Maps Ireland interactive map was used to map NIAH sites (National Inventory of Architectural Heritage), RPS sites (Record of Protected Structures) in Donegal, and Industrial Heritage Record for Northern Ireland. This is shown in Figure 33 and outlined in Table 5.

**Table 5: Heritage locations in Lifford**

| Site Number | Land Use |
|---|---|
| 1 | St Lugadius Church of Ireland (1621) |
| 2 | Old Court House (1740-1750), other land uses include Prison/Jail |
| 3 | Houses (1860-1890) |
| 4 | Town/County Hall (1829-1890), other land uses include Barracks |
| 5 | Church/Parish Hall (1850-1870) |
| 6 | Rectory (1900-1920), other land uses include a community centre |
| 7 | RIC Barracks (1850-1890), now used as a shop/retail outlet |
| 8 | Shop/Retail Outlet (1790-1830), now used as a house |
| 9 | Bridge Street House (1790) |
| 10 | Post Box (1922-1950) |

**Figure 33: Heritage Map of Lifford**




It should be noted that detailed historical land use was not available, yet historical maps show a railway line and station is present at the southwest corner of the Lifford site, running northwest along the site boundary.

Although not mapped, according to the National Inventory of Architectural Heritage, Lifford Railway Station is the building south of the Three Rivers Centre, along Station Road southwest from the site. The railway line came from Strabane across the River Foyle, joined by a bridge. The railway line travelled from Lifford Railway Station northwest towards Ballindrait.

**Strabane**: A review of the Industrial Heritage Records and Historical Land Use records indicates 22 recorded sites within 250m of the site as presented on Figure 34 below.

Of these 6 are located within the site boundary, all relating to the old railway: including a Goods Shed, Engine House, 2 Signal Posts, a Bridge (rail over rail), and a Railway Line. Key sites are detailed in Table 6 below.

**Figure 34: Industrial Heritage Records and Historical Land Use records for Strabane**

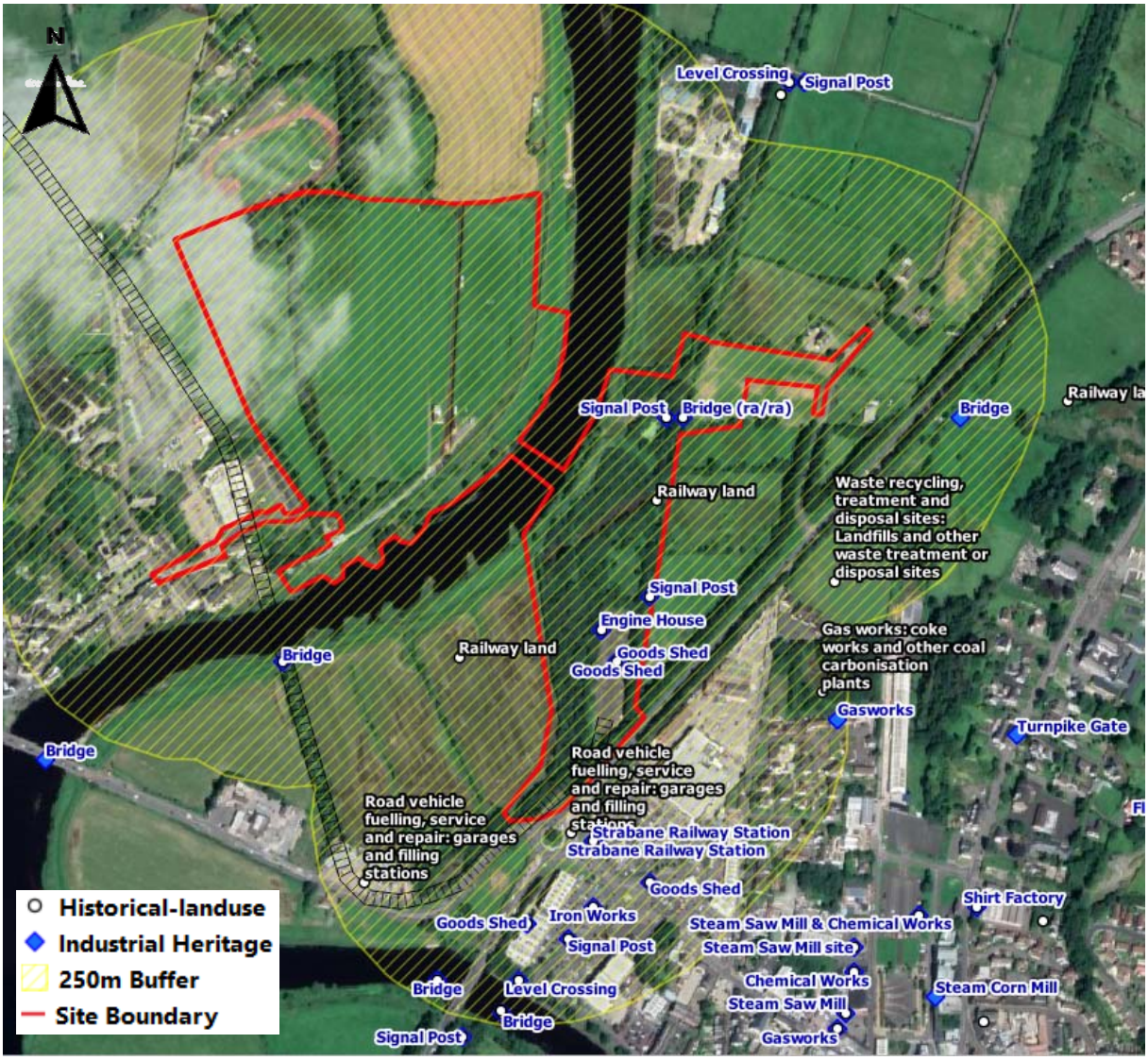


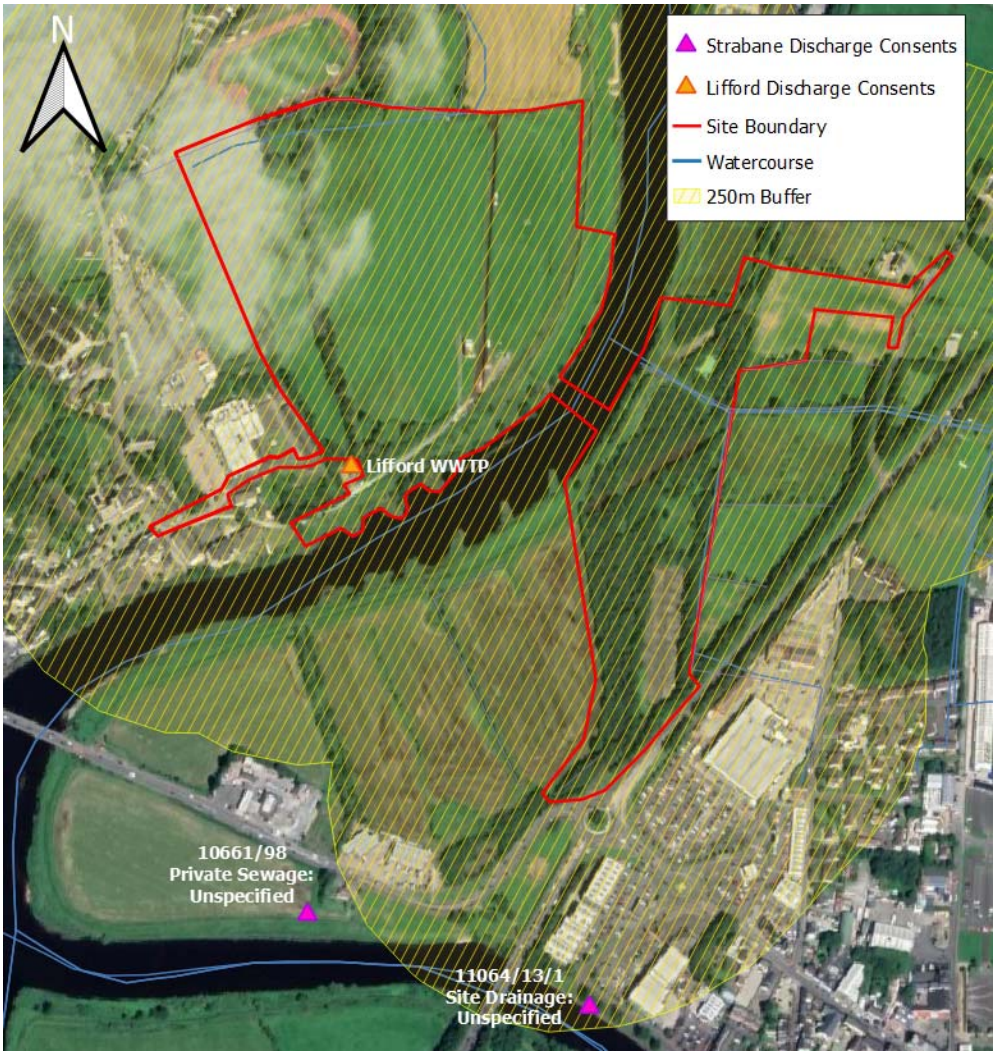
**Table 6: Summary of Strabane Historical Land Use and Industrial Heritage Information**

| Historical Land Use and Site ID | Distance and Direction | Year and Description |
|---|---|---|
| Railway Line | On site | 1976: Rail Line (Disused), 1856-1930s: Rail Line<br>1834: Agriculture |
| | 110m south | 1976: Rail Line (Disused), 1856-1930s: Rail Line<br>1834: Agriculture |
| Goods Shed | On site | GNR Branch Line, Portadown – L'Derry / Strabane – L'Derry Narrow Gauge Railway |
| | 130m south | GNR Branch Line, Portadown – L'Derry |
| | 140m SE | Strabane – L'Derry Narrow Gauge Railway |
| Engine House | On site | Strabane – L'Derry Narrow Gauge Railway |
| Waste Recycling, Treatment and Disposal Sites | 210m east | 1976: Refuse Tip,<br>1834-1930s: Agriculture |
| Gas Works: Coke Works and other Coal Carbonisation Plants | 220m east | 1904-1976: Gas Works<br>1834-1856: Agriculture |
| Gas Works | 230m east | To east of Canal, North of Graving Dock |
| Road Vehicle Fuelling, Service and Repair: Garages and Filling Stations | 40m south | 1976: Bus Depot<br>1856-1930s: Rail Line<br>1834: Agriculture |
| | 200m southeast | 1996: Filling Station<br>1834-1930s: Agriculture |
| Iron Works / Metal Manufacturing, refining and finishing works: iron and steel works | 140m south | Between Railway and Branch Road |

### 5.1.3 Discharges

**Lifford:** The EPA Ireland website indicates that in Lifford, only 1 Waste Water Discharge Authorisation exists for Irish Water, from Lifford Waste Water Treatment Plant as shown in Figure 35. There are no Water Framework Directive Section 4 Discharges (21/22/2016) within 1km of the site, the closest located 11km northwest.

**Figure 35: Discharge Consents**




**Strabane:** Review of the NIEA Water Information Viewer informs of 1no. consented discharge within 250m of the site as shown in Figure 35 above. This is located c.220m south east, identified as 'Site Drainage: Unspecified' (11064/13/1). Another is located c.310m south west, identified as 'Private Sewage: Unspecified' (10661/98).

There will be a Final Treated Effluent Outfall at the Strabane WwTW which located c.200m north, discharging Final Treated into the River Foyle. This discharge will not have an impact on the proposed development of the site. There may also be an Emergency Overflow at the WwTW, which will reduce the quality of the River Foyle.

There is also likely to be an Emergency Overflow on the Lifford WwTW. Whilst both will not have an impact on the development as no surface water abstractions are proposed, sewage related debris (SRD) may be visible during/immediately afternoon storm events or failure.

### 5.1.4 Licensed Waste and Authorized Transfers

**Lifford:** Using the EPA Ireland online map viewer indicates the nearest waste facility is Chirchtown Landfill, located 3.5km southwest of the site.

**Strabane:** There are no active NIEA authorised landfill site within 1km of the site. There is 1 Transfer and Storage site within 250m of the site, which relates to Strabane Wastewater Treatment Works (WWTW) predominately used for sludge thickening. The Works is located c.200m north.

## 5.2 Geology

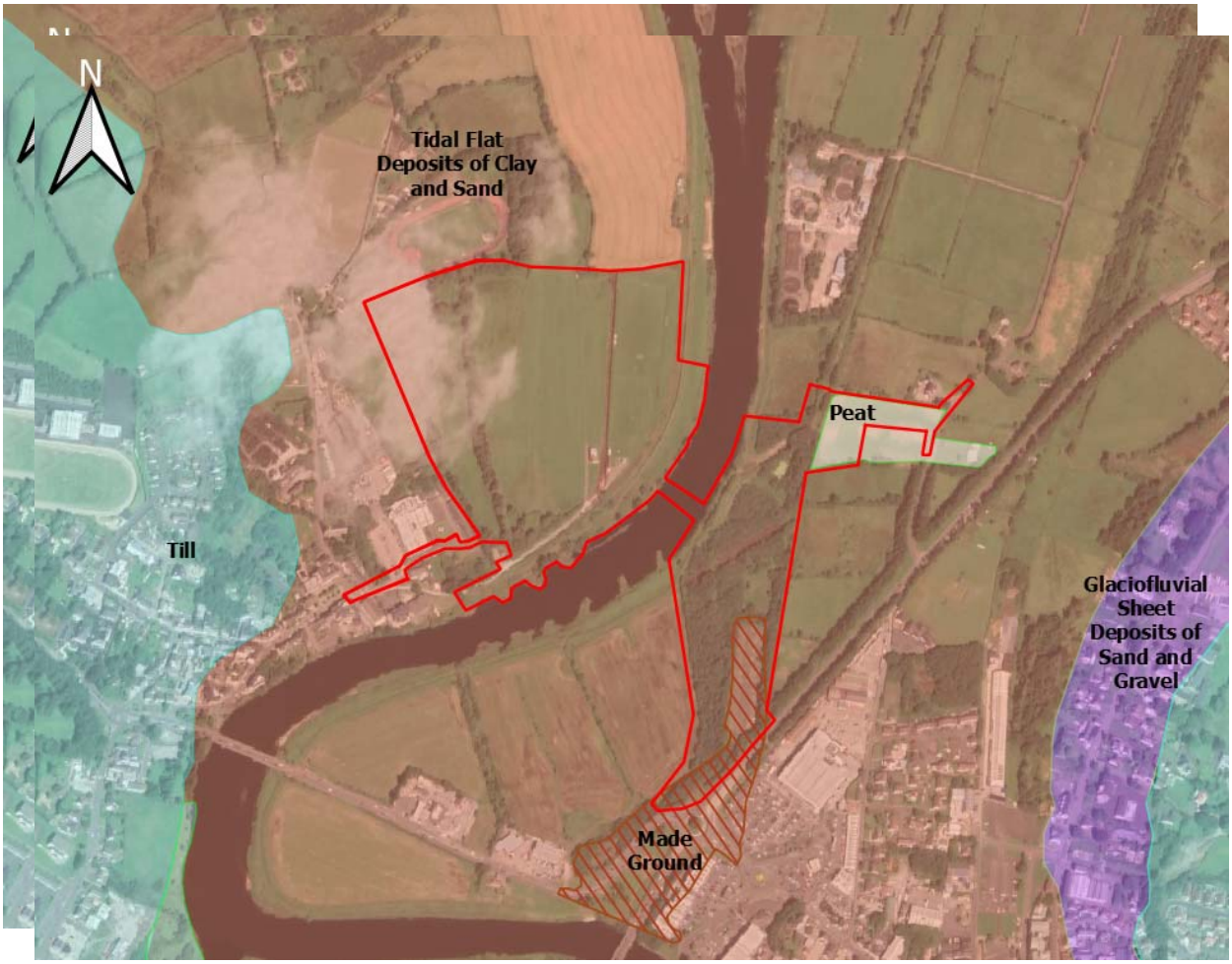
### 5.2.1 Superficial and Bedrock Geology

Geological information on the site was obtained from the GSNI GeoIndex 1:10,000 Mapping and GSI. This indicates the site is predominantly situated on Tidal Flat Deposits (Clay and Sand) as shown on Figure 36, overleaf.

Peat is indicated in the north-eastern area of the Strabane side (Zone 4). This area is currently improved grass land and is proposed to be a car parking area. Peat is known for compressing under pressure, soft and waterlogged conditions therefore any proposed infrastructures in this area of the site will likely encounter POOR ground conditions. Made Ground should be expected in this area of the site due to the historical mapping implying ponds which are no longer present.

Made Ground is shown on the GSNI mapping to be located beneath the existing hardstanding area on the Strabane side(Zone 1). The historical mapping showed this is area to have been associated with extensive historical railway infrastructure.

**Figure 36: GSNI 10k Superficial Deposits**

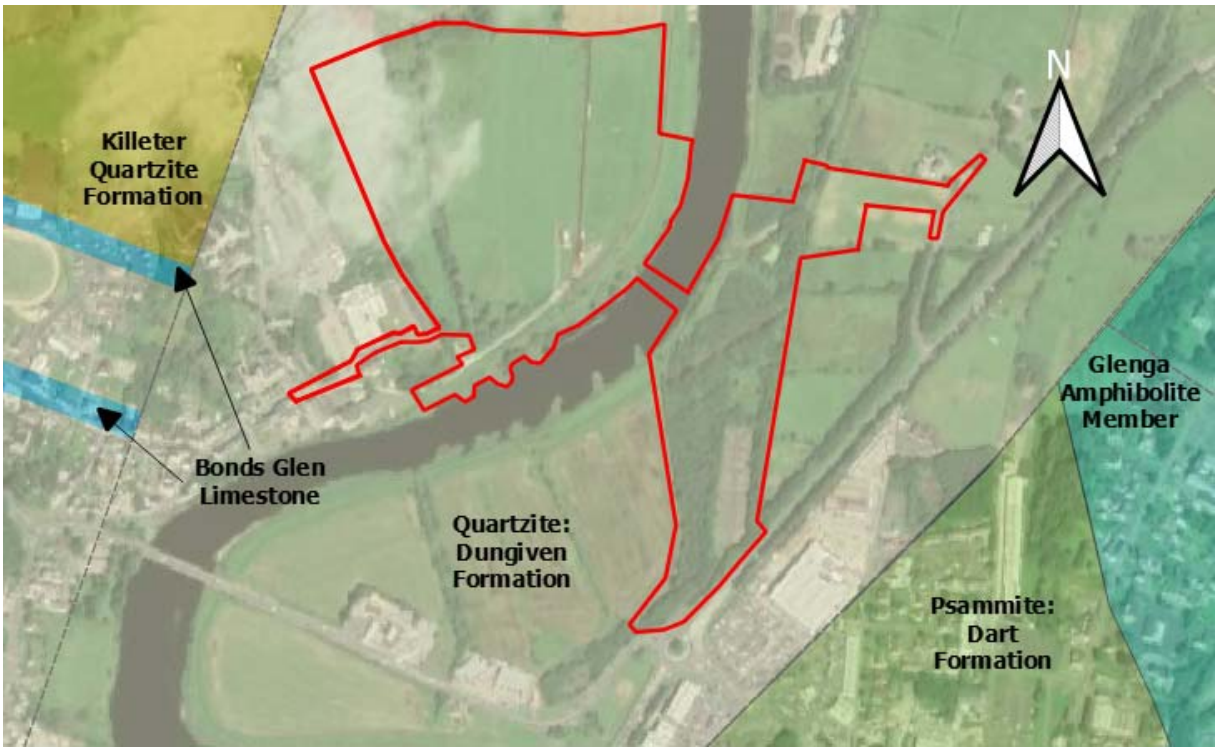



Further areas of Made Ground should be expected across the majority of the Strabane side due to the historical railway infrastructure which crossed the site in several places. The Made Ground may lead to variable ground conditions therefore for any proposed infrastructure geotechnical investigation (CBR, DCP, Plate Loads) will be required to develop a suitable subbase thickness.

The underlying bedrock is the Dungiven Quartzite Formation(GSNI) or the Claudy Formation (*Psammite, pebbly grity quartzite*, GSI). Geological maps shown the quartize to be dipping to the north-east 10 to 35°.

A Fault is located c.+60m north west of the Lifford boundary, which is +250m from the proposed building as shown in Figure 37 below. A Fault is located c. 140m south of the Strabane boundary. Given the nature of the development, a single building confined to the south-western corner of the Lifford side, the Faults are Unlikely to have any significant impact on the structural design of the project.

**Figure 37: GSNI 10k Bedrock Geology**




Southeast of the Strabane site is a Psammite layer, known as the 'Dart Formation, and in the east is the Glenga Amphibolite Member layer. These two layers of bedrock are separated by a fault approximately 200m east of the site, moving northeast to southwest. West of the Lifford site is another fault running northeast to southwest, which separates a Killeter Quartzite.

### 5.2.2 Review of GSNI and GSI Boreholes

**Strabane:** A review of the GSNI GeoIndex indicates there are 17no. GSNI boreholes located within 250m of this site.

A borehole was located on the Strabane side of the River Foyle ('BH 6' for the Strabane Flood Protection scheme). The borehole was terminated at 9m below ground level and did not encounter rock head. No further information is provided on the GeoIndex.

Boreholes completed at the Mourne Bridge (72NE22 and 72NE23) c.240m to the south of the site in the middle of the River were terminated at 22m below ground (-17.97mOD). Both boreholes are indicated not to have encountered rock head.

Due to the depth of variable nature of Tidal deposits, anticipated shallow groundwater table piled foundations will likely be needed for the proposed building and footbridge. Superficial Deposits across the site a likely to be +10m in thickness.

### 5.2.3 Abandoned Mines and Shafts

**Lifford:** A review of the GSI Public Data Viewer Series indicates that there are no mapped Active Quarries within 1km of the site.

**Strabane:** A review of the GSNI GeoIndex Historic Mine Workings dataset indicates that there is no mapped mine shafts or workings within 1km of the site. The 'Milltown Adit' is the closest, located 2km southwest.

### 5.2.4 Karst and Dissolution Features

**Lifford:** Using the GSI Spatial Resources, there are no natural dissolution features within 1km of the site.

**Strabane:** On review of the GSNI GeoIndex, there are no natural dissolution features within 1km of the site.

### 5.2.5 Radon

**Lifford:** Using EPA (Ireland) online radon map viewer indicates the site is located between 5-10% of homes within this 10km grid square are estimated to be above the reference level

**Strabane**: Review of the Public Health England UK maps of radon indicates the site is located within the 'highest potential in 1km grid square', with a maximum radon potential of 10-30%.

## 5.3 Hydrogeology and Hydrology

### 5.3.1 Hydrogeology and Groundwater Vulnerability

The Superficial Tidal Flat Deposits are classified as a potential Superficial Aquifer as identified on the NIEA River Basin Viewer, however the area is not identified as a being in Surface Water Protection Area. The GSI identifies the Tidal Deposits as a locally important gravel aquifer.

The underlaying Quartzite (Dungiven Formation) under the GSNI/NIEA aquifer classification reports the bedrock as Bl(f), *having limited productivity potential, with negligible intergranular porosity. Flow occurs through fractures and a weathered upper surface, and significant groundwater flow is restricted to the upper zones typically above 30m depth.*

On the Lifford side, under the *GSI the Groundwater Recharge* Classification is *Extremely vulnerable* and the *Groundwater Vulnerability* is *High.* This is assessed as being attributable

to due to groundwater being within 3m of the ground surface. This due to the granular nature of the Superficial Deposits, which will be in hydraulic Conductivity with the River.

On the Strabane side the site is shown to be located in an area under the Northern Ireland regional groundwater vulnerability screening layer as Class 4e, on a scale from 1 to 5 where 1 is lowest vulnerability and 5 is highest vulnerability.

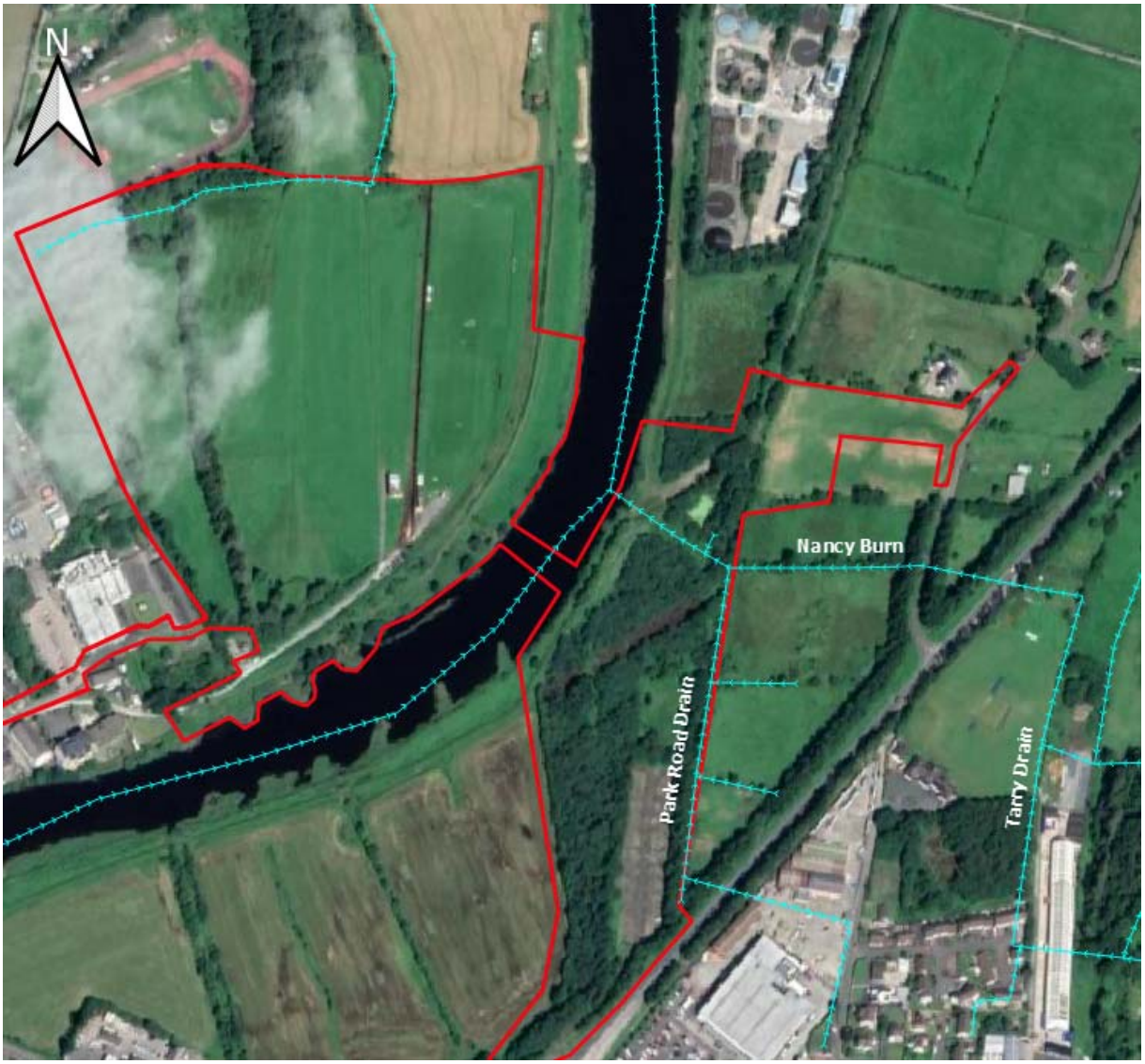
### 5.3.2 Hydrology (Lifford)

The EPA Ireland online map viewer shows a watercourse along the northern boundary of the site flowing west to east initially, then north to flow into the Deele River c.780m to the north.

### 5.3.3 Hydrology (Strabane)

Several watercourses and water features are present as shown on Figure 38 below. The Park Road Drain runs parallel with the eastern boundary of the site with several field drains flowing into the Park Road Drain. The Park Road Drain flows northerly into the Nancy Burn.

**Figure 38: Water Features**




The Nancy Burns flows westerly through the site predominantly within an open steep sided channel, discharging into the River Foyle. The watercourse is culverted in to places on site where existing tracks cross over, and drains the main area of wooded wetland.

A stagnate pond is situated on the Strabane side, north of the Nancy Burn. A potential outflow channel from the pond was observed however, no inflow ditch was identified. Across the western area of the Strabane side within the wooded areas, the ground surface is waterlogged and marked on OSNI mapping as marsh. A shallow water table in the Superficial Deposits is expected across the entire site due proximity to the River Foyle. Tidal influence is also expected as this area of the Foyle is still within the Transitional Coastal waterbody.

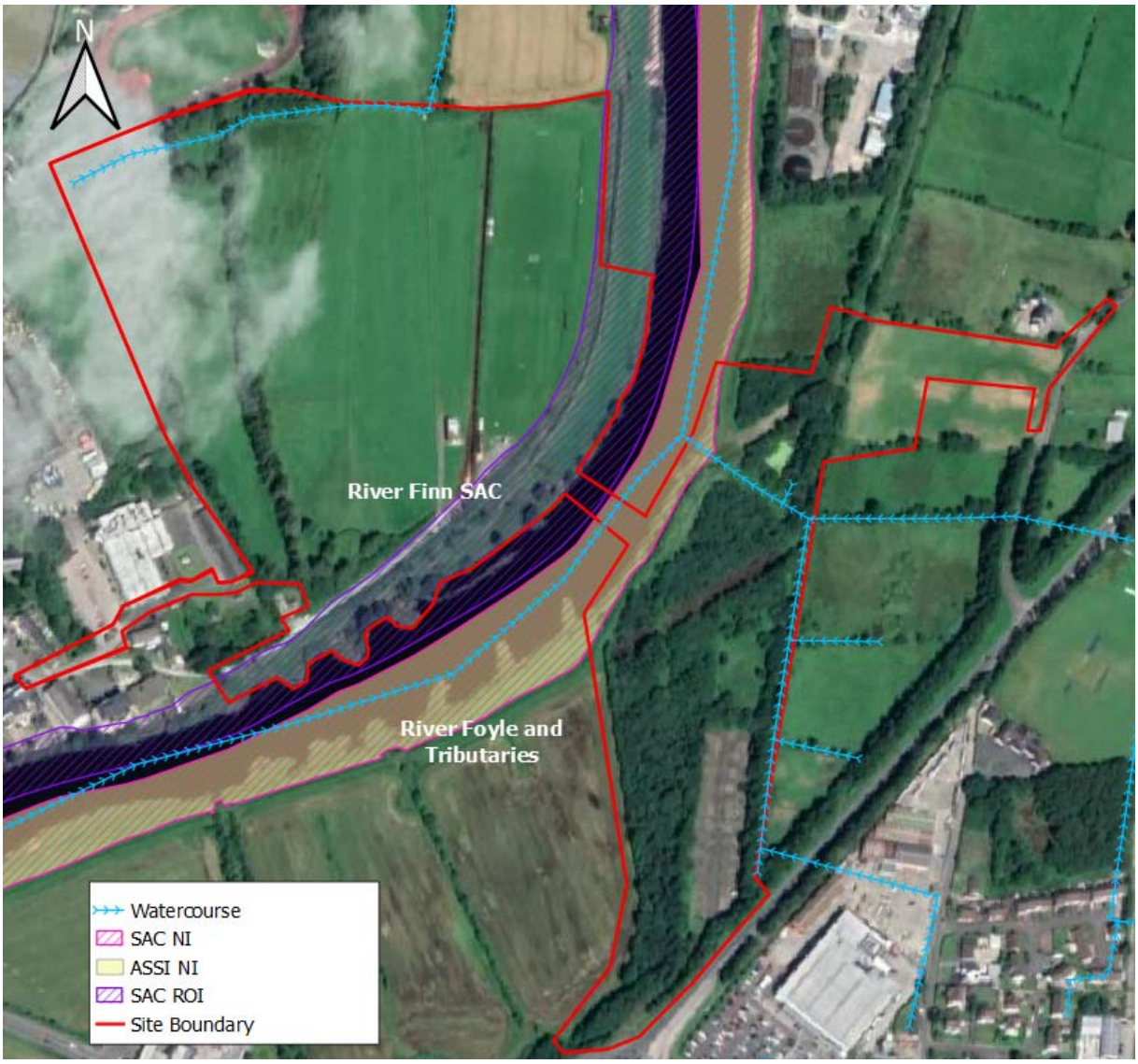
### 5.3.4 Flood Risk (Lifford)

A review of the FloodInfo Ireland Flood Maps indicates that this site is within the High Probability for River Flooding. The DfI Rivers Flood Maps NI also indicates that the majority of the site is within the 1%AEP Floodplain. A Flood Risk and Drainage Assessment are outside the scope of a PRA PSSR and has been undertaken by McCloy Consulting.

## 5.4 Protected Areas

A review of the NIEA Natural Environment Map Viewer indicates that the Foyle Valley running through the centre of the development is subject to several Designations: ASSI and SAC protected areas on both sides of the border.

**Figure 39: Designated Sites**




The ASSI is for Atlantic Salmon, and Otters. Shallow groundwater beneath the site within the Superficial Deposits is likely to be in hydraulic conductivity with the River and as such any change in water quality will feed into the Designated Sites.

# 6.0 PRELIMINARY ENVIRONMENTAL RISK ASSESSMENT

## 6.1 Introduction to Initial Conceptual Model

In the context of land contamination, there are three essential elements to any risk that must be considered as termed in the LCRM guidance:

- A source – *a contaminant or pollutant that is in, on or under the land and that has the potential to cause harm or pollution*
- A pathway – *a route by which a receptor is or could be affected by a contaminant*
- A receptor – *something that could be adversely affected by a contaminant, for example a person, controlled waters, an organism, an ecosystem, or Part 2A receptors such as buildings, crops or animals.*

Each of these elements can exist independently at a site, but they create a risk only where viable links are present, such that a particular contaminant affects a particular receptor through a particular pathway. In this preliminary risk assessment stage they are *potential pollutant linkages* (until they are confirmed as per the LCRM guidance. Consideration has also been given to BS EN ISO 21365:2020 *Soil quality: Conceptual site models for potentially contaminated sites*.

The Likelihood of an event occurring referred to below is classified as the risk classification methodology presented in C552.

## 6.2 Screening of Sources

**Lifford Side**

- Limited development shown to have taken place. Currently used for limited grazing and Greyhound Coursing.
- South western corner has been partly land raised therefore unknown fill material.
- Flood embankment along eastern and southern boundary is of unknown material.

**Strabane:**

- Former Railway lines crossed the site with several sidings terminating in the central area. A range of railway embankments are still present across the site. The historical railway industry is a known contaminative industry (Department of Environment (DoE) Industry Profile, (published in 1995).
- The terminal sidings area in Zone 1, included an Engine Shed and a Goods Shed, therefore hydrocarbon contamination may be concentrated in these areas. This area is currently covered with hardstanding. Historical railway Infrastructure may be present beneath with the GSNI identifying Made Ground.

- Historical maps show large pond features on site in Zone 4, which are no longer present therefore High risk of Made ground/historical contaminated infill.
- Possible shallow groundwater impact from historical refuse tip and gas works (hydraulically connected to site) situated to the east of the site.
- Areas of contamination and infill present a potential risk to construction workers organic in inorganic pollution risk / asbestos risk and nearby groundwater and surface water receptors.

## 6.3 Receptors

A community resource building is to be provided on the Lifford side, therefore providing a ground gas receptor. An operational and maintenance compound is also proposed, and as this includes enclosed structures, gas protection measures will be required.

Site workers and end users all at risk from coming into contact with contaminated soils from the various construction and earth moving works.

Areas of ponded surface water and watercourses within the site will be hydraulically connected to the River Foyle. The underling water-bearing Superficial Deposits will also be hydraulically connected to the River Foyle.

The site will have large areas of open soft landscaping and the existing embankments widened where necessary to create pathways. The end site receptors fall into the Land Quality Management/ Chartered Institute of Environmental (LQM/CIEH) Public Park land use.

## 6.4 Initial Conceptual Site Model

Taking into consideration all the information in the previous sections, the following presents initial Conceptual Site Models (iCSM) for different areas of the site. The iCSM is based on the assessment of risk; *a combination of likelihood of an event occurring and its magnitude of consequence,* as per the risk classification methodology presented in C552.

**Table 7: Initial Conceptual Site Model for Lifford**

| Source | Pathway | Receptor | Risk Category / Rating |
|---|---|---|---|
| ON Site:<br>Made ground Limited to discrete areas<br><br>OFF SITE:<br>limited to beyond the south-western corner with the adjacent historical railway and treatment works. | Ingestion / Direct Contact | End Site Users | **Low across the majority of the site. Moderate in the southern and south-eastern:**<br>The end use of the site is public space with large areas of soft landscaping therefor Highly Likely users of the site will come into contact with the soils however, in several areas of the site no development has taken place/limited contamination Sources.<br>Discrete made ground will be present along the southern boundary and in the land raised section. Historical maps indicate mainly used for agricultural purposes and recreational activities too.<br>The main of concern is the south-western area: infilled land south of the site for Greyhound Coursing purposes. |
| | | Construction Workers & Maintenance Workers | **Moderate/Low:** Proposed community hub building is on the northern fringes of the land raised area. Site workers may come into contact with unknown Made Ground. Additional walking path will be construction in the southern area of site, and some changes along the embankment therefore workers will come into contact with these made ground soils.<br><br>Large areas of the site will remain as soft landscaping which will be attended to by maintenance workers. |
| | Root Uptake | Planted trees/vegetation | **Low:** the land is currently occupied by open fields. The northern section of the site will remain unchanged as the hare coursing ground relocated from it's current southern location. A new stand is proposed for hare coursing, location of which is yet to be decided.<br>Landscaping will be undertaken across the southern area around the events space, play areas and building however the majority of the site has remained undeveloped and the existing vegetation shows no sign of distress. |
| | Direct Contact | Buildings and structures | **Moderate/High:** Community building proposed however new hardstanding will be laid across Zone 4 which is currently grazing land. Unknown pH and sulphate concentrations across the site which may be aggressive to contact materials. Alluvial soils known to be aggressive. |
| Groundwater Contaminants | Leaching, lateral and vertical migration | Groundwater Bedrock | **Moderate** No groundwater abstractions in surrounding area. +10m of Superficial Deposits however assigned High vulnerability due to the granular nature of the overlying Drift deposits. |
| | Lateral Migration | Watercourse | **Very High:** High shallow water table in the Superficial Deposits is expected and will be in conductivity with the River Foyle and Nancy Burn. River Foyle still under tidal influence.<br>Superficial Deposits expected to be interlayered with granular beds which will laterally and vertically aid contaminant flow.<br>Main Building is within >70m of the Foyle, 45m north of where the SAC Designation commences. Ground levels slope towards the River therefore Highly Likely surface water runoff will occur. Permeable nature of underlying drift will allow for considerable infiltration of runoff to |

| Source | Pathway | Receptor | Risk Category / Rating |
|---|---|---|---|
| | | | ground, rather than into he River Foyle.<br>Any spillages at ground level will have the opportunity to travel through the layered Superficial Deposits and shallow groundwater table to the River.<br>CEMP will required to demonstrate how risks during the bridge construction will be managed to cause no impact on the SAC. |
| Ground gas / vapors generated from Made Ground | Gas ingress into buildings and site infrastructure | End site users | **High/Moderate:** May be organic layers within the Raised Tidal Deposits beneath the proposed building location and Made Ground expected in the area to the south of the building. |
| | Migration into services, inhalation of ground gas by workers | Construction Workers, Maintenance Workers | **Moderate**: Exposure times likely to be limited and may be dealt with in safe systems of works. |
| Radon | Gas ingress into buildings and site infrastructure | End site users | **Very High:** In an elevated radon area 5-10%. Depending on the design of the building radon protection may be required. |

**Table 8: ICSM for Strabane Zone 1 and Zone 4 (hardstanding and proposed parking)**

| Source | Pathway | Receptor | Risk Category / Rating |
|---|---|---|---|
| ON Site Soil : Historical Made Ground from railway<br><br>OFF SITE: Railway land, refuse tip and gas works | Ingestion / Direct Contact | End Site Users | **Moderate:** No previous investigation of the site, therefore composition and contaminant concentrations of Made Ground is unknown.<br>Made ground expected in the former Pond areas of Zone 4 and Made Ground beneath the Zone 1 hardstanding. Good Shed and Engine house identified in this area therefore may be localised hydrocarbon contamination. The buildings no longer exist, possible risk of asbestos in the ground. The hard standing will be removed, to be replaced by a soft landscaped field. |
| | | Construction Workers & Maintenance Workers | **High:** Historical railways are known sources of contaminants, including asbestos. No previous investigation of the site, therefore composition and contaminant concentrations of Made Ground is unknown to quantify the risk to the site workers. |
| | Root Uptake | Planted trees/vegetation | **Moderate :** Invasive species present across the site in specific locations.<br>The exiting site vegetation shows no sign of destress and has had to be cut back. Majority of the landscaping will be maintained in the redevelopment. |
| | Direct Contact | Buildings and structures | **Moderate/Low:** No buildings proposed however new hardstanding will be laid across Zone 4 which is currently grazing land. Unknown pH and sulphate concentrations across the site which may be aggressive to contact materials.<br>Alluvial soils known to be potentially aggressive. |
| Groundwater Contaminant on an off sites | Leaching, lateral and vertical migration | Deep Groundwater Bedrock | **Moderate** No groundwater abstractions in surrounding area. +10m of Superficial Deposits however assigned High vulnerability due to the granular nature of the overlying drift deposits. |
| | Lateral Migration | Watercourse / Shallow groundwater in Tidal Deposits in continuity | **Very High:** High shallow water table in the Superficial Deposits is expected and will be hydraulically connected to the River Foyle and Nancy Burn. River Foyle Likely under tidal influence and is SAC/ASSI<br>Superficial Deposits expected to be interlayered with granular beds which will laterally and vertically aid contaminant flow. |

| Source | Pathway | Receptor | Risk Category / Rating |
|---|---|---|---|
| Ground gas / vapors generated from Made Ground | Gas ingress into buildings and site infrastructure | End site users | **Low :** May be organic layers within the Raised Tidal Deposits and extensive Made Ground beneath the carpark and the infilled ponds however no buildings/structures proposed on the Strabane side. |
| | Migration into services, inhalation of ground gas by workers | Construction Workers, Maintenance Workers | **Low:** Exposure times likely to be limited and may be dealt with in safe systems of works. |
| Radon | Gas ingress into buildings and site infrastructure | End site users | **Low:** Within an elevated radon area however no structures proposed. |

**Table 9: ICSM for Strabane Zone 2 and Zone 3: Proposed Soft Landscaping**

| Source | Pathway | Receptor | Risk Category / Rating |
|---|---|---|---|
| ON Site Soil : Historical Made Ground from railway<br><br>OFF SITE: Railway land, refuse tip and gas works | Ingestion / Direct Contact | End Site Users | **Very High:** Historical railway embankments across both zones. These will be retained and no significant changes in ground levels are proposed. End users, public park, will come into contact with the soil. No previous investigation of the site, therefore composition and contaminant concentrations of the shallow Made Ground is Unknown. |
| | | Construction Workers & Maintenance Workers | **Very High:** Historical railways are known sources of contaminants, including asbestos. The embankments will be retained as part of the public park with new path surfacing for walking in some areas. Construction workers will therefore come into direct contact with the soils.<br>These zones of the site will be remain as soft landscaping therefore maintenance workings will have the opportunity to have come into contact with the soils. |
| | Root Uptake | Planted trees/vegetation | **High:** These Zones will remain soft landscaping. Although no signs of distress at present. Significant landscaping area will be kept in the development. |
| | Direct Contact | Buildings and structures | **Moderate** No buildings proposed in the Strabane side, however foundations for the footbridge required.<br>Some walkways are proposed around the wetland. These will need to be designed to with stand waterlogged soils and in the consideration to the chemical composition of any made ground and Drift Deposits. |
| Groundwater Contaminants | Leaching, lateral and vertical migration | Deeper Groundwater Bedrock | **Moderate** No groundwater abstractions in surrounding area. +10m of Superficial Deposits however assigned High vulnerability due to the granular nature of the overlying Tidal deposits. |
| | Lateral Migration | Watercourse / Shallow groundwater in Tidal Deposits in continuity | **Very High:** High shallow water table in the Superficial Deposits is expected and will be in conductivity with the River Foyle and Nancy Burn. River Foyle still under tidal influence.<br>Superficial Deposits expected to be interlayered with granular beds which will laterally and vertically aid contaminant flow.<br>Buffers will need to be maintained for DfI Rivers access and to provide protection during the development phase.<br>CEMP will required to demonstrate how risks during the bridge construction will be managed as the River Foyle is SAC and ASSI. |
| Ground gas / vapors generated from Made Ground | Gas ingress into buildings and site infrastructure | End site users | **Low :** May be organic layers within the Alluvial Drift Deposits and extensive Made Ground beneath the carpark and the infilled ponds however no buildings/structures proposed on the Strabane side. |
| | Migration into services, inhalation of ground gas by workers | Construction Workers, Maintenance Workers | **Low:** Exposure times likely to be limited and may be dealt with in safe systems of works. |

| Source | Pathway | Receptor | Risk Category / Rating |
|---|---|---|---|
| Radon | Gas ingress into buildings and site infrastructure | End site users | **Moderate:** Within an elevated radon area however no structures proposed. |

# 7.0 PRELIMINARY ASSESSMENT OF LAND QUALITY AND GEOTECHNICAL RISKS

Table 10 and Table 11 below provides commentary on the preliminary assessment findings of Section 2 and Section 6.

**Table 10: Lifford Site Assessment Summary**

| Geotechnical and Health and Safety Assessment Feature | Influence | Commentary, Concerns |
|---|---|---|
| Existing Services and Structures | Constraints on site investigation and possible existing foundations and live services | In the south-western area ESB underground electric cables are indicated to running initially along the western boundary and then within the site in an east west direction to the building located on the coursing ground. ESB cables will be diverted underground.<br><br>There is a Final Effluent Outfall pipe crosses north-south across the south-western corner of the site. The Lifford treatment plant is located beyond the southern boundary. The foul gravity sewer is shown run parallel with the boundary.<br><br>Septic tank next to the crossing stadium, which will be made redundant as part of the development, as the coursing area will be relocated northerly and served by contained system.<br><br>Part culverted watercourse in the northern area. |
| Topography | Site Layout,<br><br>Groundworks,<br><br>Accessibility | Topography is relatively flat and gently slopes down to the river, reducing from 3.45mOD in the southern area of the site north of the sewage treatment plant.<br><br>Majority of the site is soft landscaping.<br><br>Currently one main access route: south-western corner from Station Road. The track then runs parallel with river extending to lands beyond the northern red line boundary. |
| Slope Stability | Embankments/<br><br>cuttings<br><br>earth retaining features<br><br>engineered fills | Ditch present in the north of the site. Embankment along the river which is some places 3m higher in elevation that the land to the south/east along the river.<br><br>It is understood an area of infill is present in the south-western area of the site associated with the coursing activities. The area is no significantly different elevation in comparison to the other areas of the site. |
| Flooding | Further Risk Assessment<br><br>Site Layout | Majority of the site is within the modelled floodplain of the River and has been subject to historical flooding events. This is discussed further in the McCloy Consulting Flood Risk Assessment. |
| Made Ground / Settlement | Variation in nature and thickness of Made Ground may influence settlement characteristics/foundation design | Made Ground fill, assumed engineered fill located in the south-western corner. New pathways and community hub proposed in this area. |
| Soft ground / | Variation in nature and thickness of natural soils | The site in within flood plain. Areas of soft clays should be expected with the Tidal Deposits variable with depth. Organic deposits may |

| Geotechnical and Health and Safety Assessment Feature | Influence | Commentary, Concerns |
|---|---|---|
| Settlement | may influence settlement characteristics/foundation design | also be present, so with the high water table piled foundations will need to be considered for the community hub.<br><br>Play areas and walkways will need to have a suitable granular subbase to ensure heave/compressible does not have a significant range.<br><br>The proposed bridge and community hub building will need to be on piles due to the expected depth of variable Superficial Deposits and high water table. |
| Bedrock Type Discontinuities | Potential for fracturing/faulting to affect ground stability and foundation design | Fault +60m north west of the Lifford boundary, which is +250m from the proposed building. Fault +140m south of the Strabane boundary. Geological maps shown the quartize to be dipping to the north-east 10 to 35°.<br><br>There are no structural faults shown on the site or immediate adjacent the site boundary. Site likely to be Unaffected. |
| Karst or Gypsum Dissolution Features | Potential to influence ground stability | Not associated with the predicted geology. |
| Mines and Shafts | Potential to influence ground stability | None identified within 1km of the site. |
| Groundwater | Large inflows requiring management<br><br>Stability of excavations | River Foyle 70m from the proposed hub building. All of the site is within floodplain.<br><br>High standing level expected. Tidal influence likely. Variable nature of Tidal Deposits granular layers are Likely to spall and collapse, with high flow water ingress. Groundwater level monitoring will be required to establish standing level and any tidal range. Temporary construction damming works may need to be considered when constructing the building floor and foundation for the footbridge should the water table be very high.<br><br>Utilities will need to be flood resistant and resilient as groundwater flooding, the shallow water table in the Tidal Deposits will vary with the river flood level. |
| Contaminated Ground | Potential for Impact on surrounding environment and human health<br><br>Potential Investigation and Remedial Costs | Unknown material in to raise the south-western corner.<br><br>Embankment along the southern area which is +3m higher in elevation than lands to the south which will be regraded in places as part of the development.<br><br>Septic tank adjacent the club house. |
| Ground gas | Potential for Impact on human health<br><br>Requirement for protective features | Alluvial soils of the Superficial Deposits may contain organic bands, thereby producing ground gas.<br>Sand and gravels bands will enable gas pathways from any unknown sources. |
| Radon | Naturally Occurring Risk | Underlying bedrock is high radon potential therefore radon |

| Geotechnical and Health and Safety Assessment Feature | Influence | Commentary, Concerns |
|---|---|---|
| | to Human Health<br><br>Requirement for protective features | protections may be needed in the community hub building. |
| Asbestos | Presence of Made Ground of unknown origin or because of past demolition<br><br>Potential for Impact on human health | The contents of the raised embankment parallel with the river are unknown. There are no known historical structures. Although not confirmed the embankment may have been part of the railway infrastructure and as such historical railway ballast may be present. |
| Requirement for S.I. | Site investigation is required | Soft , variable Alluvial soils site with high water table expected. Geotechnical testing CBR/DCPs/Plate loads to determine strength of the shallow soils for the proposed pathways.<br><br>SPTs around the proposed building and where large structures required. Boreholes to determine depth to rock head as piled foundations likely needed for the building and will be required for the footbridge foundations.<br><br>Chemical analysis of the soils to confirm the pH and SO4 so that the correct concrete class can be utilised for the building and footbridge foundations.<br><br>Groundwater level monitoring will be required to establish standing level and any tidal range.<br><br>Consideration of the intrusive technique due to the proximity of the Foyle and SAC designation. |

**Table 11: Strabane Site Assessment Summary**

| Geotechnical and Health and Safety Assessment Feature | Influence | Commentary, Concerns |
|---|---|---|
| Existing Services and Structures | Constraints on site investigation and possible existing foundations and live services | Nancy Burn crosses the northern area of the site. Park Road Drain located along eastern boundary. Buffers to both will need to be maintained.<br><br>Buried railway infrastructure has a probability of being encountered across the site. Foundations of engine house and goods shed may be present in Zone 1, which is proposed as soft landscaping.<br><br>Large areas are covered by dense vegetation and water logging in the north-western area (Zone 3).<br><br>NIE Electric cable shown to enter the site in the south-eastern corner. Redundant services for the previous traveller accommodation is likely to present across the existing hardstanding area. |
| Topography | Site Layout, | Existing hardstanding area in the south of the site will become soft |

| Geotechnical and Health and Safety Assessment Feature | Influence | Commentary, Concerns |
|---|---|---|
| | Groundworks,<br>Accessibility | landscaping in the development.<br>New car park in the north-east is currently a grass field, across which the historical mapping showed ponds, a railway and peat. This area will require groundworks to ensure it is suitable for its proposed end use.<br>Site levels vary due to the majority of the historical railway embankments. These will be retained and some positions will become walkways. No significant changes to ground levels proposed.<br>Access available from the north and south. |
| Slope Stability | Embankments/<br>cuttings<br>earth retaining features<br>engineered fills | Outfall of the Nancy Burn will be within 10m of the purposed foot bridge.<br>Two raised railway embankment features are present (along the eastern boundary, and along the western and central portion of the site). These are unlikely to have been engineered fill in compliance with todays Standards however their end use will be as walkways therefore no significant loads to be applied.<br>Nancy Burn ditch crosses the northern area of the site, passed through a culvert beneath two tracks. |
| Flooding | Further Risk Assessment<br>Site Layout | Majority of the site is within the modelled floodplain of the River and has been subject to historical flooding events. This is discussed further in the McCloy Consulting Flood Risk Assessment. |
| Made Ground / Settlement | Variation in nature and thickness of Made Ground may influence settlement characteristics/foundation design | In the north-west of the Strabane side, historical peat and ponds are shown therefore soft ground expected, which is indicated to have subsequently been infilled.<br>Made Ground associated with the historical railways, with a large area of Made Ground marked on the GSNI mapping beneath the existing hardstanding area. These areas are proposed for car parking. |
| Soft ground / Settlement | Variation in nature and thickness of natural soils may influence settlement characteristics/foundation design | The site in within flood plain. Areas of soft clays should be expected with the Tidal Deposits variable with depth. Organic deposits may also be present, with the high water table due to the proximity of the River Foyle. The hardstanding areas will need to have a suitable subbase to support the vehicle loads.<br>Piled foundations will need to be considered for the foot bridge foundations.<br>The railway embankment may need to have a suitable granular subbase to ensure heave/compressible does occur on the proposed walk ways. |
| Bedrock Type Discontinuities | Potential for fracturing/faulting to affect ground stability and foundation design | Quartzite is the bedrock across the entire site. |
| Karst or Gypsum Dissolution Features | Potential to influence ground stability | Not associated with quartzite. |
| Mines and Shafts | Potential to influence ground stability | Highly unlikely for both sites due to no Mines and Shafts sites being located near both the Strabane and Lifford sites. |

| Geotechnical and Health and Safety Assessment Feature | Influence | Commentary, Concerns |
|---|---|---|
| Groundwater | Large inflows requiring management<br>Stability of excavations | High standing level expected. Tidal influence likely. Variable nature of Tidal Deposits granular layers are likely to spall and collapse, with high speed water ingress around any foundation preparation for the footbridge across the Foyle.<br>Groundwater level monitoring will be required to establish standing level and any tidal range.<br>Utilities associated with the car parking will need to be flood resistant and flood resilient as groundwater flooding, the shallow water table in the Tidal Deposits will vary with the river flood level. |
| Contaminated Ground | Potential for Impact on surrounding environment and human health<br>Potential Investigation and Remedial Costs | Although no buildings are proposed for the site, the site will predominantly be soft landscaping public open space.<br>Historical railways known to be a contamination industry. Contaminant concentrations will need to be established to confirmed if any remedial actions will be needed to protect the end users or the construction workers from the historical railway embankment material. Possible remedial works to protect SAC, construction workers and end users. |
| Ground gas | Potential for Impact on human health<br>Requirement for protective features | Zone 1 is shown to be Made Ground by GSNI. Peat and made ground expected in Zone 4. Alluvial soils of the Superficial Deposits may contain organic bands, thereby producing ground gas.<br>Sand and gravels bands will enable gas pathways from any unknown gases sources.<br>However, no permanent structures proposed on this Strabane side of the site therefore no end user receptor.<br>Construction and utility workers risks would be eliminated through confined spaces protocol. |
| Radon | Naturally Occurring Risk to Human Health<br>Requirement for protective features | Elevated radon area, however no permanent structures proposed. |
| Asbestos | Presence of Made Ground of unknown origin or because of past demolition<br>Potential for Impact on human health | Historical railways area a known contaminative industry, with asbestos fibres known to have been released from breaks and as fire retardants in buildings. Goods sheds and Engine House in Zone 1 hardstanding area. Risk of hydrocarbon and other soil/groundwater pollution being present.<br>Investigate areas of historical significance as this is likely where contamination will be. Made Ground could contain ACM, and investigate areas previously mapped as bog or ponds, as infill may contain ACM. |
| Requirement for S.I. | Site investigation is required | Site investigation required to investigate the Made Ground across the site to protect the end users, site workers and the environment from the historical railway materials expected to be present across the site.<br>Soft Alluvial soils across all the site with high water table. Geotechnical testing CBR/DCPs/Plate loads to determine strength of the shallow soils for the proposed pathways.<br>SPTs and Boreholes to determine depth to rock head as piled |

| Geotechnical and Health and Safety Assessment Feature | Influence | Commentary, Concerns |
|---|---|---|
| | | foundations be needed for the footbridge foundations.<br><br>Chemical analysis of the soils to confirm the pH and SO4 so that the correct concrete class can be utilised for the building and footbridge foundations.<br><br>Groundwater level monitoring will be required to establish standing level and any tidal range.<br><br>Consideration of the intrusive technique due to the proximity of the Foyle and SAC designation. |

# 8.0 SUMMARY AND RECOMMENDATIONS

Limited development is shown have occurred across the Lifford side of the site. Lifford WwTP is located beyond the south-western boundary. A limited area of land raise has taken place in the south-western area, as part of greyhound coursing activities. The depth and composition of the fill is unknown and presents a source of ground gas, and contaminant risk to the end users and groundwater. The proposed community building will be located immediately to the north of this area and therefore requires investigation.

A raised embankment is located along the southern boundary of the Lifford side will regraded in places. The composition of the embankment is known and therefore requires investigation to quantify the risks to human health.

The Strabane side of the site, historically was crossed by several railway lines and terminal sidings. A Goods Shed and Engine House were situated in the south eastern area of the site which is now hardstanding. Hotpot areas of hydrocarbon contamination may be present around these buildings. Underground structures may still be present in this area. The area was more recently utilised as a traveller residential park with multiple utilities installed. The development will utilise this area as soft landscaping.

The historical railway embankments are still present in the western and eastern areas of the site, with historical railways know to be a contaminative industry, including the use of fibrous asbestos and asbestos lagging. These embankments will be utilised as a walkways in the development, with little change in proposed final ground levels therefore potential pollutant linkages exists between the unknown soils and the public users of the site. These will require an intrusive investigation to allow an assessment of risk to the end public users of the site and the construction workers in preparing the site, widening and resurfacing the walkways.

Regarding the northern area of the site, that is proposed for car park, the historical mapping identified ponds and a railway line in this area, however at current ground level no evidence of these structures is observed. Unknown fill material and made ground is likely to be present in this area, which will become carparking. The nature of the underlying soils in this area needs to be determined geotechnically and chemically.

The Nancy Burn crosses northern area of the site discharging to the River Foyle which is Designated a SAC and ASSI. The Park Road flows northerly at the toe of the eastern

embankment, discharging into the Nancy Burn. A stagnant pond is also located in the northern area, with several areas of standing water located across the central area of the site. This central area is proposed to be developed into a wetland.

A shallow water table is expected due to the proximity of the River Foyle and the site is shown to be impacted by the Modelled in Detail flood plain. The underlying Tidal Deposits are likely to be variable in nature and will allow hydraulic conductivity from the soils on site to the surrounding surface water receptors. The depth to standing groundwater level needs to be established to allow an assessment of risk to the surface water receptors.

A footbridge is proposed to span the River Foyle. Piled foundations will be required due to the high water table, proximity of the river and anticipated thickness and variability of the Tidal Deposits. Boreholes are recommended, drilled to rockhead with the installation of groundwater monitoring wells. The drilling technique will need to consider the proximity of the River and Designated status.

**A ground investigation to quantify the risks to human health and the environment is required under LRCM due to the multiple potential pollutant linkages identified in the initial conceptual models.**

A ground investigation comprising deep and shallow boreholes is required to be undertaken across the site to establish groundwater levels and existing groundwater quality. Level loggers should also be installed across site to establish the tidal range on both sides of the river.

Gas monitoring will be required surrounding the proposed community building to determine if ground gas protection measures will be required due to potential for gas from the land raised area and the underlying natural Tidal Deposits. Radon protection measures maybe required in the building at the site is located in an elevated radon area.

Shallow soil samples should be obtained across the site to allow an assessment of the shallow soil contaminant concentrations. Proposed toddler and child play areas are proposed with little change in existing ground levels therefore contact pathways will exist.

A Construction Environmental Management Plan will need to be developed to detail how the risks to surface waters will be managed during construction.

Invasive species were observed across the site, including Giant Hogweed and Japanese Knotweed. The Giant Hogweed presents as risk to human health and therefore an invasive species management plan will be needed.

| **Report prepared by:** | **Reviewed by:** |
|---|---|
| **Thomas Martin BSc MSc FGS**<br>**Land Quality Consultant** | **David McLorinan BSc MSc FGS CGeol**<br>**Senior Consultant** |

# APPENDIX A: Utility Information from Free Providers

ESB Networks

# TITLE:

20210428-046_A0

COLOUR CODE:

- BLACK - 38KV & HIGHER VOLTAGE OVERHEAD LINES
- GREEN - MV(10KV/20KV) OVERHEAD LINES
- BLUE - LV (400V/230V) OVERHEAD LINES
- CYAN - 38KV & HIGHER VOLTAGE UNDERGROUND CABLE ROUTES
- RED - MV/LV (10KV/20KV/400V/230V) UNDERGROUND CABLE ROUTES

DATE: 28-Apr-2021

** SCALE: 1:2000

** SCALE WHEN PRINTED ON AN A0 PAGE
XY COORDINATES DISPLAYED IN IRISH GRID COORDINATE SYSTEM

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## WARNING

THIS MAP INDICATES THE APPROXIMATE LOCATION OF ESB TRANSMISSION (400KV, 220KV, 110KV, 38KV) AND DISTRIBUTION (20KV, 10KV, 230V/400V) UNDERGROUND CABLES AND OVERHEAD LINES IN THE GENERAL AREA OF THE PROPOSED WORKS. ESB NETWORKS TAKES NO RESPONSIBILITY FOR THE ACCURACY OR COMPLETENESS OF THE MAP. IT IS THE USER'S RESPONSIBILITY TO INDEPENDENTLY VERIFY THE INFORMATION AND THE LOCATION OF UNDERGROUND CABLES AND OVERHEAD LINES. LOW VOLTAGE (230V/400V) SERVICE CABLES (E.G. HOUSE SERVICES, FACTORY/SHOP SERVICES, PUBLIC LIGHTING LAMP SERVICES, ETC) ARE NOT INCLUDED BUT THEIR PRESENCE SHOULD BE ANTICIPATED. THE DEPTHS OF UNDERGROUND CABLES MUST NEVER BE ASSUMED. ADDITIONAL MORE DETAILED INFORMATION IS AVAILABLE FOR HIGH VOLTAGE TRANSMISSION UNDERGROUND CABLES (38KV, 110KV, 220KV, 400KV) FROM THE LOCAL ESB NETWORKS TRANSMISSION REPRESENTATIVE - SEE ATTACHED LIST FOR CONTACT DETAILS OR CALL 1850 372 757. NO WORK SHOULD BE CARRIED OUT IN THE VICINITY OF 38KV OR HIGHER VOLTAGE UNDERGROUND CABLES WITHOUT PRIOR CONSULTATION WITH ESB NETWORKS. BEFORE ANY MECHANICAL EXCAVATION IS UNDERTAKEN, THE ACTUAL LOCATION OF ALL UNDERGROUND ELECTRICITY CABLES MUST BE ESTABLISHED AND VERIFIED ON THE SITE USING:
(A) UP-TO-DATE MAP RECORDS; (B) CABLE LOCATER EQUIPMENT OPERATED IN BOTH POWER AND RADIO MODES;
(C) CAREFUL HAND DIGGING OF TRIAL HOLES USING 'SAFE DIGGING PRACTICE'. REFER ALSO TO 'HSA CODE OF PRACTICE FOR AVOIDING DANGER FROM UNDERGROUND SERVICES'. ESB TAKES NO RESPONSIBILITY FOR AND SHALL BEAR NO LIABILITY, HOWSOEVER ARISING, IN RELATION TO ANY DAMAGE, INJURY/DEATH OR LOSS OF SUPPLY AS A RESULT OF DAMAGE OR INTERFERENCE WITH ITS NETWORKS.

ESB NETWORKS HAS ISSUED THIS MAP AS A PDF DOCUMENT. IF VIEWING A PAPER VERSION OF THIS MAP, THE VIEWER MUST ENSURE THAT IT HAS BEEN PRINTED IN COLOUR TO FIT TO AN A0 (OR LARGER) PAGESIZE AND THAT EACH OF THE COLOURS INDICATED ON THE COLOUR CODE LEGEND ABOVE ARE CLEAR AND DISTINCT FROM EACH OTHER TO MAINTAIN A CORRECT REPRESENTATION OF THE ELECTRICAL NETWORK INFORMATION.

X,Y: 232354 , 399646

X,Y: 234675 , 399646

X,Y: 232354 , 398108

X,Y: 234675 , 398108

DRUMBOY
CROGHAN HTS
COMMON
GREYHOUND STADIUM
LETTERKENNY RD
SERVICE STATION
LIFFORD BARRACKS
AUTO EXCHANGE
LIFFORD BOG
LIFFORD N
CO CO YARD
3 RIVER CENTRE
LIFFORD CELTIC
STATION RD PLANT
MAIN STREET
TAR HEATING PLANT
CO HOSP

# Enquiry Confirmation

**Job No 19128**

Date of enquiry: 27/04/2021

## Enquirer

| | | | |
|---|---|---|---|
| Name | Miss Victoria Reain | Phone | 07719958754 |
| Company | MCL Consulting | Mobile | Not Supplied |
| | | Fax | Not Supplied |
| Address | 48 Duncrue Street Duncrue Street<br>Belfast | | |
| Email | victoria@mclni.com | | |
| Notes | Asset Owners have been requested to respond to you via these contact details, please ensure they are correct. Where Asset Owners charge for plans they have been requested to send you a quote before proceeding. | | |

## Enquiry Details

| | | | |
|---|---|---|---|
| Scheme/Reference | Not Supplied | | |
| Enquiry type | Planned Works | Work type | Design Only |
| Start date | 30/04/2021 | End date | 09/05/2021 |
| Site size | 203854 metres square | | |
| Searched location | XY= 633735, 898754 | | |
| Confirmed location | Not Supplied | | |

## Site Map






Map data ©2012 Google

# Enquiry Confirmation

Date of enquiry:

## Asset Owners

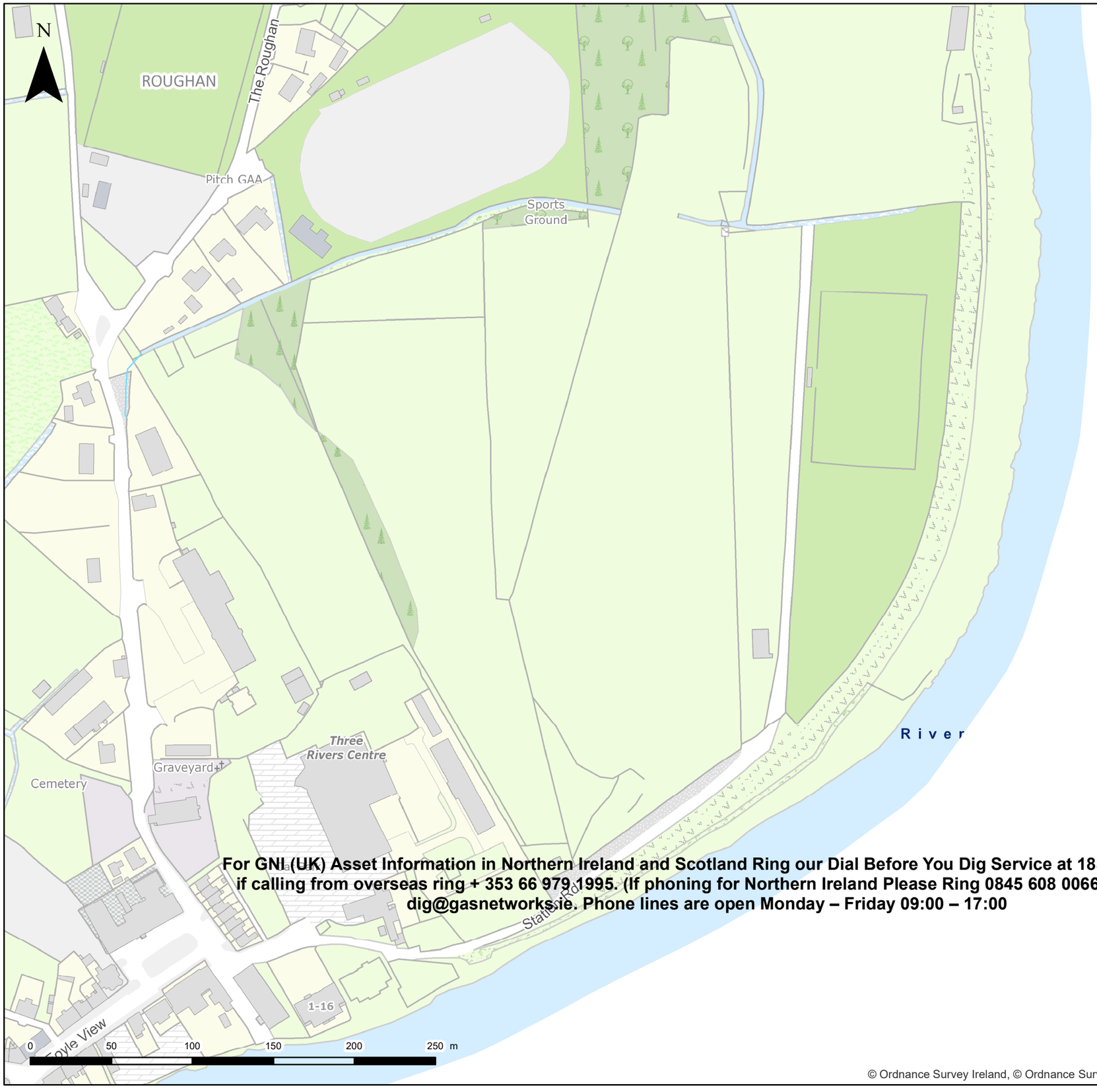
Subject always to our standard terms and conditions, this enquiry result is valid for 28 days only from the date of enquiry and is based on the confirmed information you entered. If the location of the work changes then a further enquiry must be made. Should the work not be undertaken within 28 days of the enquiry then a further enquiry must be made.

The following Asset Owners MAY have assets near your proposed work site.

Please note, Asset Owners with the status of 'Not Notified' are not registered with the beforeUdig service and have not been informed of your intention to dig. beforeUdig is aware of their existence and they are listed here for information purposes only. Please note that this list in not exhaustive and all contact details are provided as a guide only. It is your responsibility to contact them directly as well as any other asset owners not listed by beforeUdig. It is your responsibility to identify and consult with all asset owners before proceeding.

| Seq. No. | Authority Name | Phone | Status |
|---|---|---|---|
| 62096 | BT Ireland | 014326400 | Not Notified |
| 62097 | COLT | 014365900 | Not Notified |
| 62104 | Donegal County Council | 0749153900 | Not Notified |
| 62098 | Eir | cbyd.emaps.eircom.ie | Not Notified |
| 62099 | enet | planning@e-net.ie | Not Notified |
| 62100 | ESB Networks | 1850928960 | Not Notified |
| 62103 | Gas Networks Ireland | 1850427747 | Not Notified |
| 62102 | Irish Water | 1850278278 | Not Notified |
| 62101 | Virgin Media | 1908 | Not Notified |

END OF UTILITIES LIST




**For GNI (UK) Asset Information in Northern Ireland and Scotland Ring our Dial Before You Dig Service at 1850 42 77 47, if calling from overseas ring + 353 66 979 1995. (If phoning for Northern Ireland Please Ring 0845 608 0066) or Email dig@gasnetworks.ie. Phone lines are open Monday – Friday 09:00 – 17:00**

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**Important Safety Notice:** Damage to gas pipelines can result in serious injury or death. Gas network information is provided as a general guide. The exact location and depth of medium or low pressure distribution gas pipes must be verified on site by carrying out necessary investigations, including, for example, hand digging trial holes along the route of the pipe. Service pipes are not generally shown but their presence should always be anticipated.

High pressure transmission pipelines are shown in red. If a transmission pipeline is identified within 10m of any intended excavations then work must not proceed before GNI has been consulted. The true location and depth of a transmission pipeline must be verified on site by a representative of GNI. Contact can be made through 1850 427 747.

**All work in the vicinity of the gas network must be completed in accordance with the current edition of the Health and Safety Authority publication, 'Code of Practice For Avoiding Danger From Underground Services' which is available from the Health and Safety Authority (1890 289 389) or can be downloaded at www.hsa.ie.**

**Legal Notice:** Gas Networks Ireland (GNI) and its affiliates, accept no responsibility for the accuracy of any information contained in this document including data concerning location and technical designation of the gas distribution and transmission network (the"Information"). The Information should not be relied on for accurate distance or depth of cover measurements.

Any representations and warranties, express or implied, are excluded to the fullest extent permitted by law. No liability shall be accepted for any loss or damage including, without limitation,direct, indirect or consequential loss, arising out of or in connection with the use or re-use of the Information.

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- Aurora Telecom Duct
- Aurora Telecom Sub Duct
- Aurora Telecom Inserted Gas Pipe

Aurora TELECOM

Aurora Telecom Queries - 01-8926166 (Office Hours)
Aurora_Network_Queries@gasnetworks.ie
Aurora Telecom Emergency Only 1850 427399 / 01 2030120

- Transmission Pipe (High Pressure)
- Transmission Pipe (Construction Issue)
- Distribution Pipe (Medium Pressure)
- Distribution Pipe (Low Pressure)
- Service Pipe (Medium Pressure)
- Service Pipe (Low Pressure)
- Strategic Pipe (Medium Pressure)
- Strategic Pipe (Low Pressure)
- Inserted
- Abandoned Pipe

| | | | |
|---|---|---|---|
| C=? | Cover (depth in metres) | | Pressure Monitor |
| CP | CP Test Point | | Protection (Slabbing) |
| | End Cap | | Protection (Sleeve) |
| | Hot Tap | | Reducer |
| | Installation | | Service Terminator |
| | Valve | | Tee |
| | Mains Verification** | | Transition |

** Please contact GNI on 1850-427747 for specific information

DIAL BEFORE YOU DIG 1850 42 77 47
In Emergency call 1850 20 50 50 Gas Networks Ireland

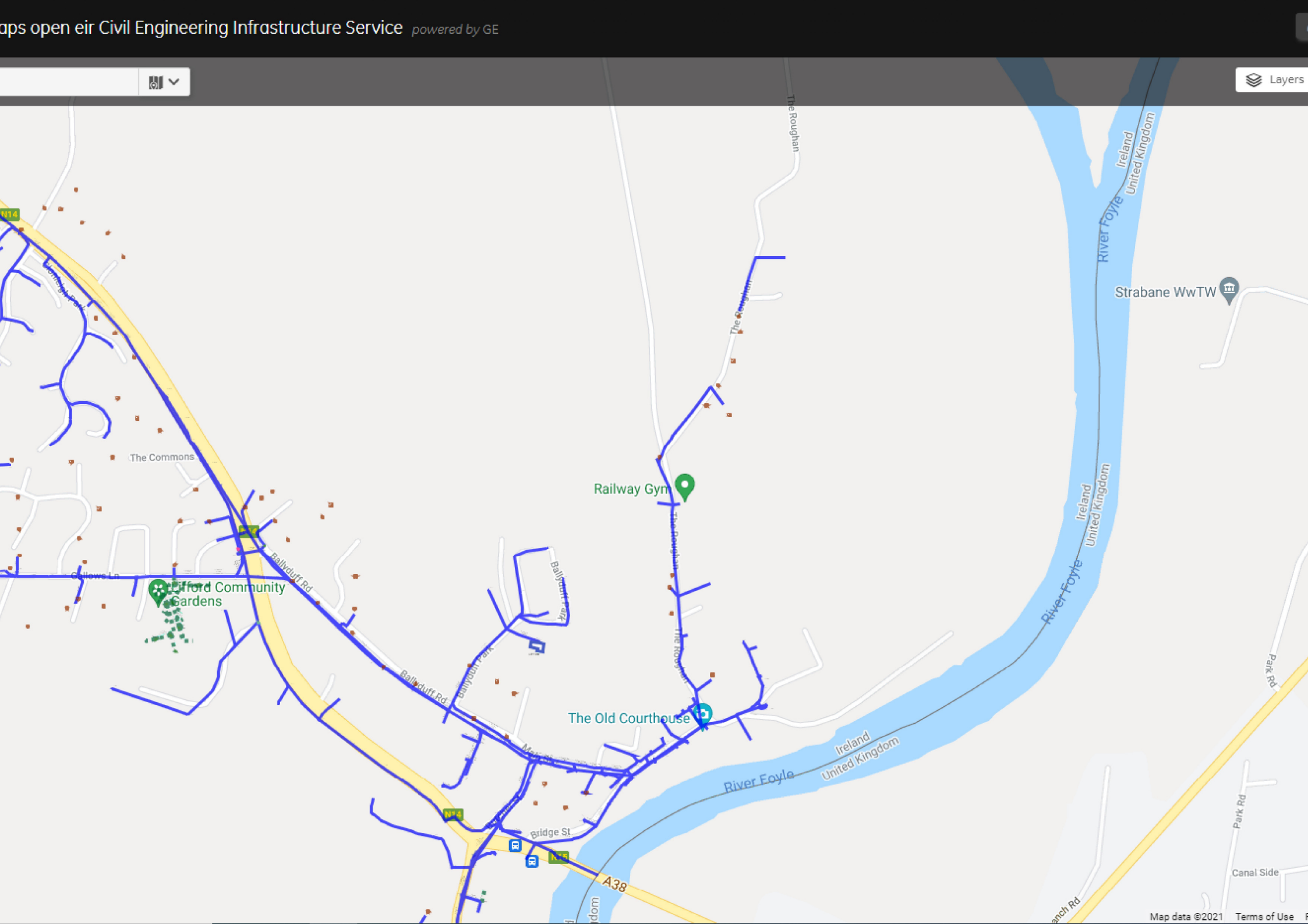
Gas Networks Ireland

# GAS NETWORK INFORMATION

Description:

Location: 633742,898764

| | |
|---|---|
| Plot Date: 28/04/2021 14:18 | Scale: 2500 @ A3 |
| Plotted By: 3074 | Ref ID: *3074_28042021141814* |


aps open eir Civil Engineering Infrastructure Service powered by GE
Layers
The Roughan
River Foyle
Ireland
United Kingdom
Strabane WwTW
The Commons
Railway Gym
Gillows Ln
Clifford Community Gardens
Ballyduff Rd
Ballyduff Park
The Old Courthouse
Bridge St
N14
A38
Park Rd
Canal Side
Map data ©2021
Terms of Use

# Legend

## CAUTION_AREA

BT.CAUTION_AREA

## EQUIPMENT

TABCD FIBRE, TCODE

COPPER, CABINET

476R COPPER, DP

## DUCT

A/C AERIAL

TUNNEL

DUCT

## PROPOSED

A/C AERIAL

DUCT

## STRUCTURE

YCODE

CABINET SHELL

SPLIT COUPLING

POLE

KIOSKS

MANHOLE

JOINTBOX

CHANGE OF STATE

DUCT TEE

## PROPOSED

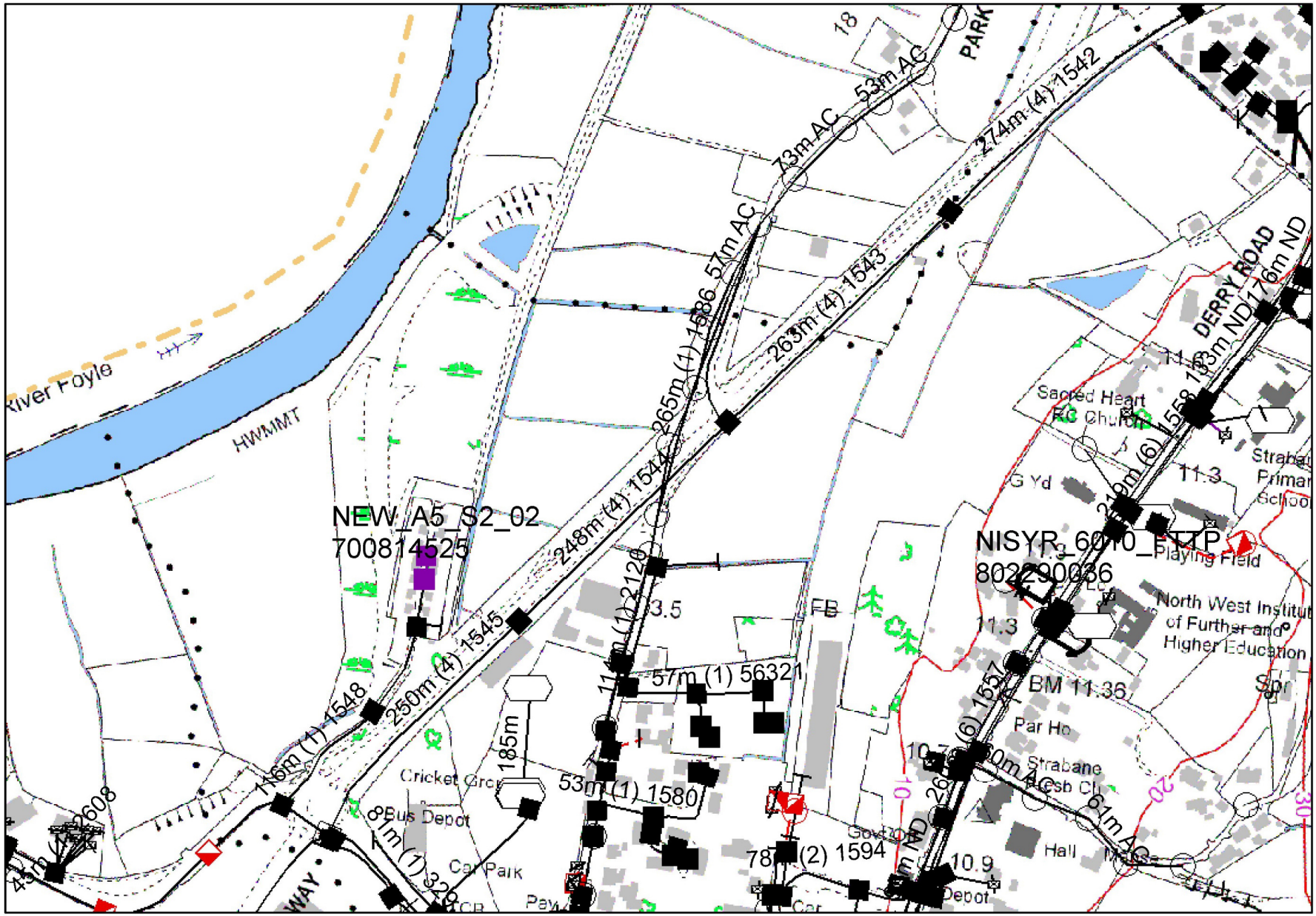
MANHOLE

JOINTBOX

DUCT TEE

Other proposed plant is shown using dashed lines.

BT symbols not listed above may be disregarded.

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Exisiting BT plant may not be recorded.
Information valid at time of preparation.

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**Asset Management Unit**

**Dfl Rivers**

**49 Tullywiggan Road**

**Loughry**

**Cookstown**

**BT80 8SG**

**Tel: 028867 68300**

**Our Ref: IN1-21-7199**

**Your Ref: P2288**

**Date: 28/04/2021**

Dear Victoria

Re: - property located to the west of the Barnhill Road, and west of Park Road, Strabane

Thank you for your enquiry received 27/04/2021 regarding the above site. There are known watercourses nearby which are designated within the terms of the Drainage (Northern Ireland) Order 1973.

The designated watercourses are shown delineated in pink. The actual alignment of the watercourses may not be accurately depicted, as realignment or culverting work may have been undertaken subsequent to designation. In these circumstances the alignment indicated by the culvert is considered to be more reliable.

It should be emphasised that any information provided is approximate and should be considered as guidance only. Before any works are carried out you should determine the exact position of these services on site. There may be undesignated watercourses, within or bounding the site, about which we are unaware. DfI Rivers does not maintain a database of undesignated watercourses, which may be present at the site. In this regard, you are advised to consult with Ordnance Survey, and/or undertake site inspections, etc. Within the terms of the above mentioned Order you are advised as follows:

1. If during the course of developing a site a watercourse is uncovered which was not previously evident, the Omagh Office at Woodside Avenue, Gortin Road, OMAGH BT79 7BS, Tel. 02882254900, must be contacted immediately in order that arrangements may be made for an investigation and direction in respect of any possible actions that may be necessary to maintain its drainage function; moreover

2. Any proposal either temporary or permanent in connection with a development that may impact on the drainage function of any watercourse within the site, now or in the future, such as release of storm water to, culverting, bridging, diverting building, adjacent to and/or over, etc. requires prior written consent from the Department. Details of such proposals,

together with accompanying drawings, maps and calculations etc. must be submitted in advance of any development to the Omagh Office at Woodside Avenue, Gortin Road, OMAGH BT79 7BS, Tel. 02882254900. Failure to obtain such a written consent is an offence under the provisions of the above Order, which may lead to prosecution or other statutory action as provided for.

The Department does not accept any liability for loss, injury or damage to any person or property as a result of any inaccuracy in the above information provided. In this regards you are advised to seek the services of qualified competent professional bodies to ascertain the suitability and completeness of the information regarding the location, condition of and responsibility for any buried services at this location.

Future requests regarding the information on the Department's drainage and flood defence infrastructure should continue to be addressed to the DfI Rivers Asset Management Unit at the above address.

Yours sincerely

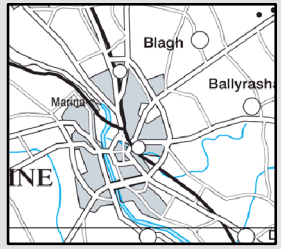
Robert Keightley

Asset Management Unit

# Dfl Rivers Infrastructure

**Location of Designated Watercourses & Assets managed by Dfl Rivers.**

MAP COVERAGE - LOCATION




Scale 1:5,000 when plotted at A4

## Dfl Rivers Infrastructure

- Watercourses (Designated)
- Network Pipe
- Network Pipe Node
- Flood Defence Structure
- River Level Gauging Station
- River Level Alert Station

NOTES on Information shown.

1. Any proposals, either temporary or permanent, which involve interference with any watercourse, such as culverting, bridging, diversion, building adjacent to, or discharge of stormwater etc. require the written consent of Dfl Rivers. Failure to obtain such written consent is an offence under the provisions of the Drainage (NI) Order 1973, which may lead to prosecution or other statutory action as provided for.

2. If during the course of developing a site, a watercourse is uncovered which was not previously evident, Dfl Rivers should be notified immediately in order that arrangements may be made for investigation and direction in respect of any action to deal with said watercourse. You are advised to assess the suitability/correctness of the information provided as Dfl Rivers does not accept liability for loss, injury or damage to any person or property caused as a result of any inaccuracy in the information provided.

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RAILWAY STREET
DERRY ROAD

Department for Infrastructure
An Roinn Bonneagair
www.infrastructure-ni.gov.uk

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N W E S

ORDNANCE SURVEY OF NORTHERN IRELAND

0 37.5 75 150 225 300 375 450 Metres

1:7,500 (at A4)

Coordinate System: Irish Grid.
Coordinates in metres.
Heights in metres above MSL Belfast.

Compiled & published by the Department for Infrastructure, Dfl Rivers, 49 Tullywiggan Road, Loughry, Cookstown, County Tyrone, BT80 8SG.

**Dfl Rivers Ref.** IN1-21-7199

Publication Date: 28/04/2021

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Forty Eight North
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Belfast
BT3 9BJ

Virgin Media
Field Services
Units 1-12
Broad Lane
Mayfair Business Park
Bradford
Yorkshire
BD4 8PW

Tel: 0870 888 3116 Opt 2

| | |
|---|---|
| Plant Enquiry Ref: | VM.1187950 |
| Letter Date | 28.04.2021 |
| Your Ref: | P2288 |
| Date: | 28.04.2021 |

Dear Sir/Madam,

Enquiry Location:

Barnhill Road, and west of Park Road, Strabane BT82 8EL

Thank you for your enquiry regarding work at the above location.
I enclose a copy of our above referenced drawing, marked to show the approximate position of plant owned and operated by Virgin Media.

You will be aware that you have a duty to ensure that no damage results to this equipment as a result of your proposed works. Please note that this apparatus may contain Fibre Optic, Coaxial and/or 240v Power Cables and as such, special care must be taken when excavating this area.

Should you require Virgin Media apparatus to be diverted we must agree a specification of works and provide a detailed estimate of costs. The costs are £720 (Business) or £240 (Residential) Inc VAT and the charge applies to each individual scheme requested.
Both the estimate and specification will be sent to you within 25 working days of when the payment was received.

This initial payment will cover the following: -

•Detailed site visit by an experienced planning engineer.(Up to 10 hours planning time)

•Detailed specification of works.

•Detailed breakdown of costs.

Payment is required in advance for the estimated cost of detailed design work and the charge applies whether or not your works proceed. Please supply us with your payment and a copy of your plans or drawings and quote ‘Our Ref’ as above.

The address to send the cheque is:

Diversionary Works, Virgin Media, 1 Dove Wynd, Strathclyde Business Park Bellshill ML4 3AL

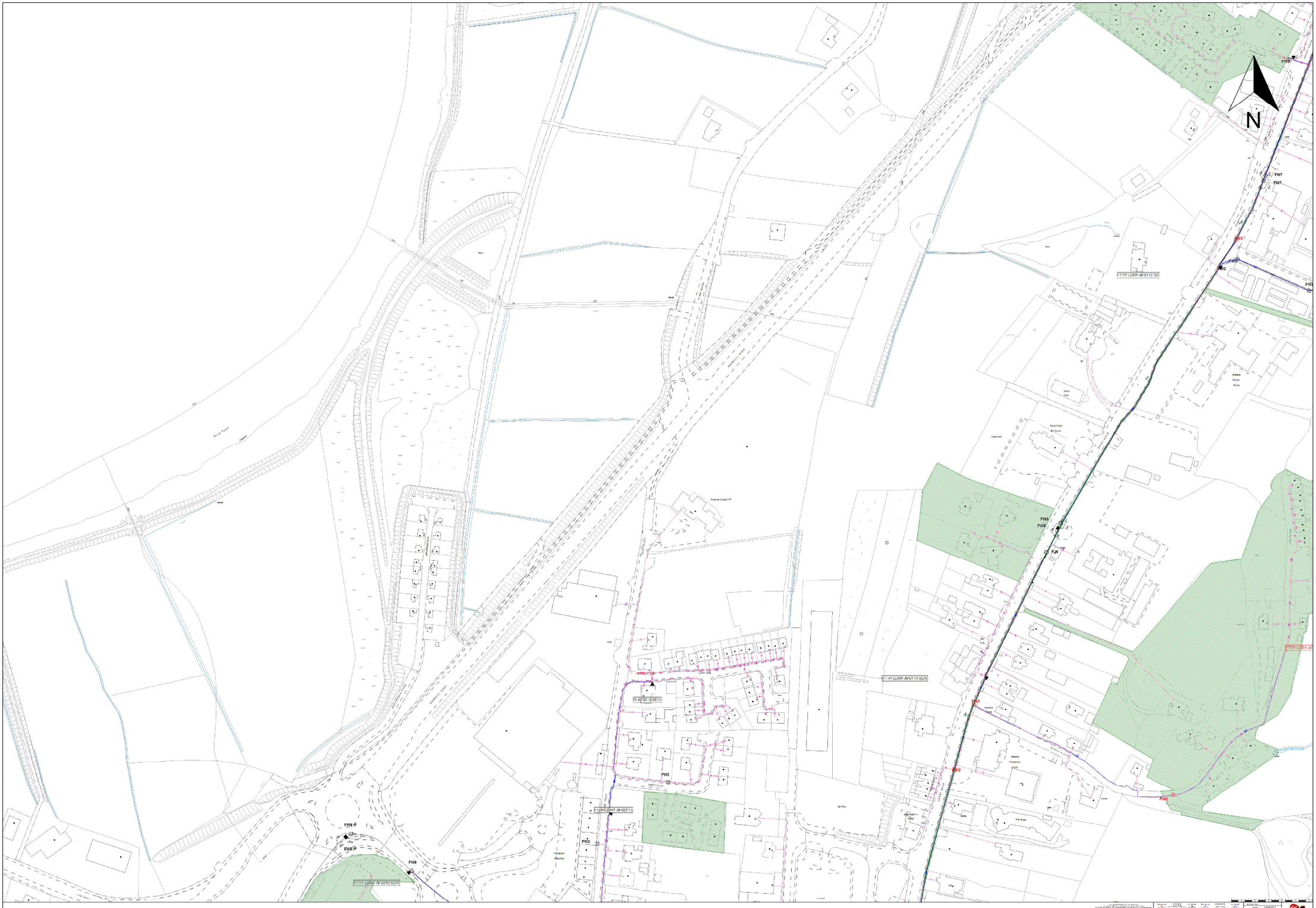
Or if you prefer to talk, please call the Diversionary Team on: 0800 408 0088 Option 1

Should your request be in relation to a Residential New Development, Virgin Media would like the opportunity to assist with your diversionary quote and serve your site free of charge, offering your customers the fastest widely available broadband speeds on the market up to 500Mbps.
For Commercial New Developments our team can also be reached through the below link, ensuring future businesses to your site are connected to our fibre network.

Simply head over to www.virginmedia.com/developer to fill in the enquiry form, and a member of our New Developments team will be in touch within 48 hours.
You will also find useful information about additional benefits to you and your site, plus a handy 'developers guide' can be downloaded with detailed installation requirements.
Or if you prefer to talk, please call the Diversionary Team on: 0800 408 0088 Option 1

Yours faithfully

National Plant Enquiries Team,


N
FTTP.LDRY.AF0112.SD
FTTP.LDRY.AF0114.SD1
FTTP.LDRY.AF0210.SD1
FW2
FW7
FW8
FJ6

Our Ref: 2104/53092 Your Ref: P2288

Ms. Victoria Reain
MCL Consulting
victoria@mclni.com

27th April 2021 Website: http://www.nienetworks.co.uk/

Dear Ms. Reain

**Re: Property located to the west of the Barnhill Road, and west of Park Road, Strabane BT82 8EL**

We refer to your request for a marked up cable drawing showing NIE Networks equipment. We enclose for your attention but ask you to note that **all cable positions are approximate only** as indicated clearly on the drawing. Therefore, the onus is on you and your subcontractor to locate and avoid all underground and overhead electrical equipment owned by NIE Networks and to prevent any damage whatsoever to **any** electrical equipment.

**Please note specifically that smaller service cables may not show on the marked up drawing and therefore all reasonable steps should be taken by you to locate any cable whether, underground or overhead.**

As you know, work in the vicinity of any electrical equipment involves a high risk of danger or injury and therefore all care must be taken.

**Any damage must be reported immediately as no matter how minor the damage may appear, live electricity cables are extremely dangerous and can kill.**

All site safety **MUST** be maintained in accordance with Health and Safety legislation and we refer you to the following guidance notes, for information, but these do not form an exhaustive list:

1. HSE guidance notes GS6 (avoidance of danger from overhead electric lines) and
2. HSE booklet HS (G) 47 avoiding danger from underground services
These guidance notes are available from the Health & Safety Executive for N.I. (HSENI).

NIE Networks also have a website section on 'Contractor Safety' to which we refer you.

If any damage whatsover occurs to NIE Networks equipment all work in the vicinity **must stop immediately** and the damage **must be reported at once** to NIE Networks on the following number: **03457 643 643**

As you will appreciate, fault location and repairs are less expensive to carry out should a matter be reported immediately at the time of damage. We would ask you to note that even what may appear insignificant damage can involve a cable faulting at some time later and the location and repair costs in such an instance are considerably higher. NIE Networks will pursue the responsible party for all costs incurred by it in the locating and repairing of any of its electrical equipment and this letter will be used in

support of that claim.

You should ensure that the attached mark up and a copy of this letter are given to any contractor or subcontractor who may have personnel or machines working on this site and we have enclosed two copies for your convenience. Also note, that NIE Networks original drawings must be used at all times and this present drawing is only valid for 3 months from the date of this letter.

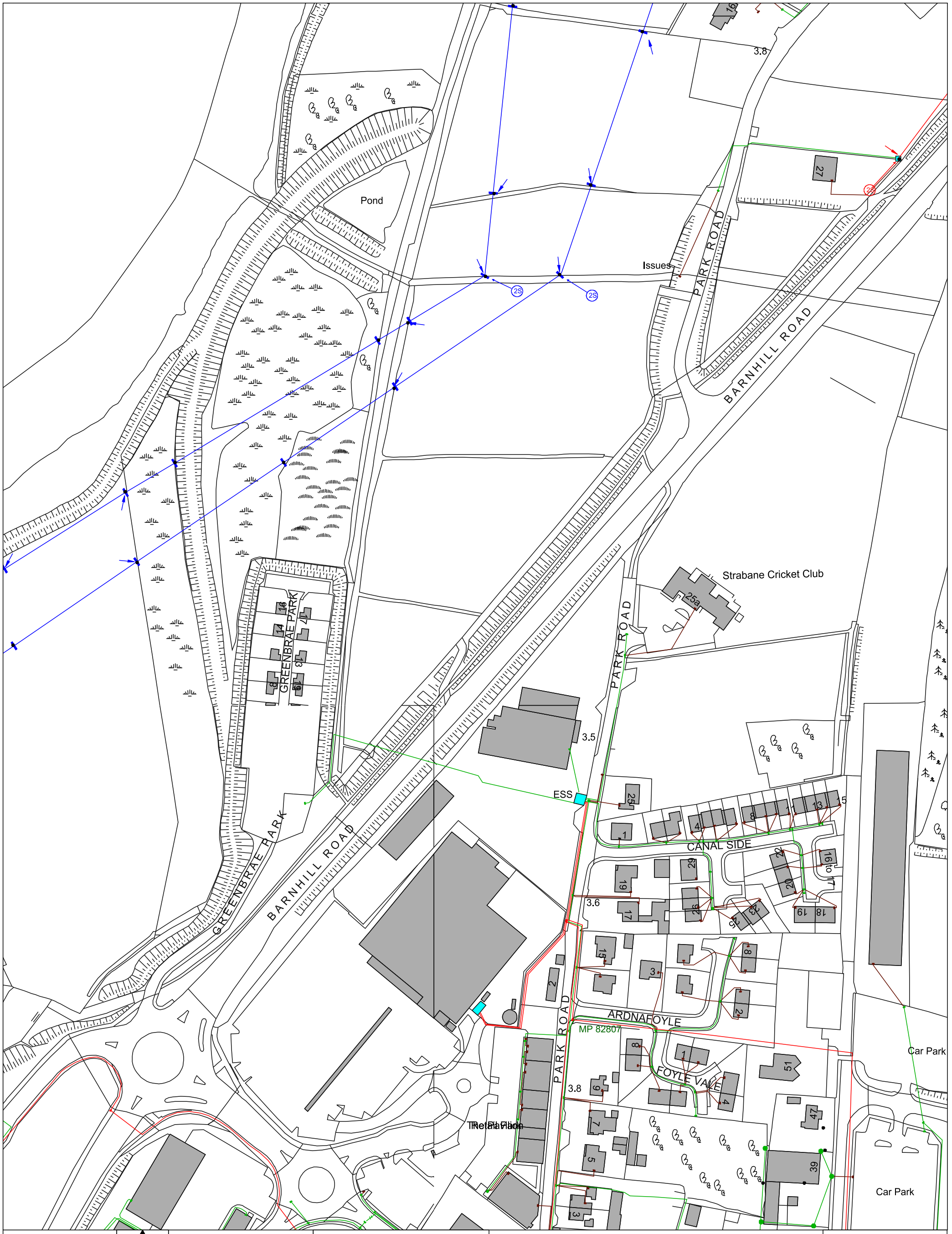
Please note that you will be working in close proximity to 33kV equipment. Therefore, a copy of your proposed works has been passed to our Network Manager, Mr. Martin McManus who should be contacted before you commence any works whatsoever on 028 82253218.

Yours sincerely

NIE Networks

Network Performance and Safety

Map No : 07204nw4

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N

Date: 27/04/2021 13:10:25

Scale: 1:2000

Map Centre : 234224,398452

400 kV
275 kV
110 kV
33 kV
11 kV
6.6 kV
L V
Service

CAUTION! CABLE POSITIONS ARE APPROXIMATE ONLY.

Please note that smaller service cables may not be shown. Always remember that it is the responsibility of the excavator to locate and avoid damage to N.I.E. equipment. Failure to do so may result in those responsible being held liable.

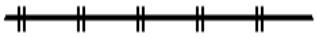
Northern Ireland Electricity Networks

1

Drawing No:

Project No:

## GNIS SYMBOLOGY

| HV Assets | | LV Assets | |
|---|---|---|---|
|  | 275KV Overhead and Towers |  | LV Overhead and poles |
|  | 275KV Cable and joint |  | LV underground and joint |
|  | 110KV Overhead, Tower and pole |  | LV Overhead to Service overhead |
|  | 110KV Cable and joint |  | Service cable and joint |
|  | 33KV Overhead, Tower and pole |  | LV Stays – 1 stay and 2 stay |
|  | 33KV Cable and joint |  | LV strut |
|  | 11KV Overhead and poles | FS OR | Flying stay and outrigger stay |
|  | 11KV Cable and joint |  | Mini Pillar |
|  | 6.6KV Overhead and poles |  | UDB |
|  | 6.6KV Cable and joint | GW | Guard Wire |
|  | HV Stays – 1 stay, 2 stays, 3 stays and V stay | SP | Steel Pole |
|  | HV Poles – 2 pole, 3 pole, 4 pole and H pole |  | LV Meter cubicle |
|  | HV Jockey pole |  | LV Jockey pole |
|  | Pole mounted transformer | | |
|  | Ground mounted substation |  | De-energised or decommissioned cable (Voltage as per colour code) |
|  | Switching site | | |

## Appendix 9-6

### Generic Quantitative Risk Assessment

**APPENDIX 9-6**

**Generic Quantitative Risk Assessment**

**Riverine Community Park**
**Lifford-Strabane**

**Client: McAdam**

**Issued: August 2021**

MCL Consulting Ltd
Unit 5, Forty Eight North
Duncrue Street
Belfast
BT3 9BJ
028 9074 7766

www.mclni.com

# CONTENTS


1.0 INTRODUCTION 3

1.1 Site Setting 3
1.2 PRA Summary 6

2.0 GROUND INVESTIGATION TO INFORM GQRA 7

2.1 Scope of Works 7
2.2 Monitoring Wells and Return Monitoring Visits 10
2.3 Selected Laboratory Analysis 10
2.4 Summary of Ground Conditions 15
2.5 Groundwater Levels 19

3.0 ASSESSMENT OF RESULTS 26

3.1 Soil Chemical Assessment 26
3.2 Asbestos Screening 27
3.3 Summary of Soil Results and Suggested Remedial Works 29
3.4 Review of Groundwater Laboratory Results 29
3.5 Summary of Groundwater Laboratory Results 32
3.6 Review of Surface Water Laboratory Results 32
3.7 Ground Gas Assessment 35

4.0 REVISED CONCEPTUAL MODEL 41

5.0 SUMMARY, REMEDIAL STRATEGY AND RECOMMENDATIONS 46

5.1 Summary 46
5.2 Remedial Strategy 48
5.3 Other Recommendations 49


## Figures


Figure 1: Lifford Zones
Figure 2: Strabane Zones
Figure 3: Intrusive Investigation Locations (Lifford)
Figure 4: Intrusive Investigation Locations (Strabane)
Figure 5: Surface Water Sample Locations
Figure 6: Logger Install Locations
Figure 7: Surface Water Hydrographs
Figure 8: Groundwater Hydrographs, Lifford
Figure 9: Groundwater Flow Map, Lifford
Figure 10: Groundwater Hydrographs, Strabane
Figure 11: Groundwater Flow Map, Strabane


## Tables


Table 1: Soil Samples (Lifford)
Table 2: Soil Samples (Strabane)
Table 3: Surface Water Sampling
Table 4: Strabane Zone 2 Soil Exceedances
Table 5: Lifford Access Zone GSV
Table 6: Lifford Western Zone GSV
Table 7: Lifford Central Zone GSV
Table 8: Lifford Eastern Zone GSV
Table 9: Strabane Zone 1 GSV
Table 10: Strabane Zone 2 GSV
Table 11: Strabane Zone 3 GSV
Table 12: Strabane Zone 4 GSV
Table 13: Worst Case Gas Data

**Table 14: Revised CSM for Lifford**
**Table 15: Revised CSM for Strabane Zone 1 and Zone 4 (hardstanding and proposed parking)**
**Table 16: Revised CSM for Strabane Zone 2 and Zone 3 (hardstanding and proposed parking)**

## Appendices

**APPENDIX A: Development Plan**
**APPENDIX B: Cut/Fill Plan**
**APPENDIX C: Borehole Logs**
**APPENDIX D: Geological Cross Sections**
**APPENDIX E: Soil Laboratory Results**
**APPENDIX F: Groundwater and Surface Water Laboratory Results**
**APPENDIX G: Ground Gas Summary**

# 1.0 INTRODUCTION

MCL Consulting Ltd (MCL) was appointed by McAdam Design to undertake a Tier 1 Preliminary Risk Assessment (PRA) and Tier 2 Generic Quantitative Risk Assessment on the lands for a proposed cross community park known as Riverine, which is straddling the River Foyle between the eastern area of Lifford Town, County Donegal, Republic of Ireland and the western area of the town of Strabane in County Tyrone, Northern Ireland.

The project will comprise the creation of new community park infrastructure in excess of twenty-three hectares either side of the border connected through the creation of a new pedestrian and cycle bridge between Lifford and Strabane. The park on the Lifford site will be a designed landscape incorporating indoor and outdoor recreational features, smaller meeting & events spaces for programmed activity, complemented by the use of the naturalised flood plain environment on the Strabane site for informal recreation and environmental education/conservation activities.

The proposed Development is presented in Appendix A. The development will involve a degree of site reprofiling by Cut/Fill and importation of make-up materials. All cut residuals are to be re-used on site where possible. The Cut/Fill plan is presented in Appendix B.

## 1.1 Site Setting

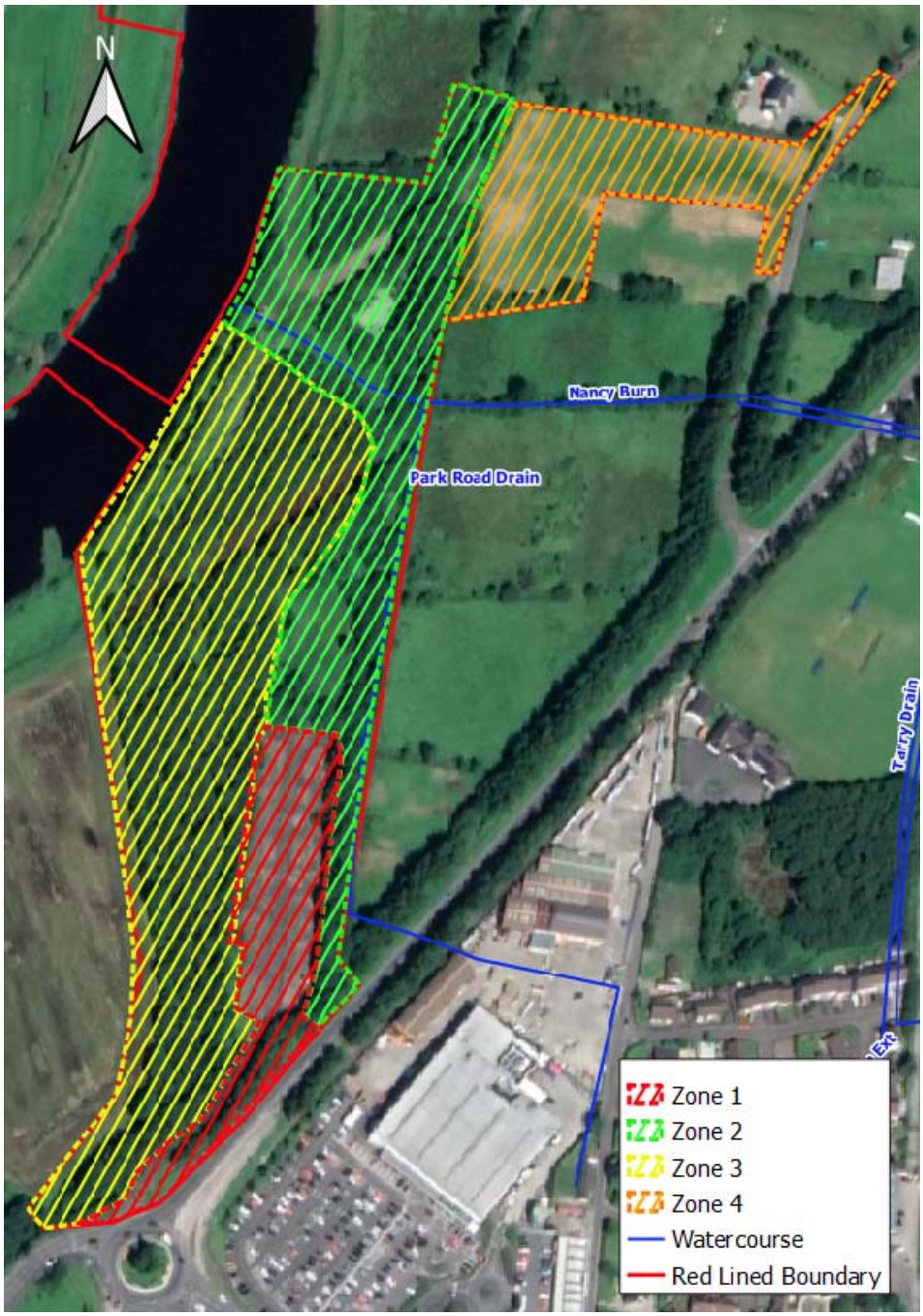
For the purposes of discussing the Lifford side, the site has been divided into four main zones: Access, Western, Central and Eastern as marked on Figure 1.

For the purposes of describing the Strabane side, the site has been zoned into 4 different zones (Zone 1 to Zone 4) in consideration of historical use and proposed development, as shown in Figure 2.

**Figure 1: Lifford Zones**



**Figure 2: Strabane Zones**



## 1.2 PRA Summary

The PRA *Preliminary Risk Assessment and Preliminary Sources Study Report (Stage 1), Riverine Community Park Lifford-Strabane, July 2021* recommended that a ground investigation to quantify the risks to human health and the environment is required under LRCM due to the multiple potential pollutant linkages identified in the initial conceptual models.

It was recommended that a ground investigation comprising boreholes drilled into the underlying drift deposits is required to be undertaken across the site to establish groundwater levels, existing groundwater quality, to allow for the collection of soil samples and ground gas data. It was also advised that Level loggers should be installed across site to examine groundwater fluctuations, given the estuarine site setting and proximity to the River Foyle.

# 2.0 GROUND INVESTIGATION TO INFORM GQRA

## 2.1 Scope of Works

Following on from the potentially complete pollutant linkages identified in the Initial Conceptual Model, an intrusive investigation was undertaken by MCL. The investigation was undertaken to obtain site specific environmental data to aid confirmation of the potential pollution linkages identified in the initial conceptual site model.

The ground investigation was carried out across the following dates; 5th, 13th, 14th 21st and 27th May, 15th and 16th June and 8th July 2021. The works comprised;

- Drilling of 27no. Windowless sampler boreholes (WS01 to WS23 and WS12A to WS12D);
- Hand Auguring of 27no. Hand Auger holes (HA01 to HA27);
- Installation of 26no. gas and groundwater monitoring wells (WS02 to WS23, and HA08, HA10, HA13 and HA23);
- Installation of 8no. Level Loggers;

-Lifford: (HA08 and WS06),

-Strabane: (WS09, WS13 and Causeway Geotech BH03),

-Pond 1 and Pond 2 (Strabane)

-River Foyle

- 4no. return gas and groundwater monitoring visits;
- Sampling and analysis of selected soils, groundwater and surface water;
- Interpretation of analytical results and determination of relevant assessment criteria;
- Production of site Generic Quantitative Risk Assessment (GQRA);
- Remediation Strategy

The locations of the investigative boreholes are presented in Figure 3 (Lifford) and Figure 4 (Strabane). The site has been divided into zones for ease of reference and description.

The drilling works were supervised on a full-time basis by an environmental engineer from MCL Consulting and the recovered soil samples were logged according to BS5930.

The works were undertaken in accordance with all relevant guidance including *Land Contamination Risk Management (LCRM)* and *Guidance on the Management of Contaminated Land and Groundwater at EPA Licensed Sites.*

**Figure 3: Intrusive Investigation Locations (Lifford)**

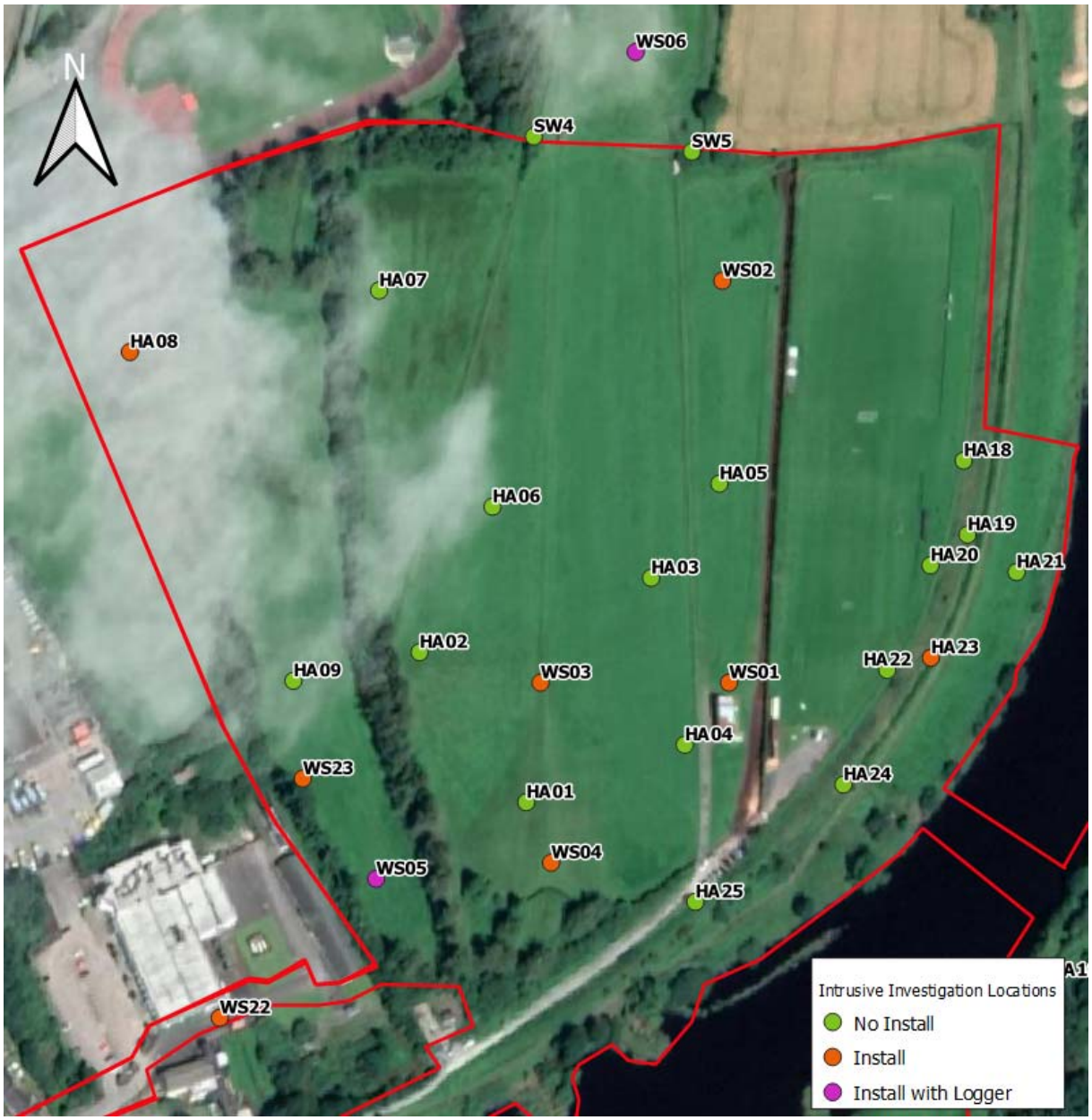


**Figure 4: Intrusive Investigation Locations (Strabane)**



## 2.2 Monitoring Wells and Return Monitoring Visits

### 2.2.1 Lifford

Groundwater and ground gas monitoring wells were installed in the windowless sampler boreholes WS02 to WS06, WS22, WS23 and Hand Auger Location HA08. Each installation was installed with 50mm (ID) HDPE. The response zones are detailed on the borehole logs in Appendix C.

### 2.2.2 Strabane

Groundwater and ground gas monitoring wells were installed in the windowless sampler boreholes WS07 to WS21 and Hand Auger Locations HA10 and HA13. Each installation was installed with 50mm (ID) HDPE. The response zones are detailed on the borehole logs in Appendix C.

### 2.2.3 Groundwater and Ground Gas Data Collection

Groundwater samples were collected on 26th and 27th May, 24th June, 2nd July and 4th August 2021, as boreholes were progressively drilled. Ground gas data was collected at every location on 4no. occasions across various dates; between 26th May and 4th August, as presented in Section 3.7. Atmospheric pressure ranged between 101mb and 1021mb.

## 2.3 Selected Laboratory Analysis

Soil samples across both the Lifford and Strabane sites were sent to UKAS accredited Element Materials Technology for selected analysis. Below summarises the soil samples from each zone within the Lifford and Strabane sites. The soil laboratory results are included in Appendix E.

Analysis of the soils included PAH 16, TPH CWG, Metals (As, Ba, Be, B, Cd, Cr, Cu, Pb, Hg, Ni, Se, V, Zn), Cr III, Hexavalent Chromium, Sulphate as SO4, Free and Total Cyanide, pH and TOC.

Screening for Asbestos Containing Materials (ACM) was undertaken on numerous samples which is explained below in Section 3.2

**Table 1: Soil Samples (Lifford)**

| Location I.D | Depth (mbgl) | Strata |
|---|---|---|

| Access Zone | | |
|---|---|---|
| WS22 | 0.80 | Made Ground |
| WS22 | 2.80 | Natural: Sand |
| **Western Zone** | | |
| WS05 | 0.30 | Natural: Clay (Alluvium) |
| HA09 | 0.30 | Natural: Clay (Alluvium) |
| WS23 | 0.30 | Natural: Clay (Alluvium) |
| WS23 | 1.20 | Natural: Clay Alluvium |
| **Central Zone** | | |
| HA01 | 0.20 | Made Ground |
| HA01 | 1.10 | Natural: Sand (Alluvium) |
| HA03 | 0.30 | Natural: Clay (Alluvium) |
| HA06 | 1.80 | Natural: Alluvium |
| HA07 | 0.20 | Natural: Clay (Alluvium) |
| WS01 | 0.50 | Natural: Clay (Alluvium) |
| WS02 | 1.50 | Natural: Clay (Alluvium) |
| WS03 | 0.70 | Natural: Clay (Alluvium) |
| WS04 | 0.90 | Made Ground |
| WS04 | 2.70 | Natural: Sand |
| WS05 | 0.30 | Natural: Clay (Alluvium) |
| **Eastern Zone** | | |
| HA21 | 0.30 | Natural: Sand (Alluvium) |
| HA24 | 0.20 | Made Ground |
| HA24 | 1.50 | Natural: Gravel (Alluvium) |
| HA25 | 0.40 | Made Ground |
| HA25 | 1.80 | Natural: Sand (Alluvium) |

### 2.3.1 Strabane Zone 1 Soil Analysis

Soil samples collected in Strabane are summarised in Table 2 below.

**Table 2: Soil Samples (Strabane)**

| Location I.D | Depth (mbgl) | Strata |
|---|---|---|
| **Zone 1** | | |
| WS10 | 0.30 | Made Ground |
| WS10 | 3.10 | Alluvium |

| | | |
|---|---|---|
| WS11 | 0.40 | Made Ground |
| **Zone 2** | | |
| WS08 | 0.20 | Made Ground |
| WS12 | 020 | Made Ground |
| WS12 | 1.40 | Made Ground |
| WS13 | 0.50 | Made Ground |
| WS14 | 0.30 | Made Ground |
| HA13 | 0.10 | Made Ground |
| HA13 | 1.60 | Made Ground |
| HA16 | 0.30 | Made Ground |
| **Zone 3** | | |
| HA10 | 0.20 | Made Ground |
| HA14 | 0.20 | Made Ground |
| WS21 | 0.30 | Made Ground |
| WS21 | 2.10 | Made Ground |
| **Zone 4** | | |
| WS15 | 0.30 | Made Ground |
| WS15 | 1.80 | Made Ground |
| WS16 | 0.50 | Made Ground |
| WS16 | 1.30 | Made Ground |
| WS17 | 0.20 | Made Ground |
| WS17 | 1.60 | Made Ground |
| WS19 | 0.30 | Made Ground |
| WS19 | 1.30 | Alluvium |
| WS20 | 0.10 | Made Ground |
| WS20 | 1.70 | Made Ground |
| WS20 | 3.80 | Alluvium |

### 2.3.2 Groundwater Sampling and Laboratory Analysis

Groundwater samples were obtained on 26th and 27th May and 4th August 2021.

On the Lifford side, groundwater samples were collected from WS02, WS06, HA08 and the Causeway Geotech BH03 (labelled in the laboratory report as CGBH(S)).

On the Strabane side, groundwater samples were collected from WS07 to WS17, WS19 and WS20.

Groundwater from all sample points were analysed for:

• Metals (As, Ba, Be, B, Cd, Cr, Cu, Pb, Hg, Ni, Se, V, Zn, Hexavalent Chromium, TPH CWG, PAH16, VOC, Phenols, Sulphate as SO4, Free and Total Cyanide, Thiocyanate, pH, Total Suspended Solids and Hardness. The laboratory analysis was undertaken by UKAS accredited laboratory Element Material Technology. The groundwater laboratory results are included in Appendix F.

### 2.3.3 Surface Water Sampling and Laboratory Analysis

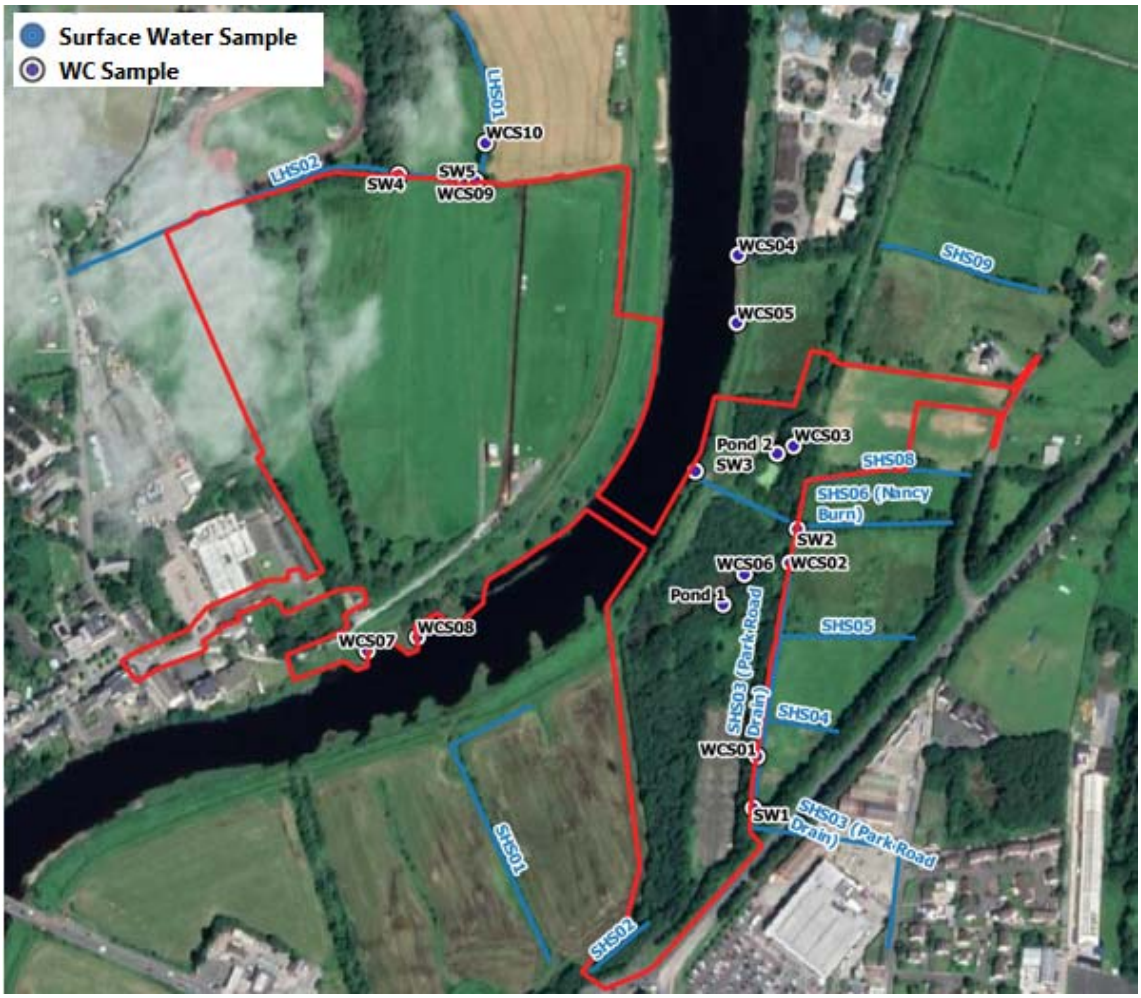
As part of the ground investigation, 5no. surface water samples were obtained on 27th May 2021 at sample points (SW1 to SW5), as presented in Figure 5. On 24th June 2021, as part of the Water Features Survey Report (MCL Consulting *P2288, Water Features Survey Report, Riverine Community Park Lifford-Strabane, August 2021),* 10no. additional surface water samples (WCS01 to WCS10) were collected, as presented in Figure 5. All surface water results are included in Appendix F. A description of the sampling visit is presented in Table 3.

**Table 3: Surface Water Sampling**

| I.D | Description |
|---|---|
| **Lifford** | |
| SW4 | Upflow |
| SW5 | Downflow |
| WCS07 | Upflow of WwTW outfall |
| WCS08 | Downflow of WwTW outfall |
| WCS09 | Upflow at LHS02 |
| WCS10 | Downflow |
| **Strabane** | |
| SW1 | Up flow Park Road Drain |
| SW2 | Midflow Nancy Burn (where Park Road Drain meets Nancy Burn) |
| SW3 | Downflow Nancy Burn (outflow into River Foyle) |
| WCS01 | Upflow/midflow Park Road Drain |
| WCS02 | Downflow Park Road Drain |

| | |
|---|---|
| WCS03 | Pond 2, Triangle Shaped Pond |
| WCS04 | Upflow River Foyle, Strabane WwTW |
| WCS05 | Downflow River Foyle, Strabane WwTW |
| WCS06 | Pond 1, main wetland |

**Figure 5: Surface Water Sample Locations**




**Lifford:**

On the Lifford side surface water samples were obtained from SW4 and SW5, and WCS07 to WCS10. SW4 was from a watercourse entering from the west of the site, flowing east. SW5 was from the same watercourse from where it exists the site before flowing north. WCS07 was taken from the River Foyle, upflow of the Lifford WasteWater Treatment Works outlet pipe and WCS08 downflow of this outlet pipe. WCS09 was collected from a similar location to SW5 and WCS10 downflow of the watercourse where it exists the site flowing north.

**Strabane:**

On the Strabane side surface water samples were obtained from SW1 to SW3 and WCS01 to WCS06. SW1 was from the Park Road Drain as it enters the site from the south, SW2 was from the Park Road Drain before it converges with the Nancy Burn and SW3 was from the Nancy Burn immediately prior to its discharge into the River Foyle. WS01 (up flow) and WCS02 (down flow) were collected from the Park Road Drain. WCS03 was taken from Pond 2, the "Triangle" shape pond. WCS04 is located on the River Foyle downflow of the discharge pipe from the Waste Water Treatment Works and WCS05 upflow the same discharge pipe. WCS06 was collected from Pond 1.

All surface water samples were sent to Element Technologies Accredited laboratory using appropriate chain of custody documents.

Surface Water analysis from SW1 to SW5 sample points included:

• Metals (As, Ba, Be, B, Cd, Cr, Cu, Pb, Hg, Ni, Se, V, Zn, Hexavalent Chromium, TPH CWG, PAH16, VOC, Phenols, Sulphate as SO4, BOD, Free and Total Cyanide, Thiocyanate, pH, Total Suspended Solids and Hardness. The laboratory analysis was undertaken by UKAS accredited laboratory Element Material Technology. The groundwater laboratory results are included in Appendix F.

Surface Water analysis from WCS01 to WCS10 sample points included:

- PAH 16, TPH CWG, Metals (As, Ba, Be, B, Cd, Cr, Cu, Pb, Hg, Ni, Se, V, Zn), Cr III, Hexavalent Chromium, Sulphate as SO4, Free and Total Cyanide, Thiocyanate, pH, Chloride, Electrical Conductivity, TOC, Suspended Solids and Colour.

## 2.4 Summary of Ground Conditions

All information given in the following sections is based on the ground conditions encountered during the site intrusive works.

The ground conditions observed during the intrusive investigation are detailed on the exploratory hole logs presented in Appendix C and Geological Cross Sections presented in Appendix D.

### 2.4.1 Lifford Access Zone Ground Conditions

WS22 is located within the Access Zone, where the former railway line came through this area of the site. Made Ground to 1.7mbgl, below which Alluvium was encountered from 1.7mbg to 2.3mbgl, Sand and Gravel was encountered from 2.3mbgl to termination at 3.0mbgl.

### 2.4.2 Lifford Western Zone Ground Conditions

This zone is characterised with grassland and natural undisturbed ground. Notable poorly drained land with reeds and puddles of standing water is located in the northern area of the site. Slightly sandy gravelly Clay (Alluvium) underlay the grass, below which sand and gravel was encountered at 0.55mbgl at WS05 and 1.5mbgl at WS23.

### 2.4.3 Lifford Central Zone Ground Conditions

This zone is characterised with grassland and natural ground, apart from at HA01 and WS04 where there is c.1.0m of fill. Poorly drained land with puddles of standing water is located in the northern area at WS06. The Hand Augers were terminated between 1.10mbgl and 2.15mbgl. The windowless sampler boreholes were terminated at depths between 1.7mbgl and 3.0mbgl.

The area of infill (HA01 and WS04) contained gravelly Clay overlying natural ground consisting of gravelly Sand.

To the north of the infill (HA02, HA03, HA04 and WS03), sandy Clay (Alluvium) is located to between 1.15mbgl and 1.70mbgl under which sandy gravel is located.

To the west of this zone (HA06 and HA07) the ground conditions are summarised as gravelly Clay (Alluvium) to a depth of between 0.90mbgl and 1.20mbgl overlying Alluvium terminated at 2.0mbgl.

The ground conditions in the eastern boundary of the Central Zone (WS01, WS02 and HA05) are characterised by gravelly Clay (Alluvium) to depths of between 1.7mbgl and 2.0mbgl, overlying gravelly sand terminated at 3.0mbgl.

At WS06, to the north of the Central Zone, gravelly Clay (Alluvium) was found to be at a depth of 1.7mbgl, with sandy Gravel located underlying the Clay (Alluvium). The depth of the gravel is unknown due to collapse of the hole at 1.80mbgl.

### 2.4.4 Lifford Eastern Zone Ground Conditions

The ground conditions encountered in the Eastern Zone was mainly grassland and Sand at termination to depths of between 0.50mbgl and 2.0mbgl (HA20 to HA24). Made Ground of sandy Clay was encountered at HA18 and HA19 to 1.6mbgl and 0.30mbgl respectively, overlying slightly sandy slightly gravelly Clay (Alluvium) to termination due to refusal at 1.6mbgl and 1.2mbgl respectively.

### 2.4.5 Strabane Zone 1 Ground Conditions

Zone 1 comprises concrete hardstanding formerly used as a traveller's halt. Fomer railway sidings and yard shed (no longer present). At WS10 and WS11, Made Ground was encountered overlying Clay (Alluvium). A core of concrete with rebar to 0.2mbgl overlies slightly sandy gravel with ash to 0.7mbgl at WS10 and 0.6mbgl at WS11. At WS10 Clay (Alluvium) was located to 2.8mbgl, followed by Alluvium to termination at 4.0mbgl. At WS11 Clay was located to 0.9mbgl, followed by gravelly Sand to 1.6mbgl, Gravel to 2.5mbgl and Alluvium to termination at 3.0mbgl.

### 2.4.6 Strabane Zone 2 Ground Conditions

Zone 2 comprises former railway lands, Engine House (no longer present), railway flood extent embankments and pond. HA16 to the east was terminated due to refusal at 0.5mbgl, which consisted entirely of Made Ground of gravelly Clay and evidence of other materials such as glass and brick.

HA13 and WS12 are situated where the former Engine House was located. At HA12, in a Clay embankment, Made Ground of gravelly Clay was encountered to termination at 1.80mbgl. At WS12, Made Ground of sandy gravel was encountered until 1.5mbgl, followed by Alluvium until termination at 2.5mbgl. After Laboratory analysis, a sample at 0.20mbgl from WS12 was identified as having asbestos fibres at a concentration of 0.019% (after Total Detailed Gravimetric Quantification analysis). This is above the Human Health limit for asbestos of <0.001%. This is discussed further in Section 3.2.

Further north WS13 and WS14 encountered Made Ground of sandy gravel overlying natural sandy Clay (Alluvium). Made Ground was located to a depth of 0.6mbgl at WS13 and 1.5mbgl at WS14. Both holes were terminated in the Alluvium at 3.0mbgl.

WS07 and WS08 were located on top of the route of the former railway embankment. Made Ground of gravelly Clay was encountered to 1.50mbgl at WS07 and to 1.40mbgl at WS08. Natural gravelly Clay (Alluvium) was located from 1.50mbgl to 2.70mbgl at WS07 and from 1.40mbgl to 2.10mbgl at WS08. Underlying the natural gravelly Clay (Alluvium) at WS07 and WS08 was Alluvium until termination at 4.0mbgl at WS07 and 3.0mbgl at WS08.

At WS09 natural ground was encountered until termination at 3.0mbgl, with gravelly sand encountered until 1.10mbgl and Alluvium until 3.0mbgl.

### 2.4.7 Strabane Zone 3 Ground Conditions

Zone 3 comprises primarily marshy wooded wetland and flood embankment to river banks. The ground conditions in the west of Zone 3 were characterised by Made Ground of gravelly sand overlying naturally clayey/gravelly Sand. Made Ground was encountered to a maximum depth of 0.80mbgl with the Hand Auger holes terminated at depths of between 0.80mbgl and 2.0mbgl.

The Hand Auger holes in the east of Zone 3, HA14, HA15 and HA17 were completed to depths of between 0.30mbgl and 0.60mbgl, due to difficult ground conditions. These locations encountered Made Ground of gravelly Sand (HA14) and gravelly Clay (HA15 and HA17).

### 2.4.8 Strabane Zone 4 Ground Conditions

Zone 4 comprises Made Ground underlying agricultural grassland, but historically comprised railway embankment and ponds (no longer present). The ground conditions in Zone 4 are characterised with a c.10m of Topsoil overlying Made Ground. The Made Ground consisted of imported Gravel and Clay containing imported materials such as ashy waste, glass, ceramic, red brick, wood chippings and scattered plastic. Made Ground was located to a max depth of 3.10mbgl (WS15). Underlying the Made Ground is Alluvium consisting of low to medium organic content. Alluvium was located until termination of boreholes at max depth of 4.0mbgl.

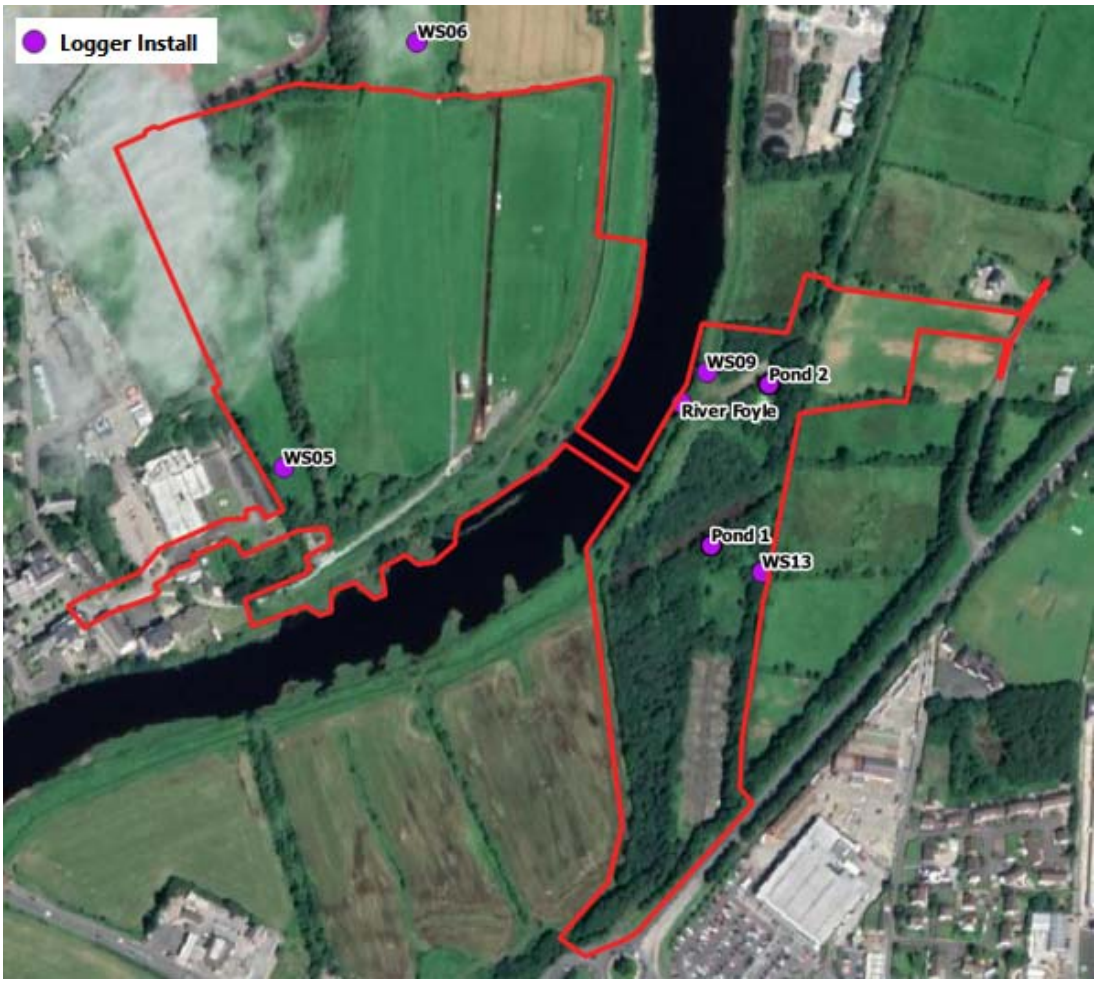
## 2.5 Groundwater Levels

Groundwater monitoring wells were installed in various boreholes throughout the site. Spot dips were taken at each point on 4no. occasions throughout the monitoring period.

Data loggers were also placed throughout the site, as shown in Figure 6, in the following locations;

- HA08 (Lifford)
- WS06 (Lifford)
- WS13 (Strabane)
- WS09 (Strabane)
- SW3(Strabane in the River Foyle)
- CGBH03 (Strabane)
- Pond 1 (Strabane)
- Pond 2 (Strabane)

**Figure 6: Logger Install Locations**



The data loggers recorded water levels at ten minute intervals, calibrated against spot dip levels and compensated with a site based barometric logger.

### 2.5.1 Surface Water Hydrographs

Surface water hydrographs were produced for the River Foyle, as well as Pond 1 and Pond 2. These are presented in Figure 7.

**Figure 7: Surface Water Hydrographs**




The River Foyle Hydrograph shows typical semi-diurnal tidally influenced water level fluctuations in the order of 1.6m variation over the normal tidal cycle. It is of note that the river level is around 0.4mOD at low tide, which is surprising given the significant distance to the coast at this locality. These levels are, however. consistent with the bathymetry survey data which shows the floor of the riverbed to be between 0mOD and -2mOD at the site and the general observable water level in this stretch of river, which has been noted to be very shallow during the summer survey period.

Water levels in Pond 1 and Pond 2 are higher in elevation at around 2.4mOD in Pond 2 and 1.5mOD in Pond 1 than the water levels in the River Foyle and both ponds show a very slight tidal fluctuation / semidiurnal wobble. Whilst Pond 2 has no overflow, Pond 1 outfalls to the Nancy Burn and hence to the River Foyle.

### 2.5.2 Groundwater Level Monitoring and Flow Patterns

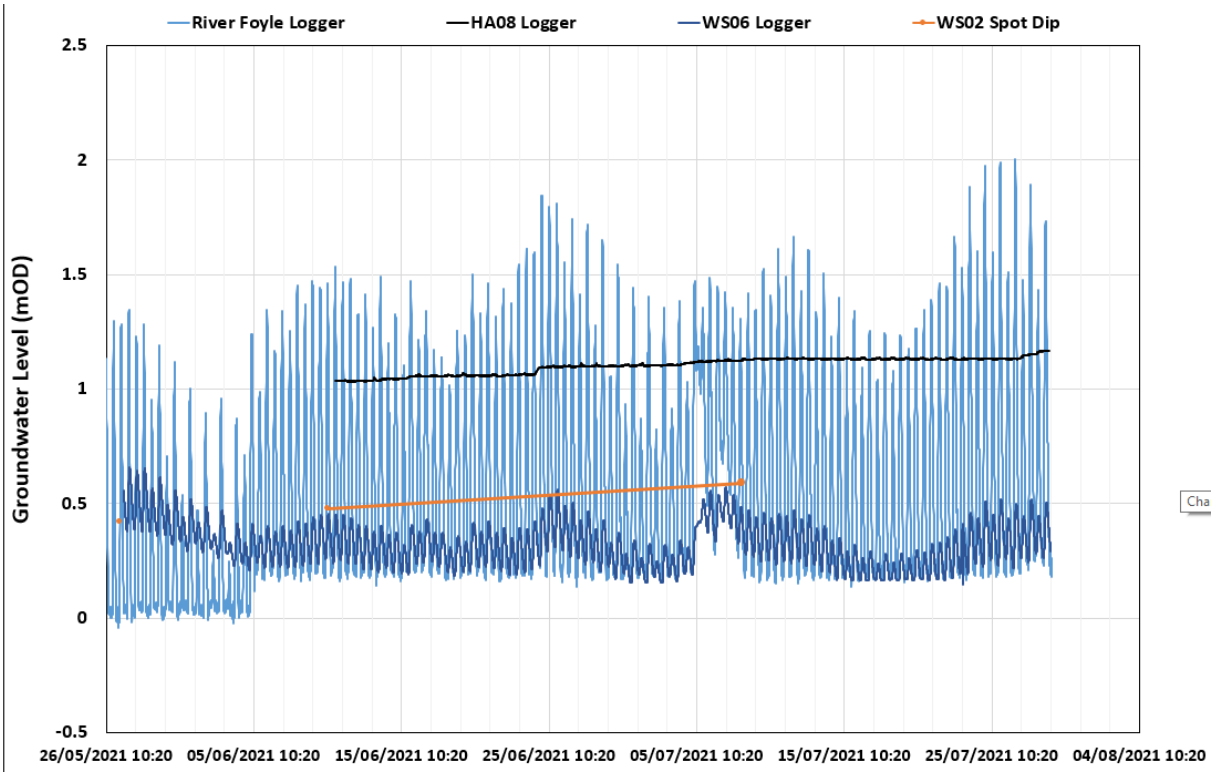
Groundwater hydrographs were produced from all manual and electronic water level data and are presented, along with level monitoring from the River Foyle logger for Lifford (Figure 8) and Strabane (Figure 10).

**Lifford:**

The hydrographs (Figure 8) for Lifford indicate that shallow groundwater levels at WS06 in the north of the site and c.210m from the River Foyle are tidally influenced, displaying typical semidiurnal fluctuations of c 0.3m – 0.4m intensity, with baseflow recharge to the River Foyle occurring during low tide cycles.

Tidal effects are however not observed at HA08, located in the south of the site and further inland at c.430m from the River Foyle. This may be due to the shallow nature of this auger borehole and it being wholly within the alluvium, not truly in the sands and gravels, with only a shallow water seepage recorded during drilling (see Appendix C).

**Figure 8: Groundwater Hydrographs, Lifford**




A basic groundwater flow map for the general conditions in the sand and gravel unit has been produced from available site-specific groundwater data and is presented in Figure 9.

**Figure 9: Groundwater Flow Map, Lifford**




The results indicate a general groundwater flow direction toward the River Foyle from the shallow sand and gravel aquifer, with water levels ranging from c.1.0mOD in the inland western boundary to 0.0mOD at the River Foyle during low tide cycles. The groundwater hydrographs indicate some fluxing and reversal of groundwater flow direction occurs during high tide cycles.

Results from deeper drilling carried out as part of the Geotechnical Assessment (see Geotechnical Report), indicated other water strikes within the sand and gravel unit at greater depths in excess of 10mbgl, with confining conditions apparent at depth from the drilling records.

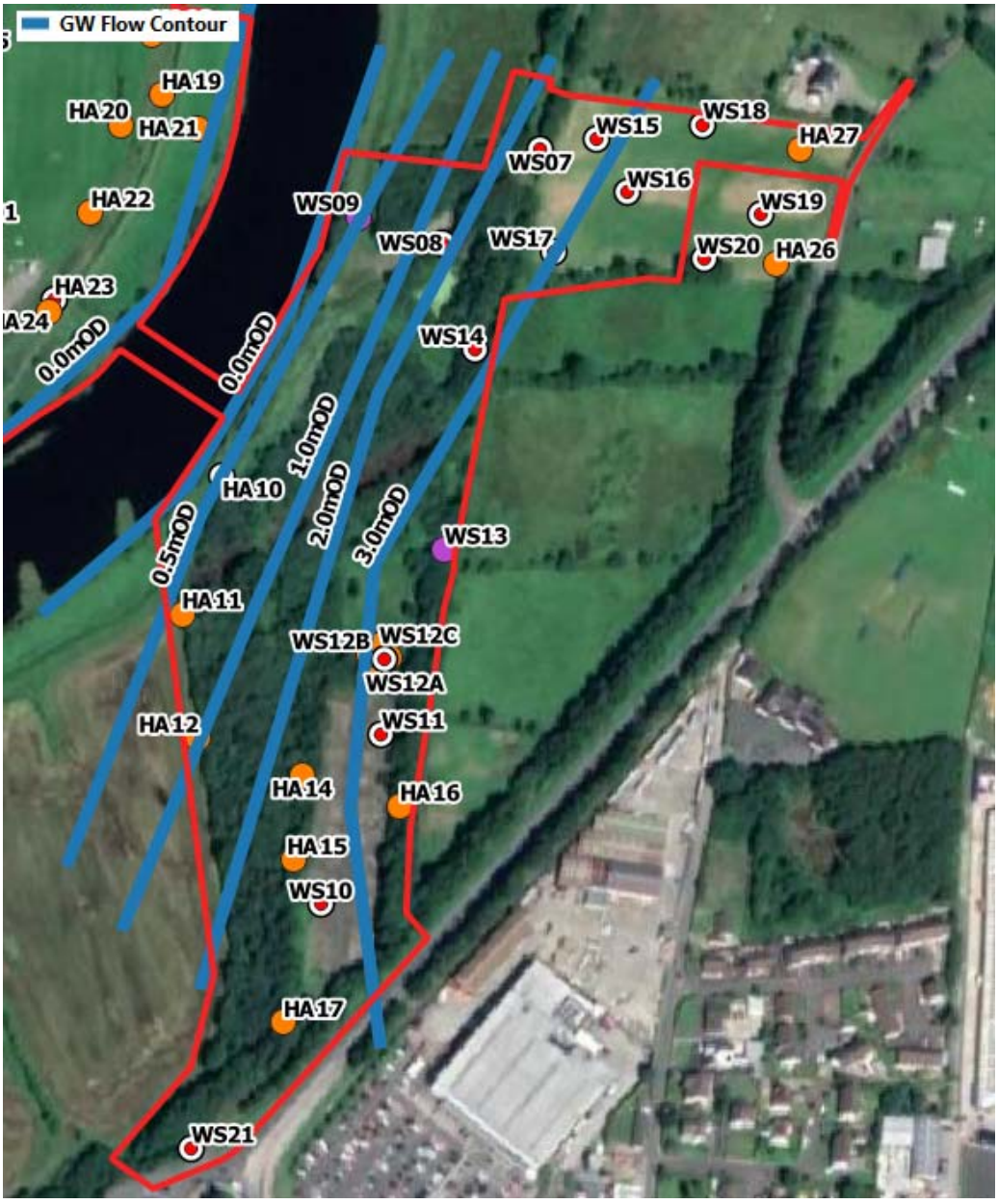
**Strabane:**

The hydrographs (Figure 10) for Strabane indicate that groundwater levels in the sand & gravel drift deposits at CBH03 close to the banks of the River Foyle (c.15m) on the western boundary of the site are strongly tidally influenced, displaying typical semidiurnal fluctuations of c 0.8m – 0.9m intensity, with baseflow recharge to the River Foyle occurring during low tide cycles.

Tidal effects are however not observed at WS09, also located on the western boundary of the site, at c.15m from the River Foyle and at WS13 on the eastern boundary of the site at c.130m distance from the River Foyle. This may be due to the fact that the response zones for these boreholes are wholly within the alluvium, not truly in the sands and gravels, with no water seepage recorded during drilling in the case of WS09 (see Borehole Logs, GQRA). This pattern is similar to that observed at Lifford, where groundwaters in the sands and gravel appear to be tidally influenced, whilst groundwaters in the alluvium are not. These systems are likely to essentially be hydraulically separate from each other. The data does indicate a groundwater flow direction broadly to the west within the sands and gravels, toward the River Foyle as would be expected.

A basic groundwater flow map for the general conditions in the sand and gravel unit has been produced from available site-specific groundwater data and is presented in Figure 11.

**Figure 11: Groundwater Flow Map, Strabane**




The results indicate a general groundwater flow direction toward the River Foyle from the shallow sand and gravel aquifer, with water levels ranging from c.3.0mOD in the inland eastern boundary to 0.0mOD at the River Foyle during low tide cycles.

# 3.0 ASSESSMENT OF RESULTS

The following sections present screening of the soil and water results in order to identify any exceedances which may present a risk to Human Health or the Environment.

## 3.1 Soil Chemical Assessment

Whilst some areas of the site may fall under the realms of Commercial end use, all locations were compared against the more sensitive Public Open Spaces (Park) 1%SOM LQM/S4ULs.

No Lead screening value is currently published by LQM, therefore the Category 4 Screening Level (C4SL) of 1300mg/kg for Public Open Space (Park) has been used, and 2330mg/kg for Commercial use. These Lead screening values were referenced from *SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document (Department for Environment, Food and Rural Affairs December 2014).*

### 3.1.1 Review of Soil Laboratory Results (Lifford)

**Access Zone:** No S4UL value exceedances were detected at WS22.

**Western Zone:** Soil samples were collected from HA09, WS05 and WS23, of which there were no exceedances detected.

**Central Zone:** In the Lifford Central Zone, soil samples were collected from; HA01, HA03, HA05 to HA07, HA25 and WS01 to WS04. There were no exceedances of S4UL values detected.

At WS02 (1.50m) there was a positive detection of m/p-Xylene at 11ug/kg.

**Eastern Zone:** There were no S4UL value exceedances detected from the soil samples collected at; HA21, HA24 nor HA25.

### 3.1.2 Review of Soil Laboratory Results (Strabane Zone 1)

There were no exceedances detected at the soil samples collected from WS10 and WS11. WS11 showed low concentrations of PAH compounds.

### 3.1.3 Review of Soil Laboratory Results (Strabane Zone 2)

The exceedances in Strabane Zone 2 are summarised in Table 4 below.

**Table 4: Strabane Zone 2 Soil Exceedances**

| Location (Depth) | Exceeding Parameter | S4UL/C4SL Limit | Exceeding Result |
|---|---|---|---|
| WS12 (0.20m) | Copper | 44,000mg/kg | 57,711mg/kg |
| WS12 (0.20m | Lead | 1,300mg/kg | 36,395mg/kg |
| WS13 (0.50m) | Arsenic | 170mg/kg | 656.3mg/kg |

No exceedances were detected at the soil samples collected from WS08, WS12 (1.40m), WS14 and HA13. WS12 and WS13 also showed low levels of various PAH compounds.

### 3.1.4 Review of Soil Laboratory Results (Strabane Zone 3)

In Zone 3, soil samples were collected from HA10, HA14 and WS21. No exceedances were detected at any of these locations.

### 3.1.5 Review of Soil Laboratory Results (Strabane Zone 4)

No S4UL exceedances were detected from the soil samples collected at WS15, WS16, WS17, WS19 and WS20. Samples from WS15, WS17, WS20 and WS22 also showed low levels of PAH compounds.

## 3.2 Asbestos Screening

Asbestos screening was initially undertaken at the following locations;

**Lifford:**

- HA01 (0.20m)
- HA01 (1.10m
- HA03 (0.30m)
- HA05 (0.30m)
- HA24 (0.20m)
- WS01 (0.50m)
- WS04 (0.90m)
- WS22 (0.80m)

**Strabane:**

- HA13 (0.10m)
- HA14 (0.20m)
- WS10 (0.30m)
- WS11 (0.40m)
- WS12 (0.20m) and (1.40m)

- WS13 (0.50m)
- WS14 (0.30m)
- WS15 (0.30m)
- WS16 (0.50m) and (1.30m)
- WS17 (0.20m) and (1.60m)
- WS19 (0.30m)
- WS20 (0.10m)
- WS21 (0.30m) and (2.10m)

Of all the above locations, Asbestos was detected only in WS12 (0.20m), Strabane. This is the location of the former Engine House. Quantification (Total Detailed Gravimetric) of this sample was subsequently requested and the sample was identified as having an asbestos fibre concentration of 0.019%. This is above the Human Health limit for asbestos of <0.001%.

Due to this exceedance in Strabane, 4no. additional windowless sampler boreholes (Appendix C) were subsequently drilled to 0.50mbgl within a 1x1m grid of WS12 and the following additional soil samples collected;

- WS12A (sample at 0.20m) one metre North of WS12
- WS12B (sample at 0.40m) one metre East of WS12
- WS12C (sample at 0.30m) one metre South of WS12
- WS12D (sample at 0.50m) one metre West of WS12

Analytical results are presented in Appendix E. Asbestos was not detected in the samples obtained from WS12A, WS12B and WS12C. At WS12D (0.50m), asbestos was detected. Total Detailed Gravimetric Quantification was undertaken on this and the concentration was reported as <0.001%.

Since Asbestos was detected in shallow soils at WS12 and WS12D, but not at WS12A, WS12B nor WS12C, it is highly likely that any asbestos contamination in soils is localised around WS12 and to the west (WS12D). It is also highly likely that asbestos is above the Human Health level of 0.001% only within the shallow soils (0.0 to a maximum 0.50mbgl) as WS12D (0.50m) consisted of asbestos at <0.001% and a deeper sample from WS12 (1.40m) tested negative for presence of asbestos.

## 3.3 Summary of Soil Results and Suggested Remedial Works

**Lifford:**

No exceedances of relevant soil standards were noted. No remedial works are therefore necessary with respect to soils to facilitate the development.

**Strabane:**

Exceedances were identified within the Made Ground at WS12 (Asbestos, Copper and Lead) and WS13 (Arsenic). The source of these exceedances is likely to be from the imported Made Ground.

Localised remediation of the shallow soils around WS12 will be required to ensure no future human health contact with asbestos, for end site users and this will also address the area of Copper and Lead exceedances at this location. In addition the shallow soils around WS13 must be excavated and removed to an appropriately authorised landfill site as part of the development, to remove the risk to Human Health, due to elevated levels of Arsenic in this area. It is noted that this area will be subject to 'cut' as part of the proposed development to facilitate the construction of the main access road. These excavation works around WS13 should comprise a 5m x 5m x 1.0m deep excavation and removal to a suitably authorised landfill site, process undertaken under the supervision of a qualified and experienced environmental scientist. All remedial works should be subject to a documented verification process.

## 3.4 Review of Groundwater Laboratory Results

The groundwater laboratory results are provided in Appendix F. Groundwater samples were obtained from MCL boreholes in which groundwater was encountered; WS02, WS06, WS07, WS09, WS10, WS11, WS12, WS13, WS14, WS15, WS16, WS17, WS19, WS20 and HA08 as shown in Figure 3 (Lifford) and Figure 4 (Strabane). In addition, a groundwater sample was obtained from a Geotechnical borehole, drilled at Strabane (bridge site) which had been fitted with a standpipe.

All groundwater results were compared against available Drinking Water Standards (DWS).

### 3.4.1 Review of Groundwater Laboratory Results (Lifford)

On the Lifford side, Figure 3, shallow groundwater samples were collected from WS02 (3m deep in sand & gravel), WS06 (1.8m Deep in alluvium) and HA08 (2.3m deep in alluvium). All other monitoring points installed by MCL Consulting in Lifford were recorded as dry.

At HA08, the Nickel DWS of 20ug/l was exceeded at 76.5ug/l. The Arsenic DWS of 10ug/l was exceeded at WS02 at 32.4ug/l and WS06 at 19.2ug/l. The Nickel DWS of 20ug/l was exceeded at WS02 at 97.9ug/l and WS06 at 34.2ug/l. No groundwater sample test positive for the presence of oils or PAHs or other significant contamination.

The minor exceedances for some metals on the Lifford side are likely to be naturally occurring since no significant development has taken place on this site. These exceedances are unlikely to have an impact on human health as there are no groundwater abstractions or private water supplies within 1km of the site. Impacts to the SAC from the baseline groundwater condition would be negligible.

### 3.4.2 Review of Groundwater Laboratory Results (Strabane)

- Zone 1 (Made ground, area of Former Railway Sidings & Goods Shed) ( See Figure 2)

The Benzo(a)pyrene (PAH) DWS of 0.01ug/l was exceeded at WS11 0.029ug/l in a shallow sample from under the concrete hardstand area (former railway sidings). This PAH compound is commonly found in ash clinker and in coal tar and heavier oils and is likely present as a result of the presence of made ground and former railway uses in this area. A shallow soil sample from this borehole tested positive for low levels of PAHs including Benzo(a)pyrene, with WS10 and WS12 in the same area not showing any PAHs in soils. This indicates that a small on-site contamination source (Made Ground) is causing the very minor impact to groundwater limited to around WS11-WS12, i.e. groundwater impact is very localised.

- Zone 2 (Made Ground, area of Former Railway Sidings & Engine House) (See Figure 2)

The Lead DWS of 10ug/l was exceeded at WS12 20.5ug/l and WS13 12.6ug/l. These are not considered significant impacts.

At WS12 the Benzo(a)pyrene (PAH) DWS of 0.01ug/l was exceeded at 0.035ug/l. Soil samples from this area do not show PAHs, so this occurrence is likely to be part of the same

small area of groundwater very slightly contaminated by PAHs associated with made ground and the former railway use, as detected at the nearby WS11. Groundwater at WS14 also shows some trace concentrations of PAHs (Total PAH 0.277mg/l) (near Zone 4).

Although groundwater flow direction will be towards the River Foyle for this location, attenuation with the shallow soils and clayey alluvium/sands between the source and receptor (River Foyle) is likely to further reduce any PAH contamination present. On-site groundwater data from boreholes downflow of the railway lands in Zone 1 and Zone 2 (at CGBH03) did not show the presence of PAH indicating contamination is not migrating towards the River Foyle.

- Zone 4 (Made ground, Former Railway Embankment, Infilled Ponds) (See Figure 2)

The Arsenic DWS of 10ug/l was exceeded at WS15 at 13.5ug/l. This is not considered as significant.

The Benzo(a)pyrene (PAH) DWS of 0.01ug/l was exceeded at WS17 0.1ug/l and marginally exceeded at WS20 0.019ug/l.

The Benzo(b)fluoranthene (PAH) DWS of 0.1ug/l was exceeded at WS17 0.13ug/l.

The presence of trace concentrations of PAH compounds in the shallow groundwater in this area is due to the past industrial uses and made ground associated with the former railway infrastructure. Soils from WS17 and WS20 both showed the presence of a range of PAH compounds. The source of the localised groundwater contamination is therefore likely to be on-site historical made ground.

The risk of this contamination to the River Foyle from this minor groundwater contamination is considered to be negligible due to the low concentrations at source, the distance to the receptor (c.100m) and the nature of the shallow aquifer system. Although groundwater flow direction will be toward the River Foyle from this location, attenuation within the shallow soils and clayey alluvium / sands between the source and receptor (River Foyle) is likely to further reduce any PAH contamination present. On-site groundwater data from boreholes downflow of the car park area (WS09) did not show the presence of PAH indicating contamination is not migrating toward the River Foyle.

## 3.5 Summary of Groundwater Laboratory Results

**Lifford:**

Various minor exceedances Metals at Lifford are likely to be naturally occurring as no significant development has taken place on this site. These exceedances are unlikely to have an impact on human health as there are no groundwater abstractions or private water supplies within 1km of the site. Impact to the SAC from shallow groundwater is considered insignificant. No groundwater remediation will be required to facilitate th development.

**Strabane:**

The Benzo(a)pyrene exceedances in groundwater from WS11, WS12 and WS17 and the Benzo(b)fluoranthene exceedance in groundwater from WS17 are likely due to the previous use of the site, as railway land, and imported Made Ground. WS11 is in the location of the former traveller community accommodation, where it is known that fuel was used and Made Ground is present. WS12 is within the area of the former Engine House. WS17 is located in Zone 4 where black ashy material was identified in Made Ground. Lower levels of PAHs were also detected in other boreholes located on former railway land in the east of the site.

It is unknown if the Metal (Arsenic, Lead and Nickel) exceedances are locally influenced (as in Lifford) or can be attributed to the imported materials.

All groundwater exceedances in Strabane are unlikely to have an impact on human health as there are no groundwater abstractions or private water supplies within 1km of the site.

The main surface water discharge for the site (see section 3.6.2) did not show any exceedances. Risk to the River Foyle SAC from shallow groundwater is considered low. Groundwater samples from boreholes hydraulically downgradient of the boreholes where organic contamination was detected, do not show the organic contamination persisting.

## 3.6 Review of Surface Water Laboratory Results

The Surface Water laboratory results are included in Appendix F. Surface Water samples were obtained from SW1 to SW5 and WCS01 to WCS10, as shown in Figure 5.

All Surface Water results were compared against available Environmental Quality Standards (EQS).

### 3.6.1 Review of Lifford Surface Water Laboratory Results

On the Lifford side, Surface Water samples were collected from SW4, SW5 and WCS07 to WCS10, as presented in Figure 5.

Upstream at SW4, in the on-site watercourse entering the site from sub-urban lands beyond, a sample obtained on 27/5/21 indicates reasonably good chemical water quality, with low levels of metals, no oils or PAHs detected and very low BOD (1mg/l) and low suspended solids (14mg/l).

A short distance further downstream in the same watercourse at SW5 (sample from 27/5/21) / WCS09 (Sample from 24/6/21), trace quantities of PAH compounds were detected, including benzo (a) pyrene 0.016µg/l (Total PAH 0.250µg/l) from the sample collected on 27/6/21 in a sample which demonstrated a high suspended solids of 725mg/l. Lower levels of PAH were detected at the same sample location (WS09) on 24/6/21 (though total PAH was reported as <0.195µg/l). The sample from WS09 obtained on 24/6/21 demonstrated elevated ammoniacal nitrogen (7.4mg/l), electrical conductivity (918µS/cm), chloride (195.2mg/l) and suspended solids (41mg/l). Further downstream in the same watercourse at WCS10, similar chemistry to that observed at WCS09 was observed. There is no clear identifiable point source for the trace levels of PAH, and the elevated ammonia and chloride detected in the downstream water samples in this small watercourse.

The local low intensity land-use, and generally green-field nature of the land history does not provide any evidence of local pollution sources, however, the presence of ammonia may suggest agricultural spreading / fertiliser inputs form surrounding farmed land, such as the field to the northeast.

Insignificant small changes were observed in chemistry in the River Foyle between sample points WCS07 (upflow) and WCWs 08 (downflow) at the Lifford WWTW discharge, however it was difficult to establish whether a discharge was being made from the WWTW at that time.

No exceedances of EQS was observed in any of the surface water data for Lifford.

### 3.6.2 Review of Strabane Surface Water Laboratory Results

On the Strabane side, Surface Water samples were collected from SW1, SW2, SW3 and WCSO1 to WCS06, as shown in Figure 5.

Upstream at SW1 in the Park Road Drain, a sample obtained on 26/5/21 indicates reasonably good chemical water quality, with low levels of metals, no oils detected and no detectable BOD, however Suspended Solids is high at 505mg/l and the sample also showed the presence of trace PAH compounds (including benzo(a)pyrene 0.025ug/l above EQS of 0.01ug/l, Total PAH 0.438µg/l), likely due to road runoff inputs (off-site source) from surrounding road infrastructure.

A second water sample in the Park Road Drain proximal to SW1 at WCS01 from 24/6/21, shows the presence of oils (EPG C8-C40 at 3.23mg/l), PAH (Total PAH 2.273µg/l) and high suspended solids (588mg/l) and ammonia (1.19mg/l NH3_N), typical of an urban catchment. In the absence of an on-site source of oils in this vicinity of the site (this surface sample point is located upflow of the area where low levels of PAHs (Total PAH 0.308µg/l WS11, Figure 4) have been detected in groundwaters under the concrete area north of this location (see section 3.4.2), an off-site source from the urban lands to the south would seem likely.

Upstream at SW2 in the Nancy Burn (downstream with respect to historical landfill and gasworks to east), a sample obtained on 26/5/21 indicates reasonably good chemical water quality, with low levels of metals, no oils detected and no detectable BOD, with a low level of suspended solids (22mg/l) and some insignificant trace PAH compounds (Fluoranthene 0.016µg/l, Pyrene 0.022µg/l).

The Park Road Drain was also sampled just before its confluence with the Nancy Burn, at WCS02 on 24/6/21. This indicates some discernible degradation in water quality as it flows along the eastern site boundary, with increased levels of nitrate (17.3mg/l) compared to the upflow conditions (<0.2mg/l), suggesting agricultural runoff input from farmed grasslands immediately to the east. However, oils and PAHs detected upflow (at SW1 and WCS01) appear to have dissipated by this point and levels of suspended solids have reduced to 73mg/l from over 500mg/l at the upflow sampling point.

Downflow in the main site discharge in the Nancy Burn at SW3, water quality appears good, with no significant organic or inorganic contamination detected and no exceedances of EQS

indicating that there is no significant impact to the River Foyle from the watercourses draining the site.

With respect to water quality in the on-site ponds, a sample from Pond 2 (triangle-shaped pond) WSC03, obtained on 24/6/21, chemical water quality appears reasonable, though low levels of oils were detected in this sample (0.2mg/l). The water in this pond has a lower conductivity (140µS/cm) that local surface waters (c400µS/cm), more typical of rainfall, which is consistent with this feature having no discernible inflow and being primarily rainfall-derived. This pond has also no discernible outfall. The outfall from Pond 3, the main water feature on site, WCS06, low levels of oils were detected (0.11mg/l) and low levels of ammonia also present (0.55mg/l NH3_N) suggesting slightly anoxic inputs.

In relation to sampling in the River Foyle around the WWTW discharges, it was difficult to determine whether the sites were actively discharging at the time of sampling. However, for the Strabane WWTW, water quality appeared good at WSC04, with a slight increase in Sulphate (2.3mg/l increasing to 9.7mg/l), Chloride (15.7mg/l increasing to 23.2mg/l) and Nitrate (4.2mg/l increasing to 6.3mg/l) between upflow and downflow (WCS05) samples.

## 3.7 Ground Gas Assessment

Ground gas monitoring was undertaken on various dates across 4no. monitoring visits across the Lifford and Strabane area.

During the monitoring period, atmospheric pressure ranged from 1010mb to 1021mb across falling, rising and constant pressures.

### 3.7.1 Gas Screening Values

The recorded Methane and Carbon Dioxide concentrations and the source of the gas have been reviewed in accordance with the guidance in C665, BS8576 and BS8485. Borehole Hazardous Gas Flow Rates (Qhg), also known as Gas screening values (GSVs), have been calculated based on the gas data collected across the 4no. monitoring visits at each location. Borehole hazardous gas flow rates for each borehole have been calculated based on:

$$Qhg = \text{Flow rate (l/hr)} \times (\text{gas concentration} /100)$$

with the Peak Flow rate and Peak concentration of Methane used, whilst the Steady State flow rate and Steady concentration of Carbon Dioxide is used.

### 3.7.2 Gas Screening Values (Lifford Access Zone)

**Table 5: Lifford Access Zone GSV**

| Date | ID | Peak Flow (l/hr) | Peak Methane %vol | Calculated Methane GSV l/hr | CS | Steady flow (l/hr) | Steady $CO_2$ %vol | Calculated CO2 GSV l/hr | CS |
|---|---|---|---|---|---|---|---|---|---|
| 18.06.2021 | WS22 | 0.0 | 0.7 | 0.0 | CS1 | 0.0 | 0.2 | 0.0 | CS1 |
| 24.06.2021 | WS22 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 0.1 | 0.0 | CS1 |
| 02.07.2021 | WS22 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 0.1 | 0.0 | CS1 |
| 08.07.2021 | WS22 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 0.0 | 0.0 | CS1 |

### 3.7.3 Gas Screening Values (Lifford Western Zone)

**Table 6: Lifford Western Zone GSV**

| Date | ID | Peak Flow (l/hr) | Peak Methane %vol | Calculated Methane GSV l/hr | CS | Steady flow (l/hr) | Steady $CO_2$ %vol | Calculated CO2 GSV l/hr | CS |
|---|---|---|---|---|---|---|---|---|---|
| 27.05.2021 | HA08 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 0.1 | 0.0 | CS1 |
| 27.05.2021 | WS05 | 0.0 | 0.5 | 0.0 | CS1 | 0.0 | 9.1 | 0.0 | CS1 |
| 15.07.2021 | WS23 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 2.5 | 0.0 | CS1 |
| 04.06.2021 | HA08 | 0.0 | 0.1 | 0.0 | CS1 | 0.0 | 0.0 | 0.0 | CS1 |
| 04.06.2021 | WS05 | 0.0 | 0.1 | 0.0 | CS1 | 0.0 | 9.6 | 0.0 | CS1 |
| 23.07.2021 | WS23 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 3.7 | 0.0 | CS1 |
| 10.06.2021 | HA08 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 0.1 | 0.0 | CS1 |
| 10.06.2021 | WS05 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 11.4 | 0.0 | CS1 |
| 29.07.2021 | WS23 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 0.4 | 0.0 | CS1 |
| 08.07.2021 | HA08 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 0.1 | 0.0 | CS1 |
| 08.07.2021 | WS05 | 0.0 | 0.6 | 0.0 | CS1 | 0.0 | 6.2 | 0.0 | CS1 |
| 04.08.2021 | WS23 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 0.1 | 0.0 | CS1 |

### 3.7.4 Gas Screening Values (Lifford Central Zone)

**Table 7: Lifford Central Zone GSV**

| Date | ID | Peak Flow (l/hr) | Peak Methane %vol | Calculated Methane GSV l/hr | CS | Steady flow (l/hr) | Steady $CO_2$ %vol | Calculated CO2 GSV l/hr | CS |
|---|---|---|---|---|---|---|---|---|---|
| 27.05.2021 | WS02 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 2.2 | 0.0 | CS1 |
| 27.05.2021 | WS03 | 0.0 | 0.6 | 0.0 | CS1 | 0.0 | 7.8 | 0.0 | CS1 |
| 27.05.2021 | WS04 | 0.0 | 0.3 | 0.0 | CS1 | 0.0 | 7.3 | 0.0 | CS1 |
| 27.05.2021 | WS06 | -1.5 | 0.0 | 0.0 | CS1 | 0.0 | 11.9 | 0.0 | CS1 |
| 04.06.2021 | WS02 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 6.6 | 0.0 | CS1 |
| 04.06.2021 | WS03 | 0.0 | 0.2 | 0.0 | CS1 | 0.0 | 3.4 | 0.0 | CS1 |
| 04.06.2021 | WS04 | 0.0 | 0.2 | 0.0 | CS1 | 0.0 | 3.6 | 0.0 | CS1 |
| 04.06.2021 | WS06 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 0.6 | 0.0 | CS1 |
| 10.06.2021 | WS02 | 0.0 | 0.3 | 0.0 | CS1 | 0.0 | 6.6 | 0.0 | CS1 |
| 10.06.2021 | WS03 | 0.0 | 0.2 | 0.0 | CS1 | 0.0 | 5.4 | 0.0 | CS1 |
| 10.06.2021 | WS04 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 9.2 | 0.0 | CS1 |
| 10.06.2021 | WS06 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 2.2 | 0.0 | CS1 |
| 08.07.2021 | WS02 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 9.1 | 0.0 | CS1 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 08.07.2021 | WS03 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 4.8 | 0.0 | CS1 |
| 08.07.2021 | WS04 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 5.4 | 0.0 | CS1 |
| 08.07.2021 | WS06 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 8.9 | 0.0 | CS1 |

### 3.7.5 Gas Screening Values (Lifford Eastern Zone)

**Table 8: Lifford Eastern Zone GSV**

| Date | ID | Peak Flow (l/hr) | Peak Methane %vol | Calculated Methane GSV l/hr | CS | Steady flow (l/hr) | Steady $CO_2$ %vol | Calculated CO2 GSV l/hr | CS |
|---|---|---|---|---|---|---|---|---|---|
| 04.06.2021 | HA23 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 2.0 | 0.0 | CS1 |
| 10.06.2021 | HA23 | 0.0 | 0.2 | 0.0 | CS1 | 0.0 | 0.3 | 0.0 | CS1 |
| 23.07.2021 | HA23 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 0.6 | 0.0 | CS1 |
| 04.08.2021 | HA23 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 0.9 | 0.0 | CS1 |

### 3.7.6 Gas Screening Values (Strabane Zone 1)

**Table 9: Strabane Zone 1 GSV**

| Date | ID | Peak Flow (l/hr) | Peak Methane %vol | Calculated Methane GSV l/hr | CS | Steady flow (l/hr) | Steady $CO_2$ %vol | Calculated CO2 GSV l/hr | CS |
|---|---|---|---|---|---|---|---|---|---|
| 26.05.2021 | WS10 | 0.0 | 0.2 | 0.0 | CS1 | 0.0 | 0.0 | 0.0 | CS1 |
| 26.05.2021 | WS11 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 0.0 | 1.5 | CS1 |
| 04.06.2021 | WS10 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 0.0 | 0.0 | CS1 |
| 04.06.2021 | WS11 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 0.2 | 0.0 | CS1 |
| 10.06.2021 | WS10 | 0.0 | 0.7 | 0.0 | CS1 | 0.0 | 0.0 | 0.0 | CS1 |
| 10.06.2021 | WS11 | 0.0 | 0.8 | 0.0 | CS1 | 0.0 | 0.0 | 0.0 | CS1 |
| 08.07.2021 | WS10 | 0.0 | 20.4 | 0.0 | CS1 | 0.0 | 4.7 | 0.0 | CS1 |
| 08.07.2021 | WS11 | 0.0 | 0.5 | 0.0 | CS1 | 0.0 | 4.8 | 0.0 | CS1 |

### 3.7.7 Gas Screening Values (Strabane Zone 2)

**Table 10: Strabane Zone 2 GSV**

| Date | ID | Peak Flow (l/hr) | Peak Methane %vol | Calculated Methane GSV l/hr | CS | Steady flow (l/hr) | Steady $CO_2$ %vol | Calculated CO2 GSV l/hr | CS |
|---|---|---|---|---|---|---|---|---|---|
| 26.05.2021 | WS07 | 0.1 | 0.0 | 0.0 | CS1 | 0.0 | 0.0 | 0.0 | CS1 |
| 26.05.2021 | WS08 | 0.0 | 0. | 0.0 | CS1 | 0.0 | 1.5 | 0.0 | CS1 |
| 26.05.2021 | WS09 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 4.8 | 0.0 | CS1 |
| 26.05.2021 | WS12 | 0.0 | 0.2 | 0.0 | CS1 | 0.0 | 0.0 | 0.0 | CS1 |
| 26.05.2021 | WS13 | 0.0 | 2.2 | 0.0 | CS1 | 0.0 | 4.7 | 0.0 | CS1 |
| 26.05.2021 | WS14 | 0.0 | 3.1 | 0.0 | CS1 | 0.0 | 10.8 | 0.0 | CS1 |
| 04.06.2021 | HA13 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 0.0 | 0.0 | CS1 |
| 04.06.2021 | WS07 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 0.0 | 0.0 | CS1 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 04.06.2021 | WS08 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 5.2 | 0.0 | CS1 |
| 04.06.2021 | WS09 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 14.0 | 0.0 | CS1 |
| 04.06.2021 | WS12 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 5.5 | 0.0 | CS1 |
| 04.06.2021 | WS13 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 4.6 | 0.0 | CS1 |
| 04.06.2021 | WS14 | 0.0 | 1.7 | 0.0 | CS1 | 0.0 | 0.6 | 0.0 | CS1 |
| 10.06.2021 | HA13 | 0.0 | 0.7 | 0.0 | CS1 | 0.0 | 0.0 | 0.0 | CS1 |
| 10.06.2021 | WS07 | 0.0 | 0.4 | 0.0 | CS1 | 0.0 | 0.0 | 0.0 | CS1 |
| 10.06.2021 | WS08 | 0.0 | 0.5 | 0.0 | CS1 | 0.0 | 7.1 | 0.0 | CS1 |
| 10.06.2021 | WS09 | 0.0 | 0.4 | 0.0 | CS1 | 0.0 | 11.8 | 0.0 | CS1 |
| 10.06.2021 | WS12 | 0.6 | 0.7 | 0.0 | CS1 | 0.0 | 3.7 | 0.0 | CS1 |
| 10.06.2021 | WS13 | 0.0 | 1.0 | 0.0 | CS1 | 0.0 | 0.2 | 0.0 | CS1 |
| 10.06.2021 | WS14 | 0.0 | 2.6 | 0.0 | CS1 | 0.0 | 0.5 | 0.0 | CS1 |
| 08.07.2021 | HA13 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 0.0 | 0.0 | CS1 |
| 08.07.2021 | WS07 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 0.0 | 0.0 | CS1 |
| 08.07.2021 | WS08 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 4.3 | 0.0 | CS1 |
| 08.07.2021 | WS09 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 12.1 | 0.0 | CS1 |
| 08.07.2021 | WS12 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 0.6 | 0.0 | CS1 |
| 08.07.2021 | WS13 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 0.7 | 0.0 | CS1 |
| 08.07.2021 | WS14 | 0.0 | 0.8 | 0.0 | CS1 | 0.0 | 1.3 | 0.0 | CS1 |
| 23.07.2021 | HA13 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 0.0 | 0.0 | CS1 |

### 3.7.8 Gas Screening Values (Strabane Zone 3)

**Table 11: Strabane Zone 3 GSV**

| Date | ID | Peak Flow (l/hr) | Peak Methane %vol | Calculated Methane GSV l/hr | CS | Steady flow (l/hr) | Steady $CO_2$ %vol | Calculated CO2 GSV l/hr | CS |
|---|---|---|---|---|---|---|---|---|---|
| 04.06.2021 | HA10 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 0.3 | 0.0 | CS1 |
| 18.06.2021 | WS21 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 2.0 | 0.0 | CS1 |
| 10.06.2021 | HA10 | 0.0 | 0.4 | 0.0 | CS1 | 0.0 | 0.9 | 0.0 | CS1 |
| 24.06.2021 | WS21 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 0.2 | 0.0 | CS1 |
| 08.07.2021 | HA10 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 0.6 | 0.0 | CS1 |
| 02.07.2021 | WS21 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 1.2 | 0.0 | CS1 |
| 23.07.2021 | HA10 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 0.4 | 0.0 | CS1 |
| 09.07.2021 | WS21 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 0.8 | 0.0 | CS1 |

### 3.7.9 Gas Screening Values (Strabane Zone 4)

**Table 12: Strabane Zone 4 GSV**

| Date | ID | Peak Flow (l/hr) | Peak Methane %vol | Calculated Methane GSV l/hr | CS | Steady flow (l/hr) | Steady $CO_2$ %vol | Calculated CO2 GSV l/hr | CS |
|---|---|---|---|---|---|---|---|---|---|
| 18.06.2021 | WS15 | 0.0 | 0.4 | 0.0 | CS1 | 0.0 | 10.3 | 0.0 | CS1 |
| 18.06.2021 | WS16 | 0.0 | 2.3 | 0.0 | CS1 | 0.0 | 2.1 | 0.0 | CS1 |
| 18.06.2021 | WS17 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 12.5 | 0.0 | CS1 |
| 18.06.2021 | WS18 | 0.0 | 0.6 | 0.0 | CS1 | 0.0 | 3.3 | 0.0 | CS1 |
| 18.06.2021 | WS19 | 0.0 | 3.1 | 0.0 | CS1 | 0.0 | 4.1 | 0.0 | CS1 |
| 18.06.2021 | WS20 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 4.1 | 0.0 | CS1 |
| 24.06.2021 | WS15 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 11.1 | 0.0 | CS1 |
| 24.06.2021 | WS16 | 0.0 | 3.9 | 0.0 | CS1 | 0.0 | 2.7 | 0.0 | CS1 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 24.06.2021 | WS17 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 10.4 | 0.0 | CS1 |
| 24.06.2021 | WS18 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 2.2 | 0.0 | CS1 |
| 24.06.2021 | WS19 | 0.0 | 0.2 | 0.0 | CS1 | 0.0 | 3.9 | 0.0 | CS1 |
| 24.06.2021 | WS20 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 2.0 | 0.0 | CS1 |
| 02.07.2021 | WS15 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 11.5 | 0.0 | CS1 |
| 02.07.2021 | WS16 | 0.0 | 3.1 | 0.0 | CS1 | 0.0 | 3.3 | 0.0 | CS1 |
| 02.07.2021 | WS17 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 6.9 | 0.0 | CS1 |
| 02.07.2021 | WS18 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 5.9 | 0.0 | CS1 |
| 02.07.2021 | WS19 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 0.1 | 0.0 | CS1 |
| 02.07.2021 | WS20 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 0.4 | 0.0 | CS1 |
| 08.07.2021 | WS15 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 11.8 | 0.0 | CS1 |
| 08.07.2021 | WS16 | 0.0 | 2.1 | 0.0 | CS1 | 0.0 | 1.1 | 0.0 | CS1 |
| 08.07.2021 | WS17 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 7.4 | 0.0 | CS1 |
| 08.07.2021 | WS18 | 0.0 | 0.1 | 0.0 | CS1 | 0.0 | 6.8 | 0.0 | CS1 |
| 08.07.2021 | WS19 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 0 | 0.0 | CS1 |
| 08.07.2021 | WS20 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 0.4 | 0.0 | CS1 |

### 3.7.10 Ground Gas Summary

After review of the Methane and Carbon Dioxide every location has been classified as a CS1. Guidance (*Ciria C665; Assessing risks posed by hazardous ground gases to buildings)* suggests consideration of CS2 for Methane concentrations of >1%vol and Carbon Dioxide concentrations of >5%vol. The locations which exceeded these values are highlighted in the tables above. Table 13 details the worst case data from each of those locations.

**Table 13: Worst Case Gas Data**

| Date | ID | Peak Flow (l/hr) | Peak Methane %vol | Calculated Methane GSV l/hr | CS | Steady flow (l/hr) | Steady $CO_2$ %vol | Calculated CO2 GSV l/hr | CS |
|---|---|---|---|---|---|---|---|---|---|
| **Lifford** | | | | | | | | | |
| 08.07.2021 | WS02 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 9.1 | 0.0 | CS1 |
| 27.05.2021 | WS03 | 0.0 | 0.6 | 0.0 | CS1 | 0.0 | 7.8 | 0.0 | CS1 |
| 10.06.2021 | WS04 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 9.2 | 0.0 | CS1 |
| 10.06.2021 | WS05 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 11.4 | 0.0 | CS1 |
| 27.05.2021 | WS06 | -1.5 | 0.0 | 0.0 | CS1 | 0.0 | 11.9 | 0.0 | CS1 |
| **Strabane** | | | | | | | | | |
| 10.06.2021 | WS08 | 0.0 | 0.5 | 0.0 | CS1 | 0.0 | 7.1 | 0.0 | CS1 |
| 04.06.2021 | WS09 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 14.0 | 0.0 | CS1 |
| 08.07.2021 | WS10 | 0.0 | 20.4 | 0.0 | CS1 | 0.0 | 4.7 | 0.0 | CS1 |
| 04.06.2021 | WS12 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 5.5 | 0.0 | CS1 |
| 26.05.2021 | WS13 | 0.0 | 2.2 | 0.0 | CS1 | 0.0 | 4.7 | 0.0 | CS1 |
| 26.05.2021 | WS14 | 0.0 | 3.1 | 0.0 | CS1 | 0.0 | 10.8 | 0.0 | CS1 |
| 08.07.2021 | WS15 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 11.8 | 0.0 | CS1 |
| 24.06.2021 | WS16 | 0.0 | 3.9 | 0.0 | CS1 | 0.0 | 2.7 | 0.0 | CS1 |
| 18.06.2021 | WS17 | 0.0 | 0.0 | 0.0 | CS1 | 0.0 | 12.5 | 0.0 | CS1 |
| 08.07.2021 | WS18 | 0.0 | 0.1 | 0.0 | CS1 | 0.0 | 6.8 | 0.0 | CS1 |
| 18.06.2021 | WS19 | 0.0 | 3.1 | 0.0 | CS1 | 0.0 | 4.1 | 0.0 | CS1 |

These locations were classified as CS1 as no flow was detected and therefore, using the below equation, each calculated GSV was 0.0l/hr

Qhg = Flow rate (l/hr) x (gas concentration /100)

After giving consideration to CS2, the following is recommended or each of the exceeding locations;

**Lifford:**

- WS02, WS03, WS05 and WS06 should remain CS1, *Very Low Risk,* as soft landscaping with no buildings is proposed in these areas, therefore no ground gas pathway will exist.
- WS04 should be classified as CS2 *Low Risk* as it is located within the footprint of the proposed Hub building. It is recommended that one or two of the following protection measurements are included in the construction of the Hub building with all joints and penetrations sealed;
    1. Reinforced concrete cast in situ floor slab (suspended, non-suspended or raft) with at least 1200 g DPM$^2$.
    2. Beam and block or pre cast concrete slab and minimum 2000 g DPM/reinforced gas membrane.
    3. Underfloor venting or pressurisation in combination with a) and b) depending on use.

**Strabane:**

- WS08, WS09, WS10, WS12, WS13, WS14 should remain CS1, *Very Low Risk,* as soft landscaping with no buildings is proposed in these areas, therefore no ground gas pathway will exist.
- WS15, WS16, WS17, WS18 and WS19 should remain CS1, *Very Low Risk,* as a car park is proposed in these locations, therefore no ground gas pathway will exist.

**Lifford:**

In summary, WS04 which is located within the footprint of the proposed Hub building in Lifford has been classified as CS2 Low Risk and will require minimal protection measures as mentioned above. Every other location monitored as part of the ground gas monitoring programme, including the proposed operational and maintenance building compound and the proposed spectator stand, have been classified as CS1 Very Low Risk, requiring no ground gas mitigation measures.

**Strabane:**

All locations monitored on the Strabane side have been classified as CS1 Very Low Risk, requiring no ground gas mitigation measures.

# 4.0 REVISED CONCEPTUAL MODEL

Based on findings from the Preliminary Risk Assessment and on findings above from the ground investigation and subsequent collection of soil samples, groundwater samples, surface waters and ground gas data, a revised conceptual site model is presented below.

**Table 14: Revised CSM for Lifford**

| Source | Pathway | Receptor | Risk Category / Rating |
|---|---|---|---|
| ON Site:<br>Made ground Limited to discrete areas<br><br>OFF SITE:<br>limited to beyond the south-western corner with the adjacent historical railway and treatment works. | Ingestion / Direct Contact | End Site Users | **Very Low:**<br>No exceedances of S4UL values and no asbestos identified during the ground investigation.<br><br>The end use of the site is public space with large areas of soft landscaping therefore Highly Likely users of the site will come into contact with the soils however, in several areas of the site no development has taken place/limited contamination Sources.<br>Discrete made ground is present along the southern boundary and in the land raised section. Historical maps indicate mainly used for agricultural purposes and recreational activities too.<br>The main concern of the site is the south-western area: infilled land south of the site for Greyhound Coursing purposes. |
| | | Construction Workers & Maintenance Workers | **Low:**<br>No exceedances of S4UL values and no asbestos identified during the ground investigation.<br>Proposed community hub building is on the northern fringes of the land raised area. Site workers may come into contact with Made Ground,<br>Additional walking path will be construction in the southern area of site, and some changes along the embankment therefore workers will come into contact with these made ground soils. However the Made Ground did not contain any soil exceeding S4UL values.<br><br>Large areas of the site will remain as soft landscaping which will be attended to by maintenance workers. |
| | Root Uptake | Planted trees/vegetation | **Low:** the land is currently occupied by open fields. The northern section of the site will remain unchanged as the hare coursing ground relocated from it's current southern location. A new spectator stand is proposed for hare coursing, in the Central Zone. Fill will be imported to raise the land. WAC and WM3 testing should be carried out on the fill before it is brought to site to ensure no risks are posed to Human Health or the groundwater which could leave to the SAC being adversely affected.<br>Landscaping will be undertaken across the southern area around the events space, play areas and building however the majority of the site has remained undeveloped and the existing vegetation shows no sign of distress. |
| | Direct Contact | Buildings and structures | **Low:** Community building proposed. Alluvial soils known to be aggressive. Sulphate and pH, which can be aggressive to contact materials are within suitable values. |

| Source | Pathway | Receptor | Risk Category / Rating |
|---|---|---|---|
| | | | Sulphate did not exceed in WS04 or HA01. pH was between 6.79 and 7.04 in WS04 and HA01. |
| Importation of Fill | Ingestion / Direct Contact<br><br>Leaching | End site users, Construction Workers, SAC | **Low/Moderate:** Fill will be imported to allow raise the profile of the land to the desired levels. WAC and WM3 testing should be carried out on any imported fill before arriving to site. Untested fill may contain contaminants hazardous to Human Health, of which End Site Users and Construction Workers may come into direct contact with. Hazardous contaminants could also reach the River Foyle SAC through lateral migration via surface runoff or vertical and then lateral migration via groundwater. |
| Groundwater Contaminants | Leaching, lateral and vertical migration | Groundwater Bedrock | **Moderate:** No groundwater abstractions in surrounding area. Causeway Geotech BH Logs indicate +20m of Superficial Deposits however assigned High vulnerability due to the granular nature of the overlying Drift deposits. |
| | Lateral Migration | Watercourse | **Very High:** High shallow water table in the Superficial Deposits was confirmed and is confirmed to be in conductivity with the River Foyle and Nancy Burn. The River Foyle is under tidal influence and<br>Superficial Deposits are confirmed to be interlayered with granular beds which will laterally and vertically aid contaminant flow.<br>Main Hub Building is within >70m of the Foyle, 45m north of where the SAC Designation commences. Ground levels slope towards the River therefore Highly Likely surface water runoff will occur. Permeable nature of underlying drift will allow for considerable infiltration of runoff to ground, rather than into the River Foyle.<br>Any spillages at ground level will have the opportunity to travel through the layered Superficial Deposits and shallow groundwater table to the River.<br>CEMP is required to demonstrate how risks during the bridge construction will be managed to cause no impact on the SAC. SUDs scheme will allow for maximisation of infiltration. |
| Ground gas / vapors generated from Made Ground | Gas ingress into buildings and site infrastructure | End site users | **Low/Moderate:** Made Ground located in the footprint of the proposed Hub building location. This area has been classified CS2 due to CO2 levels of >5%vol and therefore protection measures should be implemented. All other areas of the site have been classified CS1. |
| | Migration into services, inhalation of ground gas by workers | Construction Workers, Maintenance Workers | **Moderate**: Exposure times likely to be limited and may be dealt with in safe systems of works. |
| Radon | Gas ingress into buildings and site infrastructure | End site users | **Very High:** In an elevated radon area 5-10%. Depending on the design of the building radon protection may be required. |

## Table 15: Revised CSM for Strabane Zone 1 and Zone 4 (hardstanding and proposed parking)

| Source | Pathway | Receptor | Risk Category / Rating |
|---|---|---|---|
| ON Site Soil : Historical Made Ground from railway<br><br>Importation of Fill<br><br>OFF SITE: Railway land, refuse tip and gas works | Ingestion / Direct Contact | End Site Users | **Low:** No S4UL values exceeded at Zone 1 or Zone 4. |
| | | Construction Workers & Maintenance Workers | **Low:** No S4UL values exceeded at Zone 1 or Zone 4. |
| | Root Uptake | Planted trees/vegetation | **Moderate :** Invasive species present across the site in specific locations.<br>The exiting site vegetation shows no sign of destress and has had to be cut back. Majority of the landscaping will be maintained in the redevelopment. |
| | Direct Contact | Buildings and structures | **Moderate/Low:** No buildings proposed however new hardstanding will be laid across Zone 4 which is currently grazing land. pH and Sulphate are known to be aggressive to contact materials. No exceedances of Sulphate identified. pH ranged from quite acidic 4.85 to neutral 7.13.<br>Alluvial soils known to be potentially aggressive |
| Importation of Fill | Ingestion / Direct Contact<br><br>Leaching | End Site Users and Construction Workers<br><br>Planted trees/vegetation<br><br>SAC | **Low/Moderate:** In Zone 1 slabs may be lifted and excavation of subbase and soils to 0.5mbgl for importation of topsoil for wildflower meadow. The imported topsoil should be tested for WAC and WM3 so that it does not pose a risk to Human Health or adversely affect the proposed wildflower meadow vegetation.<br><br>Zone 4 will undergo cut/fill process which creates a risk to construction workers via dermal contact of Made Ground. |
| Groundwater Contaminant on an off sites | Leaching, lateral and vertical migration | Water bearing Sand and Gravel aquifer (up to 20 to 30m thick) and underlying Deep Groundwater Bedrock | **Moderate:** No groundwater abstractions in surrounding area. +20m of Superficial Deposits however assigned High vulnerability due to the granular nature of the overlying drift deposits. |
| | Lateral Migration | Watercourse / Shallow groundwater in Tidal Deposits in continuity | **Very High:** High shallow water table in the Superficial Deposits is confirmed and is confirmed to be hydraulically connected to the River Foyle and Nancy Burn. River Foyle is under tidal influence and is SAC/ASSI<br>Superficial Deposits is confirmed to be interlayered with granular beds which will laterally and vertically aid contaminant flow. |
| Ground gas / vapors generated from Made Ground | Gas ingress into buildings and site infrastructure | End site users | **Low:** No buildings/structures proposed on the Strabane side. All areas classified as CS1. |
| | Migration into services, inhalation of ground gas by workers | Construction Workers, Maintenance Workers | **Low:** Exposure times likely to be limited and may be dealt with in safe systems of works. |
| Radon | Gas ingress into buildings and site infrastructure | End site users | **Low:** Within an elevated radon area however no structures proposed. |

**Table 16: Revised CSM for Strabane Zone 2 and Zone 3 (hardstanding and bridge site)**

| Source | Pathway | Receptor | Risk Category / Rating |
|---|---|---|---|
| ON Site Soil : Historical Made Ground from railway<br><br>OFF SITE: Railway land, refuse tip and gas works | Ingestion / Direct Contact | End Site Users<br><br>Construction Workers | **Very High:** Historical railway embankments across both zones. These will be retained and no significant changes in ground levels are proposed. End users, public park, will come into contact with the soil. Localised asbestos detected at WS12 exceeding the Human Health level of 0.001%. Exceedances of Copper and Lead (WS12) and Arsenic (WS13). Remediation of soils around WS12 will be required. Soils located at WS13 are planned for excavation as part of the development proposal.<br><br>Top of bund excavated to allow for new surfaces. Once remediation is completed, risk will revert to Low. |
| | | Construction Workers & Maintenance Workers | **Very High:** Historical railways are known sources of contaminants, including asbestos. The embankments will be retained as part of the public park with new path surfacing for walking in some areas. Construction workers will therefore come into direct contact with the soils.<br>These zones of the site will be remain as soft landscaping therefore maintenance workings will have the opportunity to have come into contact with the soils. |
| | Root Uptake | Planted trees/vegetation | **High:** These Zones will remain soft landscaping. Although no signs of distress at present. Significant landscaping area will be retained in the development. |
| | Direct Contact | Buildings and structures | **Moderate** No buildings proposed on the Strabane side, however foundations for the footbridge required.<br>Some walkways are proposed around the wetland. These will need to be designed to withstand waterlogged soils and in the consideration to the chemical composition of any made ground and Drift Deposits. |
| Groundwater Contaminants | Leaching, lateral and vertical migration | Water bearing Sand and Gravel aquifer (up to 20 to 30m thick) and underlying Deep Groundwater Bedrock | **Moderate** No groundwater abstractions in surrounding area. +20m of Superficial Deposits however assigned High vulnerability due to the granular nature of the overlying Tidal deposits. Sand and Gravel Aquifer is hydraulically connected to the River Foyle SAC. |
| | Lateral Migration | Watercourse / Shallow groundwater in Tidal Deposits in continuity | **Very High:** High shallow water table in the Superficial Deposits is confirmed and is confirmed be in conductivity with the River Foyle SAC and Nancy Burn. River Foyle is under tidal influence.<br>Superficial Deposits confirmed to be interlayered with granular beds which will laterally and vertically aid contaminant flow.<br>Buffers will need to be maintained to watercourses to provide protection during the construction phase.<br>CEMP will be required to demonstrate how risks during the bridge construction will be managed as the River Foyle is SAC and ASSI. Silt traps and silt fencing will be required for construction where works occur within close proximity to the watercourses. |

| Source | Pathway | Receptor | Risk Category / Rating |
|---|---|---|---|
| Ground gas / vapors generated from Made Ground | Gas ingress into buildings and site infrastructure | End site users | **Low:** Organic layers within the Alluvial Drift Deposits and extensive Made Ground beneath the carpark and the infilled ponds is confirmed. However, no buildings/structures proposed on the Strabane side. All areas classified as CS1. |
| | Migration into services, inhalation of ground gas by workers | Construction Workers, Maintenance Workers | **Low:** Exposure times likely to be limited and may be dealt with in safe systems of works. |
| Radon | Gas ingress into buildings and site infrastructure | End site users | **Moderate:** Within an elevated radon area however no structures proposed. |

# 5.0 SUMMARY, REMEDIAL STRATEGY AND RECOMMENDATIONS

## 5.1 Summary

**Lifford:**

Limited development is shown have occurred across the Lifford side of the site. A limited area of land raise has taken place historically with gravelly clay in the south-western area, as part of greyhound coursing activities. A spectator stand, incorporating welfare facilities (toilets and handwashing) served by a nearby septic tank and soakaway arrangement, is present in the southeast corner of the site. A small outbuilding is located in the north of the site. The development will comprise the construction of a hub building, car parking, open space, a small jetty, a rebuilt spectator stand (relocated to lands in the northern part of the site) and re-formed embankments with paths, limited to the Strabane side by a pedestrian and cycle bridge. The development will involve a degree of reprofiling by cut and fill and importation of make-up materials.

The ground investigation concluded that there were no exceedances of S4UL levels at any of the soil sampling locations at Lifford. There were some naturally occurring DWS exceedances for Nickel and Arsenic in the shallow groundwaters. However, these are considered to not pose a significant human health or environmental risk impact as there are no groundwater abstractions or private water supplies within 1km of the site, and are not likely to cause impact to the SAC. There were no EQS exceedances of the surface water samples.

Regarding ground gas, the majority of the site has been classified as CS1. However, the footprint of the community hub building has been classified as CS2, with passive gas protection measures required, due Carbon Dioxide levels of >5.0%vol.

Groundwater level monitoring on both sides of the River Foyle has indicated there is a high water table and that the site is hydraulically connected to the River Foyle, which is tidally influenced. Any potential spills on site could make their way into the River Foyle, which is an SAC and ASSI designated area. The development must therefore be sensitive to the pollution risk posed during the construction and operational phases.

**Strabane:**

The Strabane side of the site, historically was crossed by several railway lines and terminal sidings. A Goods Shed and Engine House were situated in the south eastern area of the site which is now hardstanding. The site includes extensive areas of overgrown wooded wetland with open water populated by numerous small trees.

The development in Strabane will comprise a two lane access road running from the Asda roundabout along the eastern site boundary, with pedestrian access paths to the bridge crossing site. the main car park for the Riverine scheme is located in the northeastern portion of the site. The development will include removal of the concrete hardstand and importation of topsoil in this area to create public open space.

Hotpot areas of hydrocarbon (TPH) contamination and asbestos in the soils has been confirmed, localised around WS12, on former railway land north of the hardstanding area. The soils containing asbestos will require remediation as asbestos levels are above the human health level of 0.001%. An Arsenic exceedance in the soils at WS13 was identified, so the soils in this location will need to be excavated and disposed of to landfill (i.e not re-used on-site during cut-fill groundworks).

The historical railway embankments are still present in the western and eastern areas of the site, with historical railways know to be a contaminative industry, including the use of fibrous asbestos and asbestos lagging. These embankments will be utilised as a walkways in the development, with little change in proposed final ground levels. There were no S4UL exceedances at these locations, therefore no potential pollutant linkages exists between the soils and the public users of the site, unless unexpected contamination is encountered during groundworks. There is no risk to the end public users of the site and the construction workers in preparing the site, widening and resurfacing the walkways.

Regarding groundwater quality in Strabane, the DWS exceedances for PAHs are likely due to the previous use of the site as railway land and imported Made Ground. However, all groundwater exceedances in Strabane are unlikely to have an impact on human health as there are no groundwater abstractions or private water supplies within 1km of the site. Groundwater samples from boreholes hydraulically downgradient of the boreholes where organic contamination was detected, do not show the organic contamination persisting. The main surface water discharge for the site (see section 3.6.2) did not show any exceedances. Risk to the River Foyle SAC from shallow groundwater is considered low.

There were no EQS exceedances at any surface water points.

Regarding ground gas, all areas in Strabane have been classified as CS1. No buildings are proposed, therefore there is no risk of the creation of ground gas pathways.

Regarding the northern area of the Strabane site, that is proposed for car park, the historical mapping identified ponds and a railway line in this area, however at current ground level no evidence of these structures is observed. Fill material and made ground is present in this area, which will become carparking. There were no exceedances of the S4UL values. However, pH was quite acidic at 4.85 in WS19 and alluvial soils are known to be potentially aggressive to contact materials.

Assessment to the soil, groundwater and ground gas concentrations as part of this GQRA has demonstrated the site is **Suitable for Use**, subject to the following remediation strategy being implemented.

## 5.2 Remedial Strategy

**Lifford:**

Ground gas protection measures should be installed under the community hub building in Lifford. One or two of the following measures should be implemented with all joints and penetrations sealed;

4. Reinforced concrete cast in situ floor slab (suspended, non-suspended or raft) with at least 1200 g DPM$^2$.
5. Beam and block or pre cast concrete slab and minimum 2000 g DPM/reinforced gas membrane.
6. Underfloor venting or pressurisation in combination with a) and b) depending on use.

**Radon protection measures are also required for all enclosed buildings as the Lifford site is located in an elevated radon area.**

**Strabane:**

The shallow soils surrounding WS12 will require remediation to alleviate the human health risk due to elevated levels of asbestos. Investigations show that asbestos is located around WS12 and to the west of this location, to maximum depth of 0.50mbgl.

The shallow soils surrounding WS13 will require remediation to alleviate the human health risk due to elevated levels of Arsenic.

Given the localised nature of the soil contamination detected, the most appropriate remedial solution will be a 'dig and dump' approach.

For the WS12 hotspot (Asbestos), soils should be excavated out at WS12 extending 5m east, 5m west, 5m north and c.2m south to the edge of the Clay bund located in this area, with excavations made to 1.0m depth. This will include materials in the vicinity of WS12D as a precautionary measure, totally c.30$m^3$ of material.

For WS13 hotspot (Arsenic), soils should be excavated out from WS13 extending as far east as 1m to the edge of the Park Road Drain , 5m to the west, 5m to the north and 5m to the south, with excavation made to 1.0m depth, totalling c.30$m^3$ of material.

Dust suppression should be used to prevent escape of air borne fibres during the excavation works and all remediation contractors and associated persons shall wear appropriate dust masks and PPE during the works.

The excavated materials shall be loaded directly into covered tipper lorries and transferred by an authorised waste carrier to an appropriately licensed landfill, subject to necessary waste classification assessment.

Validation samples shall be obtained from the base and sides of each excavation to demonstrate removal of all contaminated soils prior to emplacement of clean backfill.

Written verification of al remedial works shall be produced for NIEA approval.

## 5.3 Other Recommendations

Piling will be required at the bridge landing sites at Lifford and Strabane. Piling may also need to be used to construct appropriate foundations for other proposed buildings and structures at Lifford. A Piling Risk Assessment should be produced to assess any contamination risks posed by piling into water bearing deposits hydraulically linked to the River Foyle SAC.

A Construction Environmental Management Plan should be completed to detail how the risks to surface waters and groundwaters will be managed during the construction phase.

A range of mitigation measures will be required for the operational phase of the development to provide appropriate longer-term protection to sensitive water bodies.

Invasive species were observed across the site, including Giant Hogweed and Japanese Knotweed. The Giant Hogweed presents as risk to human health and therefore an invasive species management plan will be required,

| **Report prepared by:** | **Reviewed by:** |
|---|---|
| **Thomas Martin BSc MSc FGS**<br>**Land Quality Consultant** | **David McLorinan BSc MSc FGS CGeol**<br>**Senior Consultant**<br>**Chartered Geologist**<br>**Chartered Waste Manager** |

# APPENDIX A: Development Plan




## LEGEND

### SOFTWORKS

- Existing Trees & Planting — To be retained and protected during works in accordance with BS5837
- Existing Trees & Planting — To be removed
- Proposed Native Trees
- Proposed Specimen Trees
- Proposed Hedgerow planting — Refer to Detail
- Proposed Amenity Grass
- Proposed Wildflower
- Proposed Rough Grassland
- Proposed Native shrubs
- Proposed Ornamental shrubs
- Proposed Suds

### SURFACES

- Exposed Aggregate Concrete — Refer to Detail
- Natural Stone Paving — Refer to Detail
- Sleeper Paving
- Proposed Boardwalk — From sustainable source
- Reinforced Grass — Surfacing type to be confirmed
- Proposed Gravel Path — Pedestrians Areas
- Proposed Asphalt — Vehicular areas
- Safety Surfacing

### FEATURES

- Walls — Refer to Detail
- 2.4m Security Fencing — Refer to Detail
- Split Rail Fencing — Refer to Detail
- Stock Proof Fencing — Refer to Detail
- Steps and Terracing — Refer to Detail
- Proposed Benches
- Indicative bicycle stand locations
- Litter Bins — Refer to Detail
- Upstand Kerb
- Dropped Kerb. Flush with Road Level To Allow Access.

### MISCELLANECUS

- Riverine Community Park Boundary
- Accommodation Works
- Proposed Bridge
- Water

### LEVELS

- (4.3) — Existing Levels
- +5.3 — Proposed Levels

N

## NOTES

1. All measurements shown are in metres, and all levels are to ordnance datum unless otherwise indicated

2. All Coordinates are to Irish Grid (TM65), unless otherwise noted.

3. All hatches are indicative and do not relate to the actual laying or planting pattern

4. Layout should be read in conjunction with all other drawing information and reports.

5. All new kerbs adjacent to exsiting roads will require a 300mm reinstatement strip within the carriageway running the entire length

6. For proposed drainage refer to engineers layout

7. For lighting and all electrical requirements refer to M&E drawings

8. Walking Routes & Connections
All main areas within the park will provide DDA compliant access

9. Riverside Access
note to be added

10. Planting
The general planting strategy is to use a primarily native planting palette introducing some specimen trees to add formality and interest within the avenue and around the Community Hub. The shrub planting proposed around the Community Hub will be mostly ornamental grasses planted through with some ornamental structural plants to provide year round colour and interest. Where possible existing areas of native planting will be increased and supplemented to create diversity and improve ecological benefit.

11. Suds
Attenuation basin locations and extents shown indicatively. Basins will be planted with a mix of native wet woodland (indicated with trees) and marginal type planting (indicated with hatch) to highlight their location and integrate them as an attractive feature within the overall site context.

12. Accommodation Works
For layout & detail please refer to engineers and architects packages

*This is a concept design that illustrates the main elements to be delivered within the park. The exact location, layout and smaller details of the park may change during the detailed design phase.*

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| Rev | Date | Description | App |
|---|---|---|---|
| P00 | 16.02.2021 | Issued for screening | DM |
| P01 | 10.06.2021 | Issued for Information | DM |

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Donegal County Council
Derry City & Strabane District Council
Comhairle Chathair Dhoire & Cheantar an Ghleanna Báin
Derry Cittie & Strabane Destrick Council

Project Status: DRAFT

Project: RIVERINE COMMUNITY PARK

Drawing: LIFFORD LANDSCAPE LAYOUT

Scale: 1:500@A0

| | | | | | |
|---|---|---|---|---|---|
| Drawn | DM | Checked | DM | Approved | AH |
| Date | 12.02.2021 | Date | 12.02.2021 | Date | 15.02.21 |

Project - Organisation - Zone - Level - Type - Role - Number - Revision
1383 · TPHC · ZO · XX · DR · LA · 101 · P01

Project Number: 1383
Status code & Description: PLANNING

All dimensions are in metres. Figured dimensions to be taken in preference to scaled dimensions. Dimensions to be checked on site. © 2021 McAdam Design Ltd.

River Foyle

Marsh

Wetland

Wetland

SUDs

SUDs

SUDs

SUDs

SUDs

Park Road

Barnhill Road

Overhead Electric Lines

Overhead Electric Lines

Existing Water Level
+(2.00)

+(2.92)

+(3.31)

+(3.90)

+(4.82)

+(4.00)

+(5.02)

+(3.90)

3.8

**Match Line to drawing ref:**
**1383-TPHC-ZO-XX-DR-LA-xxxx_revP00**

**Match Line to drawing Insert (see right)**

**Match Line to drawing Insert (see right)**

**Boardwalk**
The proposals intend to retain as much of the wetland habitat as possible. Creating access sensitively, using an elevated boardwalk to minimise disruption to the sensitive habitats during construction and use.
The proposals also intend to create opportunity for social areas (for educational purposes eg. Woodland / Nature Schools) these will be on small level areas just off the boardwalk.

**Proposed Car Park**
A surfaced car park which will provide approximately 120 spaces and 10 disabled bays. There will also be provision for coach bays which can double as loading and offloading if required.

**Boardwalk Loop**
The proposals intend to retain as much of the wetland and adjacent habitat as possible. Creating access sensitively, using an elevated boardwalk to minimise disruption to the delicate habitats during construction and use.
The proposals also intend to create opportunity for social areas (for educational purposes eg. Woodland / Nature Schools) these will be on small level areas just off the boardwalk. Located for least disruption.

**Stepped Access**
This point at the bridge landing there is an opportunity to create stepped access to the east and the west of the embankment. To ensure existing connections are retained (to the riverside paths) and access is maximised within the project boundary.
The Boardwalks create access through the more difficult to construct and ecologically sensitive areas. In themselves they will be wheelchair accessible as well as an identified 'walking' route.

**Bridge Landing**
At the bridge landing there is a proposed seating area to make the most of the spectacular vantage point.

**Proposed Boardwalk**
The existing landscape in Strabane has naturalised having benefited from many years of neglect. In this respect it holds many important ecologically sensitive assets. To ensure that these can provide visitor experience at a distance the boardwalk enables access at a sensible distance and is elevated to ensure that wildlife retains uninterrupted and safe passage.

**Pathway Converging**
To make the most of connections both to the Strabane North Greenway and pathway routes within the park. Junctions ensure that desire lines are managed so that walking routes are identifiable. This also reduces possibility of people walking over the planted areas.

**Wildlife Gates**
Gates to be located every 10m within proposed fencelines and hedging. These will provide safe access for variety of wildlife to ensure access to their feeding ground to the east.

**Existing Planting**
The Strabane site is typified by a naturalised and overgrown landscape evolved from its former use as a quarry. The site now represents an ecologically sensitive landscape that brings along many benefits which contribute positively to the proposed parkland. Existing planting provides a unique and biodiverse habitat which is acknowledged within the proposals ensuring that these identified areas are safeguarded. Access therefore is limited and planting will be encouraged to continue to grow. Where required and not affected by A5 route - additional native whip planting will be proposed

**Existing Planting**
New Tree Planting will be proposed in areas that does not conflict with the long term consequence of the A5 and where it is agreed beneficial.

**Halting Site**
The former halting site is identified as the location for the approach road to the proposed carpark. The proposals include removing the existing concrete base and reinstating in a mixture of wildflower native grass. This can be aloud to naturalise until such time the proposed A5 link road commences the arrangement.

**Entrance**
it is proposed that the site will be accessed from the Barnhill Road roundabout both for vehicles, cyclists and pedestrians.

**Emergency / Event Entrance & Exit**
Emergency access onto Park Road, as required aswell as an overflow on event days.

**Drawing Insert**
**Scale 1:500 @ A0**

N

## LEGEND

### SOFTWORKS

- Existing Trees & Planting — To be retained and protected during works in accordance with BS5837
- Existing Trees & Planting — To be removed
- Proposed Native Trees
- Proposed Specimen Trees
- Proposed Hedgerow planting — Refer to Detail
- Proposed Amenity Grass
- Proposed Wildflower
- Proposed Rough Grassland
- Proposed Native shrubs
- Proposed Ornamental shrubs
- Proposed Suds

### SURFACES

- Exposed Aggregate Concrete — Refer to Detail
- Natural Stone Paving — Refer to Detail
- Sleeper Paving
- Proposed Boardwalk — From sustainable source
- Reinforced Grass — Surfacing type to be confirmed
- Proposed Gravel Path — Pedestrians Areas
- Proposed Asphalt — Vehicular areas
- Safety Surfacing

### FEATURES

- Walls — Refer to Detail
- 2.4m Security Fencing — Refer to Detail
- Split Rail Fencing — Refer to Detail
- Stock Proof Fencing — Refer to Detail
- Steps and Terracing — Refer to Detail
- Proposed Benches
- Indicative bicycle stand locations
- Litter Bins — Refer to Detail
- Upstand Kerb
- Dropped Kerb. Flush with Road Level To Allow Access.

### MISCELLANECUS

- Riverine Community Park Boundary
- Accommodation Works
- Proposed Bridge
- Water

### LEVELS

- (4.3) — Existing Levels
- +5.3 — Proposed Levels

## NOTES

1. All measurements shown are in metres, and all levels are to ordnance datum unless otherwise indicated

2. All Coordinates are to Irish Grid (TM65), unless otherwise noted.

3. All hatches are indicative and do not relate to the actual laying or planting pattern

4. Layout should be read in conjunction with all other drawing information and reports

5. All new kerbs adjacent to existing roads will require a 300mm reinstatement strip within the carriageway running the entire length

6. For proposed drainage refer to engineers layout

7. For lighting, electrical requirements refer to M&E drawings

8. Walking Routes & Connections
All main routes within the park boundary will provide DDA compliant access

9. Riverside Access
Note to be added

10. Planting
The general planting strategy is to use primarily a native planting palette introducing some specimen trees within the new car park to add formality. Where possible existing areas of native planting will be increased and supplemented to create diversity and improve ecological benefit. This planting will be suggested from the naturalised fauna surveyed

11. Suds
Attenuation basin locations and extents shown indicatively. Basins will be planted with a mix of native wet woodland (indicated with trees) and marginal type planting (indicated with hatch) to highlight their location and integrate them as an attractive feature within the overall site context.

12. Bridge
Note to be added

13. Invasive Weeds
Note to be added

14. No Topographic Survey Information
The principles have been considered on the basis of site visits and discussion with the engineers, ecologist, client and community groups. However, there is a substantial area of the Project Area (see hatch) that is unsurveyed (due to poor access). In this respect assumptions have had to have been made with regard detailed proposals. Levels, existing vegetation extent, type as well as extent of wetland are underlined.
on this basis the amount of tree cover identified as removed is unclear. Removed trees indicated are limited to where the survey is clear and loss is certain.

15. A5
Note to be added, if required

*The revision cloud highlighted areas of the park which were inaccessible for the*

*This is a concept design that illustrates the main elements to be delivered within the park. The exact location, layout and number of features in the park may change during the detailed design phase.*

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| Rev | Date | Description | App |
|---|---|---|---|
| P00 | 16.02.2021 | Issued for screening | DM |
| P01 | 10.06.2021 | Issued for Information | DM |

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European Regional Development Fund

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Donegal County Council
Derry City & Strabane District Council
Comhairle Chathair Dhoire & Cheantar an tSratha Báin
Derry Cittie & Strabane Destrick Council

Project Status: DRAFT

Project: RIVERINE COMMUNITY PARK

Drawing: STRABANE LANDSCAPE LAYOUT

Scale: 1:500@A0

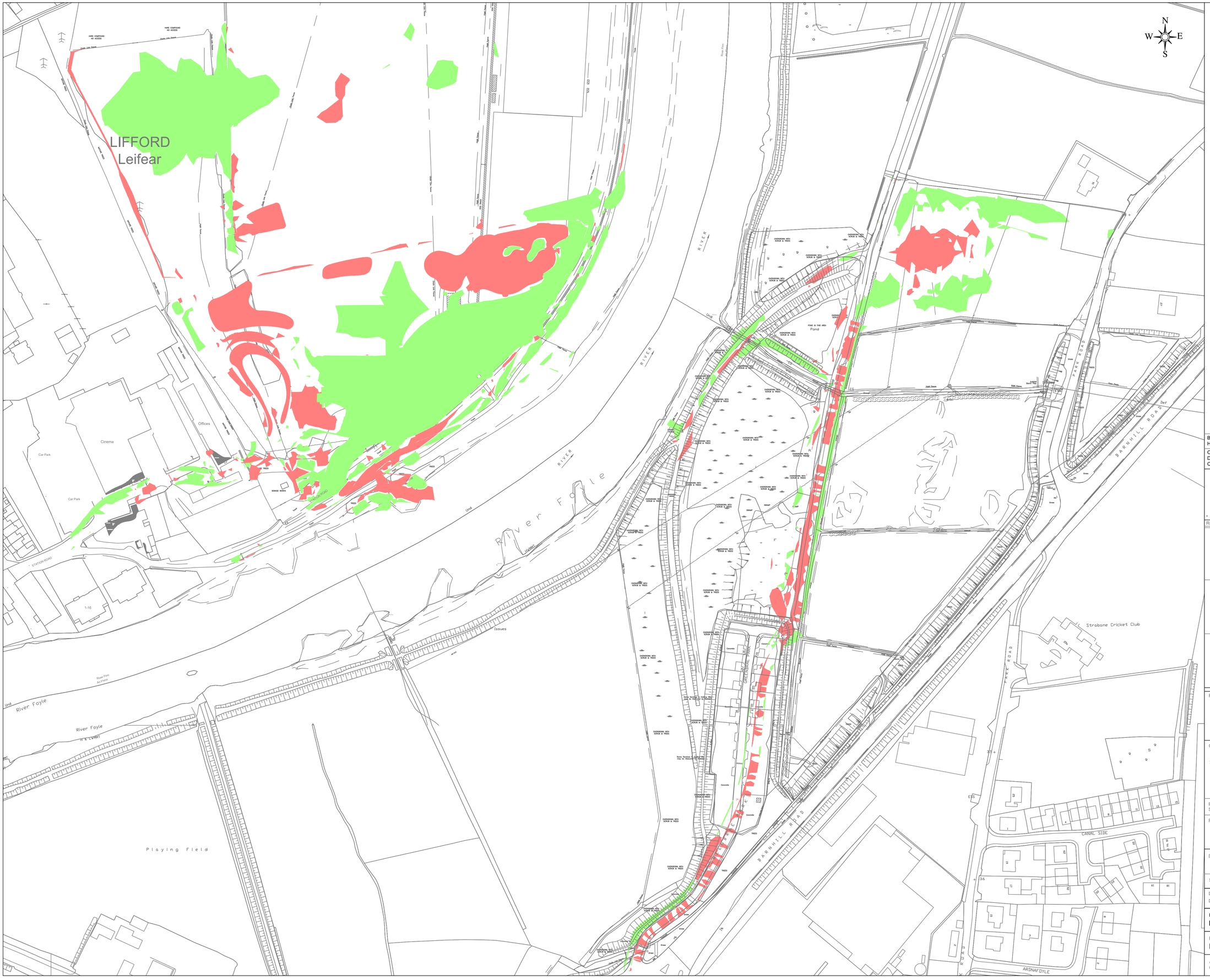
| | | | | | |
|---|---|---|---|---|---|
| Drawn | DM | Checked | DM | Approved | AH |
| Date | 12.02.2021 | Date | 12.02.2021 | Date | 15.02.21 |

| Project | Organisation | Zone | Level | Type | Role | Number | Revision |
|---|---|---|---|---|---|---|---|
| 1383 | TPHC | ZO | XX | DR | LA | 102 | P00 |

Project Number: 1383
Status code & Description: PLANNING

All dimensions are in metres. Figured dimensions to be taken in preference to scaled dimensions. Dimensions to be checked on site. © 2021 McAdam Design Ltd.

## APPENDIX B: Cut/Fill Plan




**NOTES**

1. All measurements shown are in metres, and all levels are to ordnance datum unless otherwise indicated

2. All Coordinates are to Irish Grid (TM65), unless otherwise noted.

**LEGEND**

CUT

FILL

**CUT / FILL STATISTICS**

| Area | Cut Vol ($m^3$) | Fill Vol ($m^3$) | Balance ($m^3$) |
|---|---|---|---|
| Accommodation Works | 549 | 5492 | 4943 [fill] |
| Lifford Riverine | 4823 | 20122 | 15,299 [fill] |
| Strabane Riverine | 2578 | 2400 | 179 [cut] |
| Overall | 7241 | 28,036 | 20,796 [fill] |

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| Rev | Issue Date | Description | App |
|---|---|---|---|
| - | - | - | - |

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Funder
Peace
Northern Ireland - Ireland
European Regional Development Fund

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Donegal County Council
Derry City & Strabane District Council
Comhairle Chathair Dhoire & Cheantar an tSratha Báin
Derry Cittie & Strábane Destrick Cooncil

Project Status: STAGE 3 - DEVELOPED DESIGN

Project: RIVERINE COMMUNITY PARK

Drawing: CUT / FILL ANALYSIS

Scale: 1:1250 @ A1

| Drawn | Date | Checked | Date | Approved | Date |
|---|---|---|---|---|---|
| DSA | 06.08.21 | CM | 06.08.21 | KOS | 06.08.21 |

| Project | Organisation | Zone | Level | Type | Role | Number | Revision |
|---|---|---|---|---|---|---|---|
| E2256 | - | - | - | - | - | SK-142 | - |

| Project Number | Status code & Description |
|---|---|
| E2256 | - - |

All dimensions are in metres. Figured dimensions to be taken in preference to scaled dimensions. Dimensions to be checked on site. © 2021 McAdam Design Ltd.

# APPENDIX C: Borehole Logs

SITE

# P2288 Riverine

BOREHOLE / TRIAL PIT REF

# HA01 (Lifford)

CLIENT

## McAdam Design

LOGGED BY **TM**

DATE **05.05.2021**

IGR: **233816** **398675**

GROUND LEVEL **3.5**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.3m MADE GROUND: Soft brown sandy Clay. Sand is fine. | 0 | | | ES | | | |
| 0.3 to 1.0m MADE GROUND: Soft greyish brown slightly sandy gravelly CLAY. Gravel is sub angular to rounded, fine, mixed lithology. | | | | | | | |
| 1.0 to 1.10m Soft brown gravelly SAND (Alluvium). Gravel is sub angular to rounded, fine, mixed lithology. | 1 | | | ES | | Seepage | |
| 1.10m Terminated at 1.10m. | 2 | | | | | | |
| | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

Groundwater encountered at 1.10m

| SITE | | BOREHOLE / TRIAL PIT REF | |
|---|---|---|---|
| **P2288 Riverine** | | **HA02 (Lifford)** | |
| CLIENT | LOGGED BY | IGR: | |
| **McAdam Design** | **TM** | **233760.1** | **398743.5** |
| | DATE | GROUND LEVEL | |
| | **05.05.2021** | **2.9** | |

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.10: Topsoil | 0 | | | | | | |
| 0.10 to 0.30m Firm brown mottled orange SAND (Alluvium). Sand is fine. | | | | | | | |
| 0.30 to 1.15m Soft brown gravelly SAND (Alluvium). Gravel is sub angular to rounded, fine, mixed lithology. | 1 | | | | | | |
| 1.15m Terminated at 1.15m | 2 | | | | | | |
| | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

No groundwater encountered

| SITE | | BOREHOLE / TRIAL PIT REF | |
|---|---|---|---|
| **P2288 Riverine** | | **HA03 (Lifford)** | |
| CLIENT | LOGGED BY | IGR: | |
| **McAdam Design** | **TM** | **233864** | **398778** |
| | DATE | GROUND LEVEL | |
| | **05.05.2021** | **2.54** | |

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.10m Topsoil | 0 | | | – ES | | | |
| 0.1 to 1.7m Soft brown slightly sandy CLAY (Alluvium) with occasional rootlets. | 1 | | | | | | |
| 1.7 to 1.90m Soft light brown slightly sandy GRAVEL. Gravel is sub angular to rounded, fine, mixed lithology. | 2 | | | | | | |
| 1.90m Terminated at 1.90m | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

No groundwater encountered

SITE

**P2288 Riverine**

BOREHOLE / TRIAL PIT REF

**HA04 (Lifford)**

CLIENT

**McAdam Design**

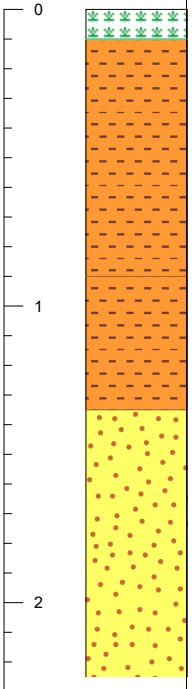
LOGGED BY **TM**

DATE **05.05.2021**

IGR: **233879** **398702**

GROUND LEVEL **3.25**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.10m Topsoil | 0 | | | | | | |
| 0.1 to 0.9m Soft brown slightly sandy CLAY (Alluvium) with occasional rootlets. | | | | | | | |
| 0.9 to 1.35m Soft dark brown slightly sandy CLAY (Alluvium) with occasional rootlets. | 1 | | | | | | |
| 1.35 to 2.25m Soft dark brown SAND (Alluvium). Sand is fine. | 2 | | | | | | |
| | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |



No groundwater encountered

| SITE | | BOREHOLE / TRIAL PIT REF | |
|---|---|---|---|
| **P2288 Riverine** | | **HA05 (Lifford)** | |
| CLIENT | LOGGED BY | IGR: | |
| **McAdam Design** | **TM** | **233897** | **398821** |
| | DATE | GROUND LEVEL | |
| | **13.05.2021** | **2.27** | |

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.05m Topsoil overlying natural ground. | 0 | | | | | | |
| 0.05 to 0.70m Firm to soft brown slightly sandy CLAY (Alluvium) with occasional rootlets. Sand is fine to coarse. | | | | ES | | | |
| 0.70 to 1.30m Soft light brown slightly sandy silty CLAY (Alluvium). Sand is fine to coarse. | 1 | | | | | | |
| 1.30m to 1.60m Soft light brown greyish slightly silty slightly gravelly CLAY (Alluvium). Gravel is subangular to subrounded fine to coarse of mixed lithology. | | | | | | | |
| 1.60 to 2.0m Soft grey silty CLAY (Alluvium) …becoming silty with depth. | | | | | | | |
| 2.0m Terminated at 2.0m | 2 | | | | | | |
| | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

No groundwater encountered

| | | | |
|---|---|---|---|
| SITE: **P2288 Riverine** | | BOREHOLE / TRIAL PIT REF: **HA06 (Lifford)** | |
| CLIENT: **McAdam Design** | LOGGED BY: **TM** | IGR: **233793** **398810** | |
| | DATE: **13.05.2021** | GROUND LEVEL: **2.67** | |

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.05m Topsoil overlying Natural Ground | 0 | | | | | | |
| 0.05 to 0.65m Soft brown slightly sandy gravelly CLAY (Alluvium) with occasional rootlets. Gravel is subangular to rounded fine to coarse of mixed lithology. | | | | | | | |
| 0.65 to 0.90m Soft orangish brown gravelly CLAY (Alluvium). Gravel is sub angular to rounded fine to coarse of mixed lithology. | | | | | | | |
| 0.90 to 1.20m Firm to soft orangish brown gravelly CLAY (Alluvium). Gravel is fine to coarse sub angular to rounded of mixed lithology. | 1 | | | | | Seepage | |
| 1.20m to 1.80m Firm to soft grey silty ALLUVIUM | | | | ES | | | |
| 1.80 to 2.0m Firm to soft dark blueish black peaty silty ALLUVIUM. | | | | | | | |
| 2.0m Terminated at 2.0m | 2 | | | | | | |
| | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

Groundwater encountered at 1.20m

| SITE | | BOREHOLE / TRIAL PIT REF |
|---|---|---|
| **P2288 Riverine** | | **HA07 (Lifford)** |
| CLIENT | LOGGED BY | IGR: |
| **McAdam Design** | **TM** | **233741.6** **398908.8** |
| | DATE | GROUND LEVEL |
| | **13.05.2021** | **2.22** |

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.05m Topsoil overlying Natural Ground | 0 | | | | | | |
| 0.05 to 0.90m Soft to firm dark brown slightly gravelly CLAY (Alluvium) with occasional rootlets. Gravel is subangular to rounded fine to coarse of mixed lithology. | | | | ES | | Seepage | |
| 0.9 to 1.30m Soft dark grey mottled orange ALLUVIUM. | 1 | | | | | | |
| 1.30 to 2.0m Soft dark grey ALLUVIUM. Slight organic smell. | | | | | | | |
| 2.0m Terminated at 2.0m | 2 | | | | | | |
| | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

Groundwater encountered at 0.90m

SITE

# P2288 Riverine

BOREHOLE / TRIAL PIT REF

# HA08 (Lifford)

CLIENT

## McAdam Design

LOGGED BY **TM**

DATE **13.05.2021**

IGR: **233632** **398875**

GROUND LEVEL **1.45**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.10m Topsoil | 0 | | | | | | |
| 0.1 to 0.60m Soft dark grey slightly gravelly slightly sandy CLAY with occasional rootlets. Gravel is subangular to rounded fine to coarse of mixed lithology. | | | | | | Seepage | |
| 0.6 to 1.70m Soft dark grey slightly gravelly ALLUVIUM. Gravel is subangular to rounded, coarse of mixed lithology. Slight organic smell. | 1 | | | | | | |
| 1.7 to 2.3m Soft blueish dark grey slightly gravelly ALLUVIUM. Gravel is subangular to rounded, coarse. | 2 | | | | | | |
| 2.3m Terminated at 2.3m | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |



Groundwater encountered at 0.45m

| SITE | BOREHOLE / TRIAL PIT REF |
|---|---|
| **P2288 Riverine** | **HA09 (Lifford)** |
| CLIENT **McAdam Design** | LOGGED BY **TM** |
| | DATE **13.05.2021** |
| | IGR: **233702** **398731** |
| | GROUND LEVEL **2.5** |

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.05m TOPSOIL overlying Natural Ground | 0 | | | | | | |
| 0.05 to 0.90m Firm to soft light brown slightly sandy slightly gravelly CLAY (Alluvium) with occasional rootlets. Gravel is sub angular to rounded, coarse of mixed lithology…becoming firm with depth. | | | | ES | | | |
| 0.90 to 1.60m Firm orangish light grey slightly clayey GRAVEL. Gravel is subangular to rounded, coarse of mixed lithology. | 1 | | | | | Seepage | |
| 1.60 to 2.0m Firm greyish dark blue very clayey GRAVEL. Gravel is subangular to rounded fine of mixed lithology. | | | | | | | |
| 2.0m Terminated at 2.0m | 2 | | | | | | |
| | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

Groundwater encountered at 1.5m

SITE

# P2288 Riverine

BOREHOLE / TRIAL PIT REF

# HA10 (Strabane)

CLIENT

## McAdam Design

LOGGED BY **TM**

DATE **27.05.2021**

IGR: **234045** **398593**

GROUND LEVEL **5.81**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.05m Grass with occasional rootlets<br>0.05 to 0.2m MADE GROUND: Soft light brown clayey SAND. Sand is fine to medium. | 0 | | | ES | | | |
| 0.2m to 0.8m MADE GROUND: Soft light brown clayey slightly gravelly SAND. Gravel is subangular to rounded medium to coarse mixed lithology. | 1 | | | | | | |
| 0.8 to 2.10m Firm to soft brown slightly gravelly slightly clayey SAND (Alluvium). Gravel is subangular to rounded medium to coarse of mixed lithology. | 2 | | | | | | |
| 2.10m Terminated at 2.10m | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

No groundwater encountered

SITE

# P2288 Riverine

BOREHOLE / TRIAL PIT REF

# HA11 (Strabane)

CLIENT

## McAdam Design

LOGGED BY **TM**

DATE **27.05.2021**

IGR: **234023** **398518**

GROUND LEVEL **3.48**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.05m Grass with occasional rootlets | 0 | | | | | | |
| 0.05 to 0.7m MADE GROUND: Soft dark brown gravelly SAND. Gravel is subangular to rounded coarse, of mixed lithology. | | | | | | | |
| 0.7 to 1.4m Soft greyish brown slightly gravelly slightly clayey SAND (Alluvium). Gravel is subangular to rounded, coarse of mixed lithology. | 1 | | | | | | |
| 1.4 to 2.0m Soft brown slightly gravelly slightly clayey SAND (Alluvium). Gravel is subangular to rounded, coarse of mixed lithology | | | | | | | |
| 2.0m Terminated at 2.0m | 2 | | | | | | |
| | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

No groundwater encountered

SITE

**P2288 Riverine**

BOREHOLE / TRIAL PIT REF

**HA12 (Strabane)**

CLIENT

**McAdam Design**

LOGGED BY **TM**

DATE **27.05.2021**

IGR: **234032** **398451**

GROUND LEVEL **3.04**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.05m Grass with occasional rootlets | 0 | | | | | | |
| 0.05 to 0.65m MADE GROUND:Soft dark brown clayey SAND. Sand is fine to medium | | | | | | | |
| 0.65 to 0.8m Soft brown slightly gravelly SAND (Alluvium). Gravel is subangular to rounded, medium to coarse of mixed lithology. | | | | | | | |
| 0.80m Terminated refusal at 0.80m | 1 | | | | | | |
| | 2 | | | | | | |
| | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

No groundwater encountered

SITE

**P2288 Riverine**

BOREHOLE / TRIAL PIT REF

**HA13 (Strabane)**

CLIENT

**McAdam Design**

LOGGED BY **TM**

DATE **27.05.2021**

IGR: **234133** **398494**

GROUND LEVEL **6.38**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.05m Topsoil overlying Made Ground | 0 | | | ES | | | |
| 0.05 to 0.7m MADE GROUND: Soft dark brown slightly gravelly CLAY. Gravel is subangular to rounded medium to coarse mixed lithology. | 1 | | | | | | |
| 0.7 to 1.8m MADE GROUND: Soft dark black mottled grey gravely CLAY. Gravel is subangular to angular medium to coarse mixed lithology. | | | | ES | | | |
| 1.80m Terminated refusal at 1.80m | 2 | | | | | | |
| | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

No groundwater encountered. Into Man-Made Soil Embankment

SITE

# P2288 Riverine

BOREHOLE / TRIAL PIT REF

# HA14 (Strabane)

CLIENT

## McAdam Design

LOGGED BY **TM**

DATE **27.05.2021**

IGR: **234088** **398431**

GROUND LEVEL **2.95**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.3m MADE GROUND: Soft dark grey gravelly SAND. Gravel is subangular to rounded, fine to coarse mixed lithology. 1no. plastic bag, 1no. crisp packet | 0 | | | – ES | | | |
| 0.3m Terminated on refusal 0.3m | 1 | | | | | | |
| | 2 | | | | | | |
| | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

No groundwater encountered

SITE

# P2288 Riverine

BOREHOLE / TRIAL PIT REF

# HA15 (Strabane)

CLIENT

## McAdam Design

LOGGED BY **TM**

DATE **27.05.2021**

IGR: **234084** **398385**

GROUND LEVEL **4.06**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.30m Soft dark brown gravelly CLAY. Gravel is subangular to angular, medium to coarse mixed lithology. | 0 | | | | | | |
| 0.3m Terminated on refusal 0.3m | 1 | | | | | | |
| | 2 | | | | | | |
| | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

No groundwater encountered

SITE

# P2288 Riverine

BOREHOLE / TRIAL PIT REF

# HA16 (Strabane)

CLIENT

## McAdam Design

LOGGED BY **TM**

DATE **27.05.2021**

IGR: **234141** **398414**

GROUND LEVEL **5.75**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.50m MADE GROUND: Soft dark grey gravelly CLAY. Gravel is subangular to angular, medium to coarse of mixed lithology, glass, yellow brick | 0 | | | – ES | | | |
| 0.5m Terminated on refusal 0.5m | 1 | | | | | | |
| | 2 | | | | | | |
| | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

No groundwater encountered

| SITE | | BOREHOLE / TRIAL PIT REF |
|---|---|---|
| **P2288 Riverine** | | **HA17 (Strabane)** |
| CLIENT | LOGGED BY | IGR: |
| **McAdam Design** | **TM** | **234078** **398297** |
| | DATE | GROUND LEVEL |
| | **27.05.2021** | **5.59** |

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.6m Soft brownish black slightly sandy gravelly CLAY. Gravel is sub angular to rounded medium to coarse of mixed lithology. | 0 | | | | | | |
| 0.6m Terminated on refusal 0.6m | 1 | | | | | | |
| | 2 | | | | | | |
| | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

No groundwater encountered

SITE

**P2288 Riverine**

BOREHOLE / TRIAL PIT REF

**HA18 (Lifford)**

CLIENT

**McAdam Design**

LOGGED BY **TM**

DATE **27.05.2021**

IGR: **234007** **398832**

GROUND LEVEL **2.36**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.05m Topsoil | 0 | | | | | | |
| 0.05 to 1.6m MADE GROUND: Soft light brown slightly sandy slightly gravelly CLAY with occasional rootlets. Sand is fine to medium. Gravel is subangular to angular, medium to coarse, mixed lithology | 1 | | | | | | |
| 1.6m Terminated on refusal 1.6m | 2 | | | | | | |
| | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

No groundwater encountered

SITE

**P2288 Riverine**

BOREHOLE / TRIAL PIT REF

**HA19 (Lifford)**

CLIENT

**McAdam Design**

LOGGED BY **TM**

DATE **27.05.2021**

IGR: **234012** **398799**

GROUND LEVEL **5.69**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.05m Topsoil overlying Made Ground<br>0.05 to 0.3m MADE GROUND: Soft light brown sandy CLAY (Alluvium). Sand is fine to medium, 1no. plastic bin bag.<br>0.3 to 1.2m Soft brown slightly sandy slightly gravelly CLAY (Alluvium). Gravel is subangular to rounded, medium, mixed lithology.<br>1.2m Terminated on refusal at 1.2m | 0<br>1<br>2<br>3<br>4<br>5 | | | | | | |

No groundwater encountered

SITE

**P2288 Riverine**

BOREHOLE / TRIAL PIT REF

**HA20 (Lifford)**

CLIENT

**McAdam Design**

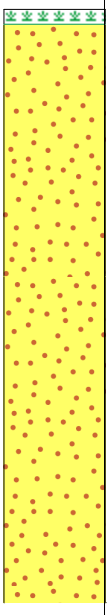
LOGGED BY **TM**

DATE **27.05.2021**

IGR: **233990** **398783**

GROUND LEVEL **2.64**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.05m Topsoil | 0 | | | | | | |
| 0.05 to 0.9m Soft light brown clayey SAND (Alluvium). Sand is fine to medium. | | | | | | | |
| 0.9 to 2.0m Firm to soft brown clayey SAND (Alluvium). Sand is fine, becoming firm with depth. | 1 | | | | | | |
| 2.0m Terminated at 2.0m | 2 | | | | | | |
| | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |



No groundwater encountered

SITE

**P2288 Riverine**

BOREHOLE / TRIAL PIT REF

**HA21 (Lifford)**

CLIENT

**McAdam Design**

LOGGED BY **TM**

DATE **27.05.2021**

IGR: **234032** **398781**

GROUND LEVEL **2.77**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.05m Topsoil | 0 | | | | | | |
| 0.05 to 0.50m Firm to soft brown mottled orange clayey SAND (Alluvium) with occasional rootlets. | | | | – ES | | | |
| 0.50m Terminated on refusal at 0.50m | 1 | | | | | | |
| | 2 | | | | | | |
| | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

No groundwater encountered

SITE

**P2288 Riverine**

BOREHOLE / TRIAL PIT REF

**HA22 (Lifford)**

CLIENT

**McAdam Design**

LOGGED BY **TM**

DATE **27.05.2021**

IGR: **233973.8** **398735.3**

GROUND LEVEL **2.81**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.05m Topsoil | 0 | | | | | | |
| 0.05 to 0.60m Soft brown clayey SAND (Alluvium). Sand is fine to medium. | 1 | | | | | | |
| 0.6 to 2.0m Soft dark brown clayey SAND (Alluvium). Sand is fine to medium. | 2 | | | | | | |
| 2.0m Terminated at 2.0m | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

No groundwater encountered

SITE

# P2288 Riverine

BOREHOLE / TRIAL PIT REF

# HA23 (Lifford)

CLIENT

## McAdam Design

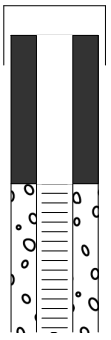
LOGGED BY **TM**

DATE **27.05.2021**

IGR: **233954** **398688**

GROUND LEVEL **4.85**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.05m Topsoil | 0 | | | | | | |
| 0.05 to 1.0m Soft dark brown clayey SAND (Alluvium). Sand is fine to medium. | | | | | | | |
| 1.0m Terminated on refusal (boulder). | 1 | | | | | | |
| | 2 | | | | | | |
| | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |



No groundwater encountered

| SITE | | BOREHOLE / TRIAL PIT REF | |
|---|---|---|---|
| **P2288 Riverine** | | **HA24 (Lifford)** | |
| CLIENT | LOGGED BY | IGR: | |
| **McAdam Design** | **TM** | **233951** | **398682** |
| | DATE | GROUND LEVEL | |
| | **27.05.2021** | **5.47** | |

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.05m Topsoil | 0 | | | ES | | | |
| 0.05 to 0.7m MADE GROUND: Soft light brown clayey SAND. Sand is fine to medium | 1 | | | | | | |
| 0.7 to 2.0m Gravel (Alluvium) is subangular to angular medium to coarse mixed lithology. | | | | ES | | | |
| 2.0m Terminated at 2.0m | 2 | | | | | | |
| | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

No groundwater encountered

| SITE | | BOREHOLE / TRIAL PIT REF | |
|---|---|---|---|
| **P2288 Riverine** | | **HA25 (Lifford)** | |
| CLIENT | LOGGED BY | IGR: | |
| **McAdam Design** | **TM** | **233885** | **398630** |
| | DATE | GROUND LEVEL | |
| | **27.05.2021** | **3.04** | |

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.05m Topsoil | 0 | | | | | | |
| 0.05 to 1.10m MADE GROUND: Soft brown slightly gravelly clayey SAND with rare rootlets. Gravel is subangular to angular medium to coarse, mixed lithology, 1no. plastic wrapper. | | | | ES | | | |
| 1.1 to 2.0m Soft dark brown clayey SAND (Alluvium). Sand is medium to coarse. | 1 | | | ES | | | |
| 2.0m Terminated at 2.0m | 2 | | | | | | |
| | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

No groundwater encountered

SITE

**P2288 Riverine**

BOREHOLE / TRIAL PIT REF

**HA26 (Strabane)**

CLIENT

**McAdam Design**

LOGGED BY **TM**

DATE **16.06.2021**

IGR: **234344.4** **398707.7**

GROUND LEVEL **3.608**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.1m Firm brown Topsoil with abundant rootlets. | 0 | | | | | | |
| 0.1 to 0.6m MADE GROUND: Soft light grey slightly sandy slightly gravelly CLAY with rare rootlets. Gravel is sub angular to angular, medium to fine, mixed lithology. | | | | | | | |
| 0.6 to 1.1m MADE GROUND: Soft light brown mottled black slightly sandy slightly gravelly CLAY with rare rootlets. Gravel is sub angular to angular, medium to fine, mixed lithology. | 1 | | | | | | |
| 1.1m Terminated on refusal at 1.1m | | | | | | | |
| | 2 | | | | | | |
| | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

No groundwater encountered

SITE

**P2288 Riverine**

BOREHOLE / TRIAL PIT REF

**HA27 (Strabane)**

CLIENT

**McAdam Design**

LOGGED BY **TM**

DATE **16.06.2021**

IGR: **234357.2** **398769.7**

GROUND LEVEL **3.675**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.1m Firm brown Topsoil with abundant rootlets. | 0 | | | | | | |
| 0.1 to 0.5m MADE GROUND: Soft light brown slightly sandy slightly gravelly CLAY with rare rootlets. Gravel is sub angular to angular, medium to fine, mixed lithology. | | | | | | | |
| 0.5 to 1.2m MADE GROUND: Soft light brown slightly sandy slightly gravelly CLAY with rare rootlets. Gravel is sub angular to angular, medium to fine, mixed lithology. | 1 | | | | | | |
| 1.2m Terminated on refusal at 1.2m | 2 | | | | | | |
| | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

No groundwater encountered

SITE

# P2288 Riverine

BOREHOLE / TRIAL PIT REF

# WS01 (Lifford)

CLIENT

## McAdam Design

LOGGED BY **TM**

DATE **13.05.2021**

IGR: **233899.792 398728.185**

GROUND LEVEL **3.101**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 1.0m TOPSOIL overlying natural ground | 0 | | | | | | |
| 0.1 to 1.0m Firm to soft brown slightly sandy slightly gravelly CLAY (Alluvium) with occasional rootlets. Gravel is subangular to rounded, fine to medium, mixed lithology. Sand is fine. | | | | – ES | | | |
| 1.0 to 1.7m Soft brown gravelly CLAY (Alluvium) with medium cobble content. Gravel is subangular to rounded coarse of mixed lithology. | 1 | | | | | | |
| 1.7 to 2.2m Soft blackish brown very gravelly SAND with medium cobble content. Gravel is subangular to rounded coarse of mixed lithology. | 2 | | | | | | |
| 2.2 to 3.0m Soft blackish brown very gravelly SAND with medium cobble and boulder content. Gravel is subangular to rounded coarse of mixed lithology. | | | | | | | |
| 3.0m Terminated at 3.0m. | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

No groundwater encountered

SITE

# P2288 Riverine

BOREHOLE / TRIAL PIT REF

# WS02 (Lifford)

CLIENT

## McAdam Design

LOGGED BY **TM**

DATE **13.05.2021**

IGR: **233896** **398912**

GROUND LEVEL **1.95**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 1.0m TOPSOIL overlying natural ground | 0 | | | | | | |
| 0.1 to 1.10m Soft brown slightly gravelly CLAY (Alluvium) with occasional rootlets. Gravel is subangular to rounded fine to medium of mixed lithology. | 1 | | | | | | |
| 1.1 to 1.3m Firm to soft grey gravelly CLAY (Alluvium) . Gravel is subangular to rounded of mixed lithology. | | | | | | | |
| 1.3 to 1.6m Firm to soft brownish grey slightly gravelly CLAY (Alluvium). Gravel is subangular to rounded fine of mixed lithology. | | | | ES | | | |
| 1.6 to 2.3m Soft blackish grey very gravelly SAND with low cobble content. Gravel is medium to coarse subangular to rounded of mixed lithology. | 2 | | | | | Seepage | |
| 2.3 to 3.0m Soft blackish dark grey very gravelly SAND with medium cobble content. Gravel is subangular to rounded coarse of mixed lithology…becoming coarse with depth. | | | | | | | |
| 3.0m Terminated at 3.0m | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

Groundwater encountered at 2.0m

SITE

# P2288 Riverine

BOREHOLE / TRIAL PIT REF

# WS03 (Lifford)

CLIENT

## McAdam Design

LOGGED BY **TM**

DATE **13.05.2021**

IGR: **233814** **398729**

GROUND LEVEL **3.22**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.1m Topsoil overlying Natural Ground | 0 | | | | | | |
| 0.1 to 0.3m Stiff brown slightly gravelly CLAY (Alluvium) with occasional rootlets. Gravel is subangular to rounded. | | | | | | | |
| 0.3 to 0.5m Stiff blackish brown sandy CLAY (Alluvium) with occasional rootlets and low cobble content. | | | | | | | |
| 0.5 to 1.3m Firm to soft orangish brown slightly sandy gravelly CLAY (Alluvium) with low boulder and cobble content. Gravel is subangular to rounded of mixed lithology. | 1 | | | – ES | | | |
| 1.3 to 1.6m Soft orangish brown sandy GRAVEL with medium boulder content. Gravel is subangular to rounded fine coarse of mixed lithology. | | | | | | | |
| 1.6 to 2.7m Soft brown orangish sandy GRAVEL with medium cobble and boulder content. Gravel is subangular to rounded coarse of mixed lithology. | 2 | | | | | | |
| 2.7 to 3.0m Soft brown sandy GRAVEL with medium cobble and boulder content. Gravel is subangular to rounded, coarse of mixed lithology. | | | | | | | |
| 3.0m Terminated at 3.0m | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

No groundwater encountered

SITE

**P2288 Riverine**

BOREHOLE / TRIAL PIT REF

**WS04 (Lifford)**

CLIENT

**McAdam Design**

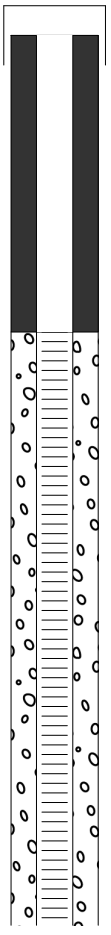
LOGGED BY **TM**

DATE **13.05.2021**

IGR: **233815** **398639**

GROUND LEVEL **4.78**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.1m Topsoil overlying Natural Ground. | 0 | | | | | | |
| 0.1 to 0.4m Stiff orangish dark brown slightly silty gravelly CLAY with medium cobble content. Gravel is subangular to rounded medium to coarse of mixed lithology. | | | | | | | |
| 0.4 to 1m Stiff greyish brown slightly silty gravelly CLAY with low cobble content. Gravel is subangular to rounded of mixed lithology. | | | | ES | | | |
| 1.0 to 1.5m Soft brown gravelly SAND (Alluvium). Sand is fine. | 1 | | | | | | |
| 1.5 to 2.5m Soft orangish brown gravelly SAND with low cobble content. Gravel is subangular to rounded, medium to coarse of mixed lithology. | 2 | | | | | | |
| 2.5 to 3m Soft orangish brown mottled black gravelly SAND with low cobble content. Gravel is subangular to rounded, fine of mixed lithology. | | | | ES | | | |
| 3.0 Terminated at 3.0m | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |



No groundwater encountered

| SITE | BOREHOLE / TRIAL PIT REF |
|---|---|
| **P2288 Riverine** | **WS05 (Lifford)** |
| CLIENT **McAdam Design** | LOGGED BY **TM** |
| | DATE **13.05.2021** |
| | IGR: **233743** **398640** |
| | GROUND LEVEL **3.41** |

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.05m Topsoil overlying natural ground | 0 | | | | | | |
| 0.05 to 0.55m Firm brown slightly sandy gravelly CLAY (Alluvium) with low cobble content and occasional rootlets. Gravel is subangular to rounded medium to coarse of mixed lithology. | | | | – ES | | | |
| 0.55 to 1.60m Firm brown slightly sandy slightly clayey GRAVEL (Alluvium) with low cobble content and occasional rootlets. Gravel sub angular to rounded, medium to coarse, mixed lithology. | 1 | | | | | | |
| 1.6 to 2.0m Mottled brownish orangish grey GRAVEL wit medium boulder content. Gravel is fine to coarse angular to rounded of mixed lithology. | | | | | | | |
| 2.0m Terminated at 2m. | 2 | | | | | | |
| | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

No groundwater encountered

SITE

# P2288 Riverine

BOREHOLE / TRIAL PIT REF

# WS06 (Lifford)

CLIENT

## McAdam Design

LOGGED BY **TM**

DATE **14.05.2021**

IGR: **233857** **399029**

GROUND LEVEL **1.14**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.1m Topsoil overlying Natural Ground | 0 | | | – ES | | Seepage | |
| 0.1 to 0.6m Stiff dark brown mottled grey gravelly CLAY (Alluvium) with occasional rootlets. Gravel is medium to coarse subangular to rounded of mixed lithology. | | | | | | | |
| 0.6 to 1.2m Firm brown mottled orange gravelly CLAY (Alluvium) with rare rootlets. Gravel is subangular to rounded medium to coarse of mixed lithology. | 1 | | | | | | |
| 1.2m to 1.7m Soft grey mottled orange gravelly CLAY (Alluvium) with rare rootlets. Gravel is subangular to rounded fine of mixed lithology. | | | | | | | |
| 1.7 to 1.8m Soft dark blueish grey sandy GRAVEL with medium cobble content. Gravel is subangular to rounded of mixed lithology. | 2 | | | | | | |
| | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

Groundwater encountered at 1.80m. Collapsed at 1.80m.

SITE

# P2288 Riverine

BOREHOLE / TRIAL PIT REF

# WS07 (Strabane)

CLIENT

## McAdam Design

LOGGED BY **TM**

DATE **14.05.2021**

IGR: **234217** **398770**

GROUND LEVEL **3.56**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.1m Topsoil | 0 | | | | | | |
| 0.1 to 0.6m MADE GROUND: Stiff to firm brown sightly gravelly CLAY with occasional rootlets. Gravel is subangular to rounded, medium to coarse, mixed lithology. | | | | | | | |
| 0.6 to 1.5m MADE GROUND: Firm orangish brown gravelly CLAY. Gravel is subangular to rounded, medium to coarse, mixed lithology. | 1 | | | | | | |
| 1.5 to 1.8m Firm to soft blackish brown gravelly CLAY (Alluvium) . Gravel is subangular to rounded, medium to coarse, mixed lithology. Organic smell. | | | | | | | |
| 1.8 to 2.7m Soft brownish grey gravelly CLAY (Alluvium) . Gravel is subangular to rounded, medium to coarse, mixed lithology. | 2 | | | | | | |
| 2.7 to 4.0m Soft dark grey gravelly ALLUVIUM. Gravel is subangular to rounded, medium to coarse, mixed lithology. | 3 | | | | | | |
| 4.0m Terminated at 4.0m | 4 | | | | | | |
| | 5 | | | | | | |

No groundwater encountered

SITE

**P2288 Riverine**

BOREHOLE / TRIAL PIT REF

**WS08 (Strabane)**

CLIENT

**McAdam Design**

LOGGED BY **TM**

DATE **14.05.2021**

IGR: **234164** **398719**

GROUND LEVEL **5.73**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.1m Topsoil | 0 | | | | | | |
| 0.1 to 0.6m MADE GROUND: Firm dark brown sightly gravelly CLAY with occasional rootlets. Gravel is subangular to rounded, medium to coarse, mixed lithology. | | | | – ES | | | |
| 0.6 to 1.4m MADE GROUND: Firm brown slightly gravelly slightly sandy CLAY with low cobble content. Sand is coarse. Gravel is subangular to rounded, medium to coarse, mixed lithology. | 1 | | | | | | |
| 1.4 to 2.10m Soft grey slightly gravelly slightly sandy CLAY (Alluvium) . Sand is coarse. Gravel is subangular to rounded, medium to coarse, mixed lithology. | 2 | | | | | | |
| 2.1 to 3.0m Soft grey slightly sandy slightly gravelly ALLUVIUM. Gravel is subangular to rounded, medium to coarse, mixed lithology. | | | | | | | |
| 3.0m Terminated at 3.0m | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

No groundwater encountered

SITE

# P2288 Riverine

BOREHOLE / TRIAL PIT REF

# WS09 (Strabane)

CLIENT

## McAdam Design

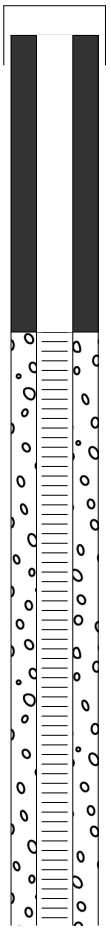
LOGGED BY **TM**

DATE **14.05.2021**

IGR: **234119** **398733**

GROUND LEVEL **3.24**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.1m Topsoil | 0 | | | | | | |
| 0.1 to 0.5m Firm dark brown gravelly CLAY (Alluvium) with occasional rootlets. Gravel is subangular to rounded, medium to coarse, mixed lithology. | | | | | | | |
| 0.5 to 1.1m Soft brown gravelly SAND (Alluvium). Sand is coarse. Gravel is subangular to rounded, medium to coarse, mixed lithology. | 1 | | | | | | |
| 1.1 to 1.9m Blackish grey gravelly ALLUVIUM. Gravel is subangular to rounded, medium to coarse, mixed lithology. | 2 | | | | | | |
| 1.9 to 3.0m Dark grey gravelly ALLUVIUM. Gravel is subangular to rounded, medium to coarse, mixed lithology. | 3 | | | | | | |
| 3.0m Terminated at 3.0m | 4 | | | | | | |
| | 5 | | | | | | |



No groundwater encountered

| SITE | BOREHOLE / TRIAL PIT REF |
|---|---|
| **P2288 Riverine** | **WS10 (Strabane)** |
| CLIENT **McAdam Design** | LOGGED BY **TM** |
| | DATE **21.05.2021** |
| | IGR: **234098** **398361** |
| | GROUND LEVEL **3.8** |

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.2m MADE GROUND: Concrete with rebar | 0 | | | | | | |
| 0.2 to 0.5m MADE GROUND: Dark grey slightly sandy GRAVEL with medium cobble content. Gravel is angular to subrounded medium to coarse of mixed lithology. Sand is coarse. | | | | ES | | | |
| 0.5m to 0.7m MADE GROUND: Dark grey mottled orange slightly sandy GRAVEL with medium cobble content. Gravel is angular to subrounded, coarse of mixed lithology….Black ashy colour and smell in places. | | | | | | | |
| 0.7m to 1.10m MADE GROUND: Stiff dark grey mottled black sandy CLAY. Sand is fine. | 1 | | | | | | |
| 1.10 to 1.5m MADE GROUND: Stiff to firm greyish dark black sandy CLAY. Sand is fine. | | | | | | | |
| 1.5m to 2.8m MADE GROUND: Firm to soft greyish dark black sandy CLAY. | 2 | | | | | Seepage | |
| 2.8 to 4.0m Firm, soft in places, greyish brown mottled orange clayey Alluvium. Organic Content. | 3 | | | ES | | | |
| 4.0m Terminated at 4.0m | 4 | | | | | | |
| | 5 | | | | | | |

Groundwater encountered at 2.80m

SITE

# P2288 Riverine

BOREHOLE / TRIAL PIT REF

# WS11 (Strabane)

CLIENT

## McAdam Design

LOGGED BY **TM**

DATE **21.05.2021**

IGR: **234131** **398453**

GROUND LEVEL **4.05**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.2m MADE GROUND: Concrete with rebar. | 0 | | | | | | |
| 0.2 to 0.6m MADE GROUND: Grey mottled orange slightly sandy GRAVEL with high cobble content. Gravel is angular to subrounded medium to coarse of mixed lithology. | | | | ES | | | |
| 0.60 to 0.90m MADE GROUND: Soft dark brown gravelly CLAY. Gravel is subangular to rounded medium to coarse of mixed lithology. | | | | | | | |
| 0.9m to 1.6m MADE GROUND:Soft dark grey gravelly SAND with low cobble content and occasional rootlets. Gravel is angular to subrounded medium to coarse of mixed lithology. | 1 | | | | | | |
| 1.6 to 2.1m MADE GROUND: Soft dark black sandy GRAVEL. Gravel is subangular to rounded, coarse of mixed lithology...slight organic smell. | 2 | | | | | | |
| 2.1m to 2.5m MADE GROUND: Dark black sandy GRAVEL. Gravel is subangular to rounded, very coarse of mixed lithology. Sand is very coarse. | | | | | | | |
| 2.5 to 3.0m Firm to soft brown mottled orange ALLUVIUM. Organic Content. | | | | | | Seepage | |
| 3.0m Terminated at 3.0m. | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

Groundwater encountered at 2.70m

SITE

# P2288 Riverine

BOREHOLE / TRIAL PIT REF

# WS12 (Strabane)

CLIENT

## McAdam Design

LOGGED BY **TM**

DATE **21.05.2021**

IGR: **234134** **398503**

GROUND LEVEL **4.6**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.1m TOPSOIL: Soft dark brown with abundant rootlets. | 0 | | | ES | | | |
| 0.1 to 0.3m MADE GROUND: Grey mottled orange slightly sandy GRAVEL with medium cobble content. Gravel is subangular to angular, coarse of mixed lithology. 1no. piece of string c.5cm in length. …..1no. boulder of concrete at 0.20m | | | | | | | |
| 0.3 to 0.9m MADE GROUND: Orangish mottled grey slightly sandy Gravel with medium cobble content. Gravel is subangular to angular, coarse of mixed lithology. | 1 | | | | | | |
| 0.9 to 1.5m MADE GROUND: Dark black slightly sandy GRAVEL with low cobble content. Gravel is subangular to angular, coarse, glass, mixed lithology. | | | | ES | | | |
| 1.5 to 2.5m Soft dark brown silty ALLUVIUM. Organic content. | 2 | | | | | Seepage | |
| 2.5m Terminated at 2.5m | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

Groundwater encountered at 1.90m

| SITE | | BOREHOLE / TRIAL PIT REF | |
|---|---|---|---|
| **P2288 Riverine** | | **WS12A (Strabane)** | |
| CLIENT | LOGGED BY | IGR: | |
| **McAdam Design** | **TM** | **234127.9** | **398488.1** |
| | DATE | GROUND LEVEL | |
| | **08.07.2021** | **6.29** | |

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.1m TOPSOIL: Soft dark brown with abundant rootlets. | 0 | | | | | | |
| 0.1 to 0.5m MADE GROUND: Dark brown slightly sandy GRAVEL with medium cobble content. Gravel is subangular to angular, coarse, mixed lithology. | | | | – ES | | | |
| 0.5m Terminated at 0.5m | 1 | | | | | | |
| | 2 | | | | | | |
| | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

No groundwater encountered

SITE

# P2288 Riverine

BOREHOLE / TRIAL PIT REF

# WS12B (Strabane)

CLIENT

## McAdam Design

LOGGED BY **TM**

DATE **08.07.2021**

IGR: **234124.2** **398496**

GROUND LEVEL **5.6**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.1m TOPSOIL: Soft dark brown with abundant rootlets. | 0 | | | | | | |
| 0.1 to 0.5m MADE GROUND: Greyish orange slightly sandy GRAVEL with medium cobble content. Gravel is subangular to angular, coarse, mixed lithology. | | | | – ES | | | |
| 0.5m Terminated at 0.5m | 1 | | | | | | |
| | 2 | | | | | | |
| | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

No groundwater encountered

| SITE | | BOREHOLE / TRIAL PIT REF | |
|---|---|---|---|
| **P2288 Riverine** | | **WS12C (Strabane)** | |
| CLIENT | LOGGED BY | IGR: | |
| **McAdam Design** | **TM** | **234129.9** | **398501.1** |
| | DATE | GROUND LEVEL | |
| | **08.07.2021** | **4.635** | |

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES | | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| | | | | Depth | Recepticles | | |
| 0.0 to 0.1m TOPSOIL: Soft dark brown with abundant rootlets. | 0 | | | | | | |
| 0.1 to 0.5m MADE GROUND: Light grey mottled orange slightly sandy GRAVEL with medium cobble content. Gravel is subangular to angular, coarse, mixed lithology, 1no. plastic wrapper | | | | – ES | | | |
| 0.5m Terminated at 0.5m | 1 | | | | | | |
| | 2 | | | | | | |
| | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

No groundwater encountered

SITE

# P2288 Riverine

BOREHOLE / TRIAL PIT REF

# WS12D (Strabane)

CLIENT

## McAdam Design

LOGGED BY **TM**

DATE **08.07.2021**

IGR: **234135.4** **398494.6**

GROUND LEVEL **6.27**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.1m TOPSOIL: Soft dark brown with abundant rootlets. | 0 | | | | | | |
| 0.1 to 0.5m MADE GROUND: Light grey mottled orange slightly sandy GRAVEL with medium cobble content. Gravel is subangular to angular, coarse, mixed lithology | | | | – ES | | | |
| 0.5m Terminated at 0.5m | 1 | | | | | | |
| | 2 | | | | | | |
| | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

No groundwater encountered

SITE

# P2288 Riverine

BOREHOLE / TRIAL PIT REF

# WS13 (Strabane)

CLIENT

## McAdam Design

LOGGED BY **TM**

DATE **21.05.2021**

IGR: **234165** **398553**

GROUND LEVEL **3.95**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.05m TOPSOIL: Soft dark brown with abundant rootlets. | 0 | | | | | | |
| 0.05 to 0.6m MADE GROUND: Dark brown slightly sandy GRAVEL with low cobble content. Gravel is angular to subangular medium to coarse of mixed lithology, 1no.rubber item c.5x5cm, terracotta, orange brick. | | | | ES | | | |
| 0.6 to 1.1m MADE GROUND: Soft orange sandy CLAY. Sand is fine. | 1 | | | | | | |
| 1.1 to 1.8m MADE GROUND: Firm to soft brown mottled orange sandy CLAY. Sand is fine. | | | | | | | |
| 1.8 to 2.4m Stiff to firm reddish brown ALLUVIUM. Organic content. | 2 | | | | | Seepage | |
| 2.4m to 3.0m Firm to soft grey ALLUVIUM with organic content. | | | | | | | |
| 3.0m Terminated at 3.0m | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

Groundwater encountered at 2.40m

SITE

# P2288 Riverine

BOREHOLE / TRIAL PIT REF

# WS14 (Strabane)

CLIENT

## McAdam Design

LOGGED BY **TM**

DATE **21.05.2021**

IGR: **234182** **398661**

GROUND LEVEL **3.85**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.1m TOPSOIL: Dark brown soft with abundant rootlets | 0 | | | | | | |
| 0.1 to 0.2m MADE GROUND: Black sandy GRAVEL. Gravel is subangular to angular, coarse of mixed lithology. | | | | | | | |
| 0.2 to 0.6m MADE GROUND: Orangish brown sandy GRAVEL.Gravel is subangular to angular, coarse of mixed lithology. | | | | ES | | | |
| 0.6 to 1.5m MADE GROUND: Firm grey slightly gravelly sandy CLAY with low cobble content. Gravel is subangular to angular, coarse of mixed lithology. | 1 | | | | | | |
| 1.5 to 2.1m MADE GROUND: Stiff brown mottled grey slightly gravelly sandy CLAY with low cobble content. Gravel is subangular to angular, coarse of mixed lithology. | 2 | | | | | Seepage | |
| 2.1 to 2.3m Stiff brown ALLUVIUM with organic content. | | | | | | | |
| 2.3 to 3.0m Firm to soft brownish grey sandy ALLUVIUM. Sand is fine. | | | | | | | |
| 3.0m Terminated at 3.0m | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

Groundwater encountered at 2.20m

SITE

# P2288 Riverine

BOREHOLE / TRIAL PIT REF

# WS15 (Strabane)

CLIENT

## McAdam Design

LOGGED BY **TM**

DATE **15.06.2021**

IGR: **234247** **398775**

GROUND LEVEL **3.63**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.1m Firm brown topsoil with abundant rootlets. | 0 | | | | | | |
| 0.1 to 0.7m MADE GROUND: Firm dark brown mottled orange slightly sandy GRAVEL. Gravel is sub angular to angular, coarse, mixed lithology, glass (white), brown glass jar, terracotta. | | | | ES | | | |
| 0.7 to 1.5m MADE GROUND: Firm dark black slightly sandy GRAVEL. Gravel is subangular to angular, very coarse, mixed lithology, burnt ashy material. | 1 | | | | | | |
| 1.5m to 3.1m MADE GROUND: Firm dark black mottled white slightly sandy GRAVEL. Gravel is subangular to angular, very coarse, mixed lithology, burnt ashy material…becoming cohesive with depth. | 2 | | | ES | | | |
| 3.1 to 4.0m Soft light grey ALUVIUM with medium organic content. | 3 | | | | | | |
| 4.0m Terminated at 4.0m | 4 | | | | | | |
| | 5 | | | | | | |

No groundwater encountered

SITE

**P2288 Riverine**

BOREHOLE / TRIAL PIT REF

**WS16 (Strabane)**

CLIENT

**McAdam Design**

LOGGED BY **TM**

DATE **15.06.2021**

IGR: **234264** **398746**

GROUND LEVEL **4.13**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.1m Firm brown topsoil with abundant rootlets. | 0 | | | | | | |
| 0.1 to 0.7m MADE GROUND: Soft light brown mottled orange sandy GRAVEL with low cobble content. Gravel is subangular to angular, medium to coarse, mixed lithology. Sand is medium. | | | | ES | | | |
| 0.7 to 2.1m MADE GROUND: Soft dark grey ALLUVIUM with low organic content. Organic smell. | 1 | | | ES | | Seepage | |
| 2.1 to 4.0m Soft light grey slightly gravelly SAND (Alluvium). Gravel subangular to angular, fine to medium, mixed lithology. | 2 | | | | | | |
| 4.0m Terminated at 4.0m | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

Groundwater encountered at 1.70m

SITE

# P2288 Riverine

BOREHOLE / TRIAL PIT REF

# WS17 (Strabane)

CLIENT

## McAdam Design

LOGGED BY **TM**

DATE **15.06.2021**

IGR: **234224** **398714**

GROUND LEVEL **3.79**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.1m Firm brown topsoil with abundant rootlets. | 0 | | | ES | | | |
| 0.1 to 0.7m MADE GROUND: Soft dark brown slightly sandy GRAVEL with rare rootlets. Sand is coarse. Gravel is sub angular to angular, coarse, mixed lithology, red brick, white glass. | | | | | | | |
| 0.7 to 1.2m MADE GROUND: Soft dark brown mottled orange slightly sandy GRAVEL. Sand is coarse. Gravel is sub angular to angular, coarse, mixed lithology, red brick, white glass, wood chippings, ceramic. | 1 | | | | | | |
| 1.2 to 1.7m MADE GROUND: Soft mottled orange, white, black, dark brown GRAVEL. Gravel is sub angular to angular, coarse, mixed lithology, glass. | | | | ES | | | |
| 1.7 to 2.5m MADE GROUND: Dark grey GRAVEL. Gravel is sub angular to angular, coarse, mixed lithology, glass. | 2 | | | | | Seepage | |
| 2.5 to 4.0m Stiff dark black, mottled brown ALLUVIUM with low organic content. | 3 | | | | | | |
| 4.0m Terminated at 4.0m | 4 | | | | | | |
| | 5 | | | | | | |

Groundwater encountered at 2.10m

SITE

# P2288 Riverine

BOREHOLE / TRIAL PIT REF

# WS18 (Strabane)

CLIENT

## McAdam Design

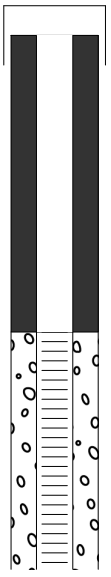
LOGGED BY **TM**

DATE **15.06.2021**

IGR: **234305** **398783**

GROUND LEVEL **3.19**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.1m Firm brown topsoil with occasional rootlets. | 0 | | | | | | |
| 0.1 to 0.7m MADE GROUND: Soft light brown gravelly CLAY with low cobble content. Gravel is sub angular to angular, medium to coarse, mixed lithology, 1no. piece of slate. | | | | | | | |
| 0.7 to 1.1m MADE GROUND: Soft light brown sandy GRAVEL with medium boulder content. Gravel is sub angular to angular, coarse, mixed lithology. | 1 | | | | | | |
| 1.1 to 2.5m MADE GROUND: Dark black sandy GRAVEL. Gravel is subangular to angular, coarse, mixed lithology, 1no.plastic wire casing .....Collapsed at 1.80m. | 2 | | | | | | |
| | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |



No groundwater encountered

SITE

**P2288 Riverine**

BOREHOLE / TRIAL PIT REF

**WS19 (Strabane)**

CLIENT

**McAdam Design**

LOGGED BY **TM**

DATE **15.06.2021**

IGR: **234336** **398734**

GROUND LEVEL **3.7**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.1m Firm brown topsoil with abundant rootlets. | 0 | | | | | | |
| 0.1 to 0.7m MADE GROUND: Soft light grey mottled black slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is sub angular to angular, medium to fine, mixed lithology. | | | | ES | | | |
| 0.7 to 1.1m MADE GROUND: Soft dark black slightly sandy slightly gravelly CLAY with rare rootlets and low organic content. Gravel is sub angular to angular, medium to fine, mixed lithology. | 1 | | | | | | |
| | | | | ES | | | |
| 1.1 to 3.0m Stiff to firm greyish brown mottled red ALLUVIUM with medium organic content. | 2 | | | | | | |
| 3.0m Terminated at 3.0m. | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

No groundwater encountered

SITE

# P2288 Riverine

BOREHOLE / TRIAL PIT REF

# WS20 (Strabane)

CLIENT

## McAdam Design

LOGGED BY **TM**

DATE **15.06.2021**

IGR: **234306** **398710**

GROUND LEVEL **3.76**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.1m Firm brown topsoil with abundant rootlets. | 0 | | | ES | | | |
| 0.1 to 1.10m MADE GROUND: Dark brown mottled black and orange slightly sandy GRAVEL. Gravel is subangular to angular, very coarse, mixed lithology, ceramic, glass, red brick, wood chippings. | 1 | | | | | | |
| 1.10 to 3.10m MADE GROUND: Dark black GRAVEL with medium cobble content. Gravel is subangular to angular, very coarse, mixed lithology, plastic, ceramic, red brick, wood chippings | 2 | | | ES | | | |
| | 3 | | | | | Seepage | |
| 3.10 to 4.0m Soft light grey mottled orange ALLUVIUM with medium organic content. | | | | ES | | | |
| 4.0 Terminated at 4.0m | 4 | | | | | | |
| | 5 | | | | | | |

Groundwater encountered at 3.20m

| SITE | | BOREHOLE / TRIAL PIT REF |
|---|---|---|
| **P2288 Riverine** | | **WS21 (Strabane)** |
| CLIENT | LOGGED BY | IGR: |
| **McAdam Design** | **TM** | **234028 398229** |
| | DATE | GROUND LEVEL |
| | **16.06.2021** | **5.81** |

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.1m Firm brown topsoil with abundant rootlets. | 0 | | | | | | |
| 0.1 to 0.3m MADE GROUND: Dark black/ashy GRAVEL. Gravel is angular, coarse. | | | | ES | | | |
| 0.3 to 2.8m MADE GROUND: Light greyish brown lightly sandy GRAVEL. Sand is medium to coarse. Gravel is subangular to angular, coarse, mixed lithology. ,,,,,,cobble at 2.7m .....hole collapsed to 1.80m | 1 | | | | | | |
| | 2 | | | ES | | | |
| | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

No groundwater encountered

SITE

# P2288 Riverine

BOREHOLE / TRIAL PIT REF

# WS22 (Strabane)

CLIENT

## McAdam Design

LOGGED BY **TM**

DATE **16.06.2021**

IGR: **233671** **398571**

GROUND LEVEL **4.5**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.4m MADE GROUND: Core of concrete, rebar. | 0 | | | | | | |
| 0.4m to 0.9m MADE GROUND: Light brown slightly sandy GRAVEL with low cobble content. Gravel is subangular to angular, medium to coarse, mixed lithology. | | | | ES | | | |
| 0.9 to 1.7m MADE GROUND: Soft brown slightly gravelly SAND. Sand is fine to medium. Gravel is subangular to rounded, medium, mixed lithology. | 1 | | | | | | |
| 1.7 to 2.3m Stiff light grey gravelly ALLUVIUM with low organic content and low cobble content. Gravel is subangular to rounded, medium to coarse, mixed lithology. | 2 | | | | | | |
| 2.3 to 3.0m Stiff to firm light brown slightly gravelly slightly clayey SAND. Sand is fine to medium. Gravel is subangular to angular, medium to coarse, mixed lithology. | | | | ES | | | |
| 3..0m Terminated at 3.0m | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

No groundwater encountered

SITE

# P2288 Riverine

BOREHOLE / TRIAL PIT REF

# WS23 (Lifford)

CLIENT

## McAdam Design

LOGGED BY **TM**

DATE **08.07.2021**

IGR: **233706** **398689**

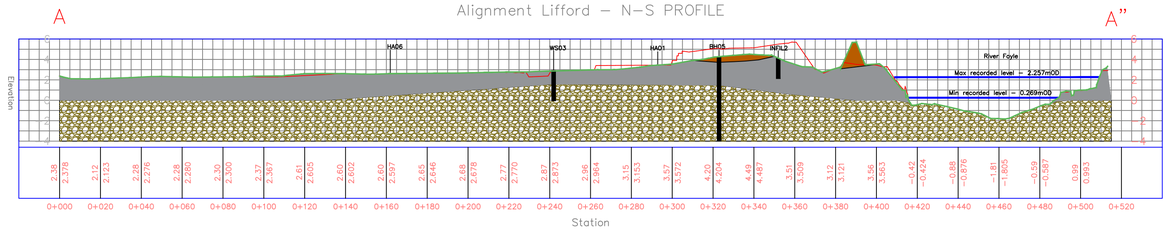
GROUND LEVEL **3.07**

| DESCRIPTION (Including comments) | DEPTH (m) | LEGEND | LEVEL (mOD) | SAMPLES Depth | SAMPLES Recepticles | WATER ENTRY | INSTALLATION |
|---|---|---|---|---|---|---|---|
| 0.0 to 0.2m Firm brown topsoil with abundant rootlets. | 0 | | | | | | |
| 0.2 to 0.6m Firm dark brown slightly gravelly CLAY (Alluvium) with occasional rootlets. Gravel is subangular to rounded, fine. | | | | ES | | | |
| 0.6 to 1.1m Stiff to firm brown mottled grey slightly gravelly CLAY (Alluvium) . Gravel is subangular to rounded, fine. | 1 | | | | | | |
| 1.1 to 1.5m Firm to soft light grey mottled orange ALLUVIUM. | | | | ES | | | |
| 1.5 to 2.0m Soft light grey gravelly SAND. Sand is fine. Gravel is subangular to rounded, fine. | | | | | | | |
| 2.0m Terminated due to bouncing at 2.0m | 2 | | | | | | |
| | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

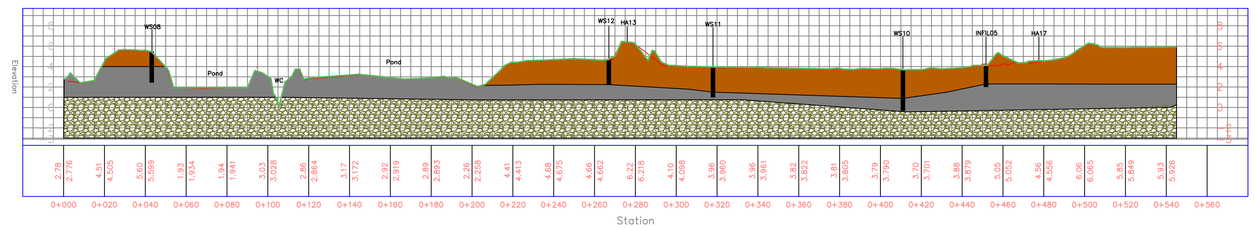
No groundwater encountered

# APPENDIX D: Geological Cross Sections

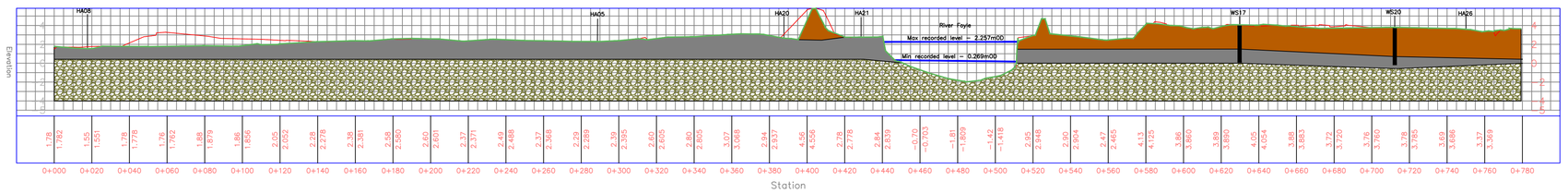
## Alignment Lifford – N–S PROFILE



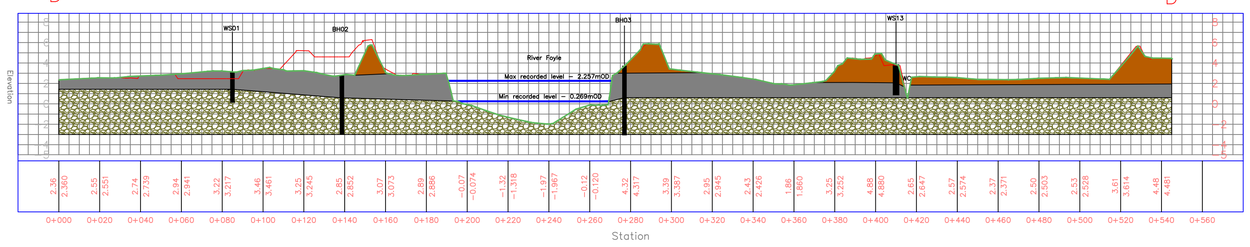

## Alignment Strabane N–S PROFILE



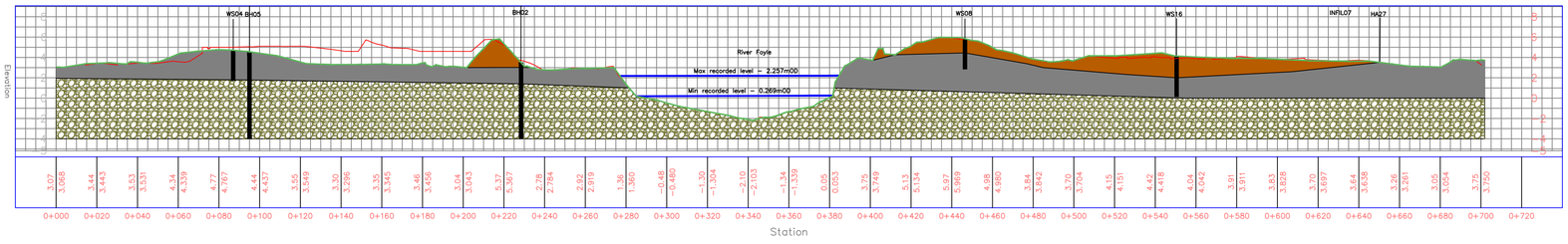

## Alignment 1 – W–E PROFILE



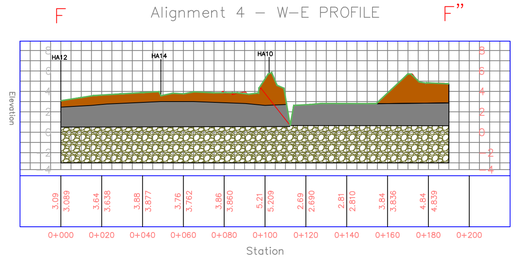

## Alignment 2 – NW–SE PROFILE

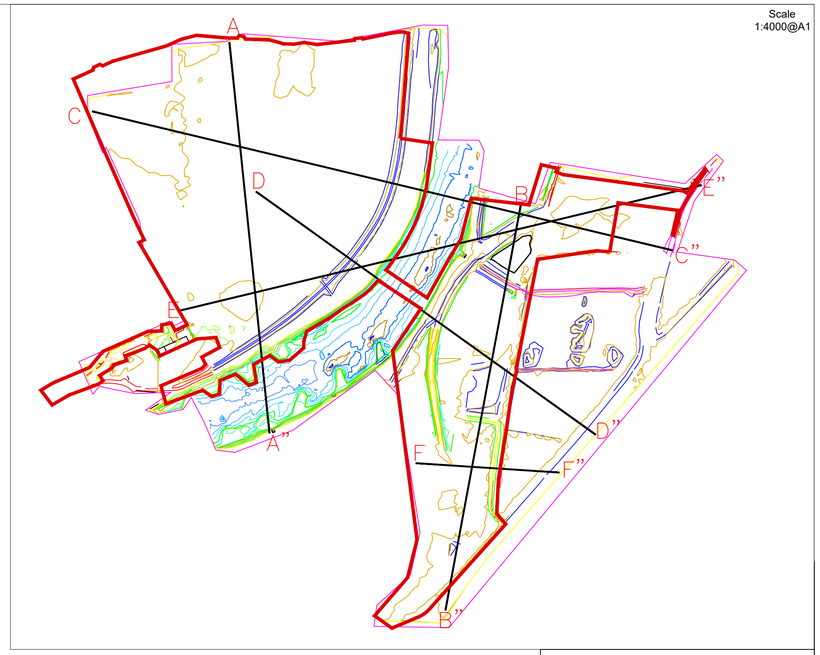



## Alignment 3 – SW–NE PROFILE




## Alignment 4 – W–E PROFILE




## Notes:

- Made Ground
- Alluvium
- Sands and Gravel
- Existing Ground Level
- Proposed Ground Level

# McAdam Design

Riverine Community Park - Strabane/Lifford

Figure 1

Geological Cross Sections

| Scale | Drawing No. | Date |
|---|---|---|
| 1:1500@A1 | P2288-SW-F2 | 08/08/21 |


Multidisciplinary Environmental Consultants
MCL CONSULTING

Unit 5, Forty Eight North, Duncrue Street, Belfast
BT3 9BJ
Tel: 028 9074 7766

# APPENDIX E: Soil Laboratory 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

MCL Consulting
Unit 5
Forty Eight North
Duncrue Street
Belfast
Northern Ireland
BT3 9LA

| | |
|---|---|
| **Attention :** | Thomas Martin |
| **Date :** | 17th May, 2021 |
| **Your reference :** | P2288 |
| **Our reference :** | Test Report 21/6942 Batch 1 |
| **Location :** | Riverine |
| **Date samples received :** | 10th May, 2021 |
| **Status :** | Final report |
| **Issue :** | 1 |

Three samples were received for analysis on 10th May, 2021 of which three 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:**

**Bruce Leslie**
**Project Manager**

Please include all sections of this report if it is reproduced

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin
**EMT Job No:** 21/6942

**Report : Solid**

**Solids:** V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

| EMT Sample No. | 1-2 | 3-4 | 5-6 | | | | | | | | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | HA01 | HA01 | HA03 | | | | | | | | | | |
| Depth | 0.20 | 1.10 | 0.30 | | | | | | | | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V J | V J | V J | | | | | | | | | | |
| Sample Date | 05/05/2021 | 05/05/2021 | 05/05/2021 | | | | | | | | | | |
| Sample Type | Soil | Soil | Soil | | | | | | | | | | |
| Batch Number | 1 | 1 | 1 | | | | | | | | | | |
| Date of Receipt | 10/05/2021 | 10/05/2021 | 10/05/2021 | | | | | | | | | | |
| Arsenic # | 9.7 | 5.8 | 14.1 | | | | | | | | <0.5 | mg/kg | TM30/PM15 |
| Barium # | 67 | 31 | 83 | | | | | | | | <1 | mg/kg | TM30/PM15 |
| Beryllium | <0.5 | <0.5 | 0.6 | | | | | | | | <0.5 | mg/kg | TM30/PM15 |
| Cadmium # | <0.1 | <0.1 | <0.1 | | | | | | | | <0.1 | mg/kg | TM30/PM15 |
| Chromium # | 76.6 | 68.7 | 60.9 | | | | | | | | <0.5 | mg/kg | TM30/PM15 |
| Copper # | 20 | 14 | 17 | | | | | | | | <1 | mg/kg | TM30/PM15 |
| Lead # | 12 | 7 | 13 | | | | | | | | <5 | mg/kg | TM30/PM15 |
| Mercury # | <0.1 | <0.1 | <0.1 | | | | | | | | <0.1 | mg/kg | TM30/PM15 |
| Nickel # | 27.0 | 21.0 | 18.4 | | | | | | | | <0.7 | mg/kg | TM30/PM15 |
| Selenium # | <1 | <1 | 1 | | | | | | | | <1 | mg/kg | TM30/PM15 |
| Vanadium | 34 | 25 | 28 | | | | | | | | <1 | mg/kg | TM30/PM15 |
| Water Soluble Boron # | 0.1 | 0.1 | 0.2 | | | | | | | | <0.1 | mg/kg | TM74/PM32 |
| Zinc # | 61 | 51 | 66 | | | | | | | | <5 | mg/kg | TM30/PM15 |
| | | | | | | | | | | | | | |
| PAH MS | | | | | | | | | | | | | |
| Naphthalene # | <0.04 | <0.04 | <0.04 | | | | | | | | <0.04 | mg/kg | TM4/PM8 |
| Acenaphthylene | <0.03 | <0.03 | <0.03 | | | | | | | | <0.03 | mg/kg | TM4/PM8 |
| Acenaphthene # | <0.05 | <0.05 | <0.05 | | | | | | | | <0.05 | mg/kg | TM4/PM8 |
| Fluorene # | <0.04 | <0.04 | <0.04 | | | | | | | | <0.04 | mg/kg | TM4/PM8 |
| Phenanthrene # | <0.03 | <0.03 | <0.03 | | | | | | | | <0.03 | mg/kg | TM4/PM8 |
| Anthracene # | <0.04 | <0.04 | <0.04 | | | | | | | | <0.04 | mg/kg | TM4/PM8 |
| Fluoranthene # | <0.03 | <0.03 | <0.03 | | | | | | | | <0.03 | mg/kg | TM4/PM8 |
| Pyrene # | <0.03 | <0.03 | <0.03 | | | | | | | | <0.03 | mg/kg | TM4/PM8 |
| Benzo(a)anthracene # | <0.06 | <0.06 | <0.06 | | | | | | | | <0.06 | mg/kg | TM4/PM8 |
| Chrysene # | <0.02 | <0.02 | <0.02 | | | | | | | | <0.02 | mg/kg | TM4/PM8 |
| Benzo(bk)fluoranthene # | <0.07 | <0.07 | <0.07 | | | | | | | | <0.07 | mg/kg | TM4/PM8 |
| Benzo(a)pyrene # | <0.04 | <0.04 | <0.04 | | | | | | | | <0.04 | mg/kg | TM4/PM8 |
| Indeno(123cd)pyrene # | <0.04 | <0.04 | <0.04 | | | | | | | | <0.04 | mg/kg | TM4/PM8 |
| Dibenzo(ah)anthracene # | <0.04 | <0.04 | <0.04 | | | | | | | | <0.04 | mg/kg | TM4/PM8 |
| Benzo(ghi)perylene # | <0.04 | <0.04 | <0.04 | | | | | | | | <0.04 | mg/kg | TM4/PM8 |
| PAH 16 Total | <0.6 | <0.6 | <0.6 | | | | | | | | <0.6 | mg/kg | TM4/PM8 |
| Benzo(b)fluoranthene | <0.05 | <0.05 | <0.05 | | | | | | | | <0.05 | mg/kg | TM4/PM8 |
| Benzo(k)fluoranthene | <0.02 | <0.02 | <0.02 | | | | | | | | <0.02 | mg/kg | TM4/PM8 |
| PAH Surrogate % Recovery | 97 | 99 | 95 | | | | | | | | <0 | % | TM4/PM8 |

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin
**EMT Job No:** 21/6942

**Report : Solid**

**Solids:** V=60g VOC jar, J=250g glass jar, T=plastic tub

| EMT Sample No. | 1-2 | 3-4 | 5-6 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | HA01 | HA01 | HA03 | | | | | | | | | |
| Depth | 0.20 | 1.10 | 0.30 | | | | | | | | | |
| COC No / misc | | | | | | | | | | | | |
| Containers | V J | V J | V J | | | | | | | | | |
| Sample Date | 05/05/2021 | 05/05/2021 | 05/05/2021 | | | | | | | | | |
| Sample Type | Soil | Soil | Soil | | | | | | | | | |
| Batch Number | 1 | 1 | 1 | | | | | | | | | |
| Date of Receipt | 10/05/2021 | 10/05/2021 | 10/05/2021 | | | | | | | | | |

Please see attached notes for all abbreviations and acronyms

| | | | | | | | | | | | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TPH CWG | | | | | | | | | | | | | |
| **Aliphatics** | | | | | | | | | | | | | |
| >C5-C6 # | <0.1 | <0.1 | <0.1 | | | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >C6-C8 # | <0.1 | <0.1 | <0.1 | | | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >C8-C10 | <0.1 | <0.1 | <0.1 | | | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >C10-C12 # | <0.2 | <0.2 | <0.2 | | | | | | | | <0.2 | mg/kg | TM5/PM8/PM16 |
| >C12-C16 # | <4 | <4 | <4 | | | | | | | | <4 | mg/kg | TM5/PM8/PM16 |
| >C16-C21 # | <7 | <7 | <7 | | | | | | | | <7 | mg/kg | TM5/PM8/PM16 |
| >C21-C35 # | <7 | <7 | <7 | | | | | | | | <7 | mg/kg | TM5/PM8/PM16 |
| Total aliphatics C5-35 | <19 | <19 | <19 | | | | | | | | <19 | mg/kg | TM5/TM36/PM8/PM12/PM16 |
| **Aromatics** | | | | | | | | | | | | | |
| >C5-EC7 # | <0.1 | <0.1 | <0.1 | | | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >EC7-EC8 # | <0.1 | <0.1 | <0.1 | | | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >EC8-EC10 # | <0.1 | <0.1 | <0.1 | | | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >EC10-EC12 # | <0.2 | <0.2 | <0.2 | | | | | | | | <0.2 | mg/kg | TM5/PM8/PM16 |
| >EC12-EC16 # | <4 | <4 | <4 | | | | | | | | <4 | mg/kg | TM5/PM8/PM16 |
| >EC16-EC21 # | <7 | <7 | <7 | | | | | | | | <7 | mg/kg | TM5/PM8/PM16 |
| >EC21-EC35 # | <7 | <7 | <7 | | | | | | | | <7 | mg/kg | TM5/PM8/PM16 |
| Total aromatics C5-35 # | <19 | <19 | <19 | | | | | | | | <19 | mg/kg | TM5/TM36/PM8/PM12/PM16 |
| Total aliphatics and aromatics(C5-35) | <38 | <38 | <38 | | | | | | | | <38 | mg/kg | TM5/TM36/PM8/PM12/PM16 |
| | | | | | | | | | | | | | |
| MTBE # | <5 | <5 | <5 | | | | | | | | <5 | ug/kg | TM36/PM12 |
| Benzene # | <5 | <5 | <5 | | | | | | | | <5 | ug/kg | TM36/PM12 |
| Toluene # | <5 | <5 | <5 | | | | | | | | <5 | ug/kg | TM36/PM12 |
| Ethylbenzene # | <5 | <5 | <5 | | | | | | | | <5 | ug/kg | TM36/PM12 |
| m/p-Xylene # | <5 | <5 | <5 | | | | | | | | <5 | ug/kg | TM36/PM12 |
| o-Xylene # | <5 | <5 | <5 | | | | | | | | <5 | ug/kg | TM36/PM12 |
| | | | | | | | | | | | | | |
| Natural Moisture Content | 23.6 | 20.2 | 28.6 | | | | | | | | <0.1 | % | PM4/PM0 |
| | | | | | | | | | | | | | |
| Hexavalent Chromium # | <0.3 | <0.3 | <0.3 | | | | | | | | <0.3 | mg/kg | TM38/PM20 |
| Sulphate as SO4 (2:1 Ext) # | 0.0039 | <0.0015 | 0.0045 | | | | | | | | <0.0015 | g/l | TM38/PM20 |
| Chromium III | 76.6 | 68.7 | 60.9 | | | | | | | | <0.5 | mg/kg | NONE/NONE |
| | | | | | | | | | | | | | |
| Free Cyanide | <0.5 | <0.5 | <0.5 | | | | | | | | <0.5 | mg/kg | TM89/PM45 |
| Total Cyanide # | <0.5 | <0.5 | <0.5 | | | | | | | | <0.5 | mg/kg | TM89/PM45 |
| | | | | | | | | | | | | | |
| pH # | 6.79 | 7.49 | 6.51 | | | | | | | | <0.01 | pH units | TM73/PM11 |



Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin

**Note:**

Asbestos Screen analysis is carried out in accordance with our documented in-house methods PM042 and TM065 and HSG 248 by Stereo and Polarised Light Microscopy using Dispersion Staining Techniques and is covered by our UKAS accreditation. Detailed Gravimetric Quantification and PCOM Fibre Analysis is carried out in accordance with our documented in-house methods PM042 and TM131 and HSG 248 using Stereo and Polarised Light Microscopy and Phase Contrast Optical Microscopy (PCOM). Samples are retained for not less than 6 months from the date of analysis unless specifically requested.

Opinions, including ACM type and Asbestos level less than 0.1%, lie outside the scope of our UKAS accreditation.

Where the sample is not taken by a Element Materials Technology consultant, Element Materials Technology cannot be responsible for inaccurate or unrepresentative sampling.

| EMT Job No. | Batch | Sample ID | Depth | EMT Sample No. | Date Of Analysis | Analysis | Result |
|---|---|---|---|---|---|---|---|
| 21/6942 | 1 | HA01 | 0.20 | 2 | 12/05/2021 | **General Description (Bulk Analysis)** | Soil/Stone |
| | | | | | 12/05/2021 | **Asbestos Fibres** | NAD |
| | | | | | 12/05/2021 | **Asbestos ACM** | NAD |
| | | | | | 12/05/2021 | **Asbestos Type** | NAD |
| | | | | | 12/05/2021 | **Asbestos Level Screen** | NAD |
| | | | | | | | |
| 21/6942 | 1 | HA01 | 1.10 | 4 | 12/05/2021 | **General Description (Bulk Analysis)** | Soil/Stone |
| | | | | | 12/05/2021 | **Asbestos Fibres** | NAD |
| | | | | | 12/05/2021 | **Asbestos ACM** | NAD |
| | | | | | 12/05/2021 | **Asbestos Type** | NAD |
| | | | | | 12/05/2021 | **Asbestos Level Screen** | NAD |
| | | | | | | | |
| 21/6942 | 1 | HA03 | 0.30 | 6 | 12/05/2021 | **General Description (Bulk Analysis)** | Soil/Stone |
| | | | | | 12/05/2021 | **Asbestos Fibres** | NAD |
| | | | | | 12/05/2021 | **Asbestos ACM** | NAD |
| | | | | | 12/05/2021 | **Asbestos Type** | NAD |
| | | | | | 12/05/2021 | **Asbestos Level Screen** | NAD |

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin

| EMT Job No. | Batch | Sample ID | Depth | EMT Sample No. | Analysis | Reason |
|---|---|---|---|---|---|---|
| No deviating sample report results for job 21/6942 | | | | | | |

**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.:*** 21/6942

**SOILS**

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

**WATERS**

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

**DEVIATING SAMPLES**

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

**SURROGATES**

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

**DILUTIONS**

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

**BLANKS**

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

**NOTE**

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

**REPORTS FROM THE SOUTH AFRICA LABORATORY**

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

**Measurement Uncertainty**

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

**ABBREVIATIONS and ACRONYMS USED**

| | |
|---|---|
| # | ISO17025 (UKAS Ref No. 4225) accredited - UK. |
| SA | ISO17025 (SANAS Ref No.T0729) accredited - South Africa |
| B | Indicates analyte found in associated method blank. |
| DR | Dilution required. |
| M | MCERTS accredited. |
| NA | Not applicable |
| NAD | No Asbestos Detected. |
| ND | None Detected (usually refers to VOC and/SVOC TICs). |
| NDP | No Determination Possible |
| SS | Calibrated against a single substance |
| SV | Surrogate recovery outside performance criteria. This may be due to a matrix effect. |
| W | Results expressed on as received basis. |
| + | AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page. |
| >> | Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher, this result is not accredited. |
| * | Analysis subcontracted to an Element Materials Technology approved laboratory. |
| AD | Samples are dried at 35°C ±5°C |
| CO | Suspected carry over |
| LOD/LOR | Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS |
| ME | Matrix Effect |
| NFD | No Fibres Detected |
| BS | AQC Sample |
| LB | Blank Sample |
| N | Client Sample |
| TB | Trip Blank Sample |
| OC | Outside Calibration Range |

**EMT Job No:** 21/6942

| Test Method No. | Description | Prep Method No. (if appropriate) | Description | ISO 17025 (UKAS/SANAS) | MCERTS (UK soils only) | Analysis done on As Received (AR) or Dried (AD) | Reported on dry weight basis |
|---|---|---|---|---|---|---|---|
| PM4 | Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465:1993(E) and BS1377-2:1990. | PM0 | No preparation is required. | | | AR | |
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM8 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required. | | | AR | Yes |
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM8 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required. | Yes | | AR | Yes |
| TM5 | Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present. | PM8/PM16 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required/Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE. | Yes | | AR | Yes |
| TM5/TM36 | please refer to TM5 and TM36 for method details | PM8/PM12/PM16 | please refer to PM8/PM16 and PM12 for method details | | | AR | Yes |
| TM5/TM36 | please refer to TM5 and TM36 for method details | PM8/PM12/PM16 | please refer to PM8/PM16 and PM12 for method details | Yes | | AR | Yes |
| TM30 | Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP | PM15 | Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground. | | | AD | Yes |
| TM30 | Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP | PM15 | Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground. | Yes | | AD | Yes |
| TM36 | Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested. | PM12 | Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis. | | | AR | Yes |
| TM36 | Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested. | PM12 | Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis. | Yes | | AR | Yes |

**EMT Job No:** 21/6942

| 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 |
|---|---|---|---|---|---|---|---|
| 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 | PM20 | Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker. | Yes | | AD | 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 | PM20 | Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker. | Yes | | AR | Yes |
| TM65 | Asbestos Bulk Identification method based on HSG 248 First edition (2006) | PM42 | Modified SCA Blue Book V.12 draft 2017 and WM3 1st Edition v1.1:2018. Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065. | Yes | | AR | |
| TM73 | Modified US EPA methods 150.1 (1982) and 9045D Rev. 4 - 2004) and BS1377-3:1990. Determination of pH by Metrohm automated probe analyser. | PM11 | Extraction of as received solid samples using one part solid to 2.5 parts deionised water. | Yes | | AR | No |
| TM74 | Analysis of water soluble boron (20:1 extract) by ICP-OES. | PM32 | Hot water soluble boron is extracted from dried and ground samples using a 20:1 ratio. | Yes | | AD | Yes |
| TM89 | Modified USEPA method OIA-1667 (1999). Determination of cyanide by Flow Injection Analyser. Where WAD cyanides are required a Ligand displacement step is carried out before analysis. | PM45 | As received solid samples are extracted with 1M NaOH by orbital shaker for Cyanide, Sulphide and Thiocyanate analysis. | | | AR | Yes |
| TM89 | Modified USEPA method OIA-1667 (1999). Determination of cyanide by Flow Injection Analyser. Where WAD cyanides are required a Ligand displacement step is carried out before analysis. | PM45 | As received solid samples are extracted with 1M NaOH by orbital shaker for Cyanide, Sulphide and Thiocyanate analysis. | Yes | | AR | Yes |
| NONE | No Method Code | NONE | No Method Code | | | AD | Yes |
| | | | | | | | |
| | | | | | | | |

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| | |
|---|---|
| **Attention :** | Thomas Martin |
| **Date :** | 28th May, 2021 |
| **Your reference :** | P2288 |
| **Our reference :** | Test Report 21/7478 Batch 1 |
| **Location :** | Riverine |
| **Date samples received :** | 19th May, 2021 |
| **Status :** | Final report |
| **Issue :** | 1 |

Eleven samples were received for analysis on 19th May, 2021 of which eleven were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

**Authorised By:**

**Phil Sommerton BSc**
**Senior Project Manager**

Please include all sections of this report if it is reproduced

## Element Materials Technology

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin
**EMT Job No:** 21/7478

**Report : Solid**

**Solids:** V=60g VOC jar, J=250g glass jar, T=plastic tub

| EMT Sample No. | 1-2 | 3-4 | 5-6 | 7-8 | 9-10 | 11-12 | 13-14 | 15-16 | 17-18 | 19-20 | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | WS01 | WS04 | HA05 | WS02 | WS03 | WS04 | WS05 | WS08 | HA06 | HA07 | | | |
| Depth | 0.50 | 0.90 | 0.30 | 1.50 | 0.70 | 2.70 | 0.30 | 0.20 | 1.80 | 0.20 | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V J | V J | V J | V J | V J | V J | V J | V J | V J | V J | | | |
| Sample Date | 13/05/2021 | 13/05/2021 | 13/05/2021 | 13/05/2021 | 13/05/2021 | 13/05/2021 | 13/05/2021 | 14/05/2021 | 13/05/2021 | 13/05/2021 | | | |
| Sample Type | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil | | | |
| Batch Number | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| Date of Receipt | 19/05/2021 | 19/05/2021 | 19/05/2021 | 19/05/2021 | 19/05/2021 | 19/05/2021 | 19/05/2021 | 19/05/2021 | 19/05/2021 | 19/05/2021 | | | |
| Arsenic # | 10.9 | 7.3 | 20.8 | 10.5 | 7.2 | 3.7 | 16.5 | 19.5 | 35.9 | 21.5 | <0.5 | mg/kg | TM30/PM15 |
| Barium # | 51 | 76 | 139 | 146 | 32 | 25 | 110 | 132 | 51 | 126 | <1 | mg/kg | TM30/PM15 |
| Beryllium | <0.5 | 1.0 | 0.7 | 1.4 | 0.5 | <0.5 | 1.1 | 0.8 | 0.9 | 1.1 | <0.5 | mg/kg | TM30/PM15 |
| Cadmium # | <0.1 | 0.1 | <0.1 | 0.5 | <0.1 | <0.1 | <0.1 | <0.1 | 0.3 | <0.1 | <0.1 | mg/kg | TM30/PM15 |
| Chromium # | 50.9 | 92.0 | 55.5 | 79.4 | 62.4 | 54.8 | 69.5 | 54.4 | 65.9 | 64.7 | <0.5 | mg/kg | TM30/PM15 |
| Copper # | 14 | 36 | 16 | 23 | 9 | 7 | 25 | 24 | 17 | 26 | <1 | mg/kg | TM30/PM15 |
| Lead # | 9 | 25 | 15 | 18 | 8 | 6 | 33 | 31 | 15 | 28 | <5 | mg/kg | TM30/PM15 |
| Mercury # | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | mg/kg | TM30/PM15 |
| Nickel # | 16.3 | 53.9 | 22.8 | 41.0 | 17.9 | 13.1 | 25.9 | 29.7 | 45.6 | 31.5 | <0.7 | mg/kg | TM30/PM15 |
| Selenium # | 1 | 1 | 3 | <1 | <1 | <1 | 1 | 1 | 2 | 2 | <1 | mg/kg | TM30/PM15 |
| Vanadium | 23 | 51 | 36 | 63 | 28 | 22 | 48 | 43 | 69 | 51 | <1 | mg/kg | TM30/PM15 |
| Water Soluble Boron # | <0.1 | 0.2 | 0.2 | 0.4 | <0.1 | <0.1 | 0.5 | 0.5 | 0.7 | 0.6 | <0.1 | mg/kg | TM74/PM32 |
| Zinc # | 59 | 82 | 82 | 110 | 51 | 41 | 68 | 77 | 93 | 79 | <5 | mg/kg | TM30/PM15 |
| PAH MS | | | | | | | | | | | | | |
| Naphthalene # | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | mg/kg | TM4/PM8 |
| Acenaphthylene | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | mg/kg | TM4/PM8 |
| Acenaphthene # | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | mg/kg | TM4/PM8 |
| Fluorene # | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | mg/kg | TM4/PM8 |
| Phenanthrene # | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | mg/kg | TM4/PM8 |
| Anthracene # | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | mg/kg | TM4/PM8 |
| Fluoranthene # | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | mg/kg | TM4/PM8 |
| Pyrene # | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | mg/kg | TM4/PM8 |
| Benzo(a)anthracene # | <0.06 | <0.06 | <0.06 | <0.06 | <0.06 | <0.06 | <0.06 | <0.06 | <0.06 | <0.06 | <0.06 | mg/kg | TM4/PM8 |
| Chrysene # | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | mg/kg | TM4/PM8 |
| Benzo(bk)fluoranthene # | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | <0.07 | mg/kg | TM4/PM8 |
| Benzo(a)pyrene # | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | mg/kg | TM4/PM8 |
| Indeno(123cd)pyrene # | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | mg/kg | TM4/PM8 |
| Dibenzo(ah)anthracene # | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | mg/kg | TM4/PM8 |
| Benzo(ghi)perylene # | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | mg/kg | TM4/PM8 |
| PAH 16 Total | <0.6 | <0.6 | <0.6 | <0.6 | <0.6 | <0.6 | <0.6 | <0.6 | <0.6 | <0.6 | <0.6 | mg/kg | TM4/PM8 |
| Benzo(b)fluoranthene | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | mg/kg | TM4/PM8 |
| Benzo(k)fluoranthene | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | mg/kg | TM4/PM8 |
| PAH Surrogate % Recovery | 97 | 96 | 93 | 93 | 94 | 94 | 91 | 90 | 94 | 98 | <0 | % | TM4/PM8 |

Please see attached notes for all abbreviations and acronyms



Please include all sections of this report if it is reproduced

All solid results are expressed on a dry weight basis unless stated otherwise.

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin
**EMT Job No:** 21/7478

**Report : Solid**

**Solids:** V=60g VOC jar, J=250g glass jar, T=plastic tub

| EMT Sample No. | 1-2 | 3-4 | 5-6 | 7-8 | 9-10 | 11-12 | 13-14 | 15-16 | 17-18 | 19-20 | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | WS01 | WS04 | HA05 | WS02 | WS03 | WS04 | WS05 | WS08 | HA06 | HA07 | | | |
| Depth | 0.50 | 0.90 | 0.30 | 1.50 | 0.70 | 2.70 | 0.30 | 0.20 | 1.80 | 0.20 | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V J | V J | V J | V J | V J | V J | V J | V J | V J | V J | | | |
| Sample Date | 13/05/2021 | 13/05/2021 | 13/05/2021 | 13/05/2021 | 13/05/2021 | 13/05/2021 | 13/05/2021 | 14/05/2021 | 13/05/2021 | 13/05/2021 | | | |
| Sample Type | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil | | | |
| Batch Number | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| Date of Receipt | 19/05/2021 | 19/05/2021 | 19/05/2021 | 19/05/2021 | 19/05/2021 | 19/05/2021 | 19/05/2021 | 19/05/2021 | 19/05/2021 | 19/05/2021 | | | |
| TPH CWG | | | | | | | | | | | | | |
| **Aliphatics** | | | | | | | | | | | | | |
| >C5-C6 # | <0.1 SV | <0.1 SV | <0.1 SV | <0.1 | <0.1 SV | <0.1 SV | <0.1 SV | <0.1 SV | <0.1 SV | <0.1 SV | <0.1 | mg/kg | TM36/PM12 |
| >C6-C8 # | <0.1 SV | <0.1 SV | <0.1 SV | <0.1 | <0.1 SV | <0.1 SV | <0.1 SV | <0.1 SV | <0.1 SV | <0.1 SV | <0.1 | mg/kg | TM36/PM12 |
| >C8-C10 | <0.1 SV | <0.1 SV | <0.1 SV | <0.1 | <0.1 SV | <0.1 SV | <0.1 SV | <0.1 SV | <0.1 SV | <0.1 SV | <0.1 | mg/kg | TM36/PM12 |
| >C10-C12 # | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | mg/kg | TM5/PM8/PM16 |
| >C12-C16 # | <4 | <4 | <4 | <4 | <4 | <4 | <4 | <4 | <4 | <4 | <4 | mg/kg | TM5/PM8/PM16 |
| >C16-C21 # | <7 | <7 | <7 | <7 | <7 | <7 | <7 | <7 | <7 | <7 | <7 | mg/kg | TM5/PM8/PM16 |
| >C21-C35 # | <7 | <7 | <7 | <7 | <7 | <7 | 45 | <7 | <7 | <7 | <7 | mg/kg | TM5/PM8/PM16 |
| Total aliphatics C5-35 | <19 | <19 | <19 | <19 | <19 | <19 | 45 | <19 | <19 | <19 | <19 | mg/kg | TM5/TM36/PM8/PM12/PM16 |
| **Aromatics** | | | | | | | | | | | | | |
| >C5-EC7 # | <0.1 SV | <0.1 SV | <0.1 SV | <0.1 | <0.1 SV | <0.1 SV | <0.1 SV | <0.1 SV | <0.1 SV | <0.1 SV | <0.1 | mg/kg | TM36/PM12 |
| >EC7-EC8 # | <0.1 SV | <0.1 SV | <0.1 SV | <0.1 | <0.1 SV | <0.1 SV | <0.1 SV | <0.1 SV | <0.1 SV | <0.1 SV | <0.1 | mg/kg | TM36/PM12 |
| >EC8-EC10 # | <0.1 SV | <0.1 SV | <0.1 SV | <0.1 | <0.1 SV | <0.1 SV | <0.1 SV | <0.1 SV | <0.1 SV | <0.1 SV | <0.1 | mg/kg | TM36/PM12 |
| >EC10-EC12 # | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | mg/kg | TM5/PM8/PM16 |
| >EC12-EC16 # | <4 | <4 | <4 | <4 | <4 | <4 | <4 | <4 | <4 | <4 | <4 | mg/kg | TM5/PM8/PM16 |
| >EC16-EC21 # | <7 | <7 | <7 | <7 | <7 | <7 | <7 | <7 | <7 | <7 | <7 | mg/kg | TM5/PM8/PM16 |
| >EC21-EC35 # | <7 | <7 | <7 | <7 | <7 | <7 | 245 | <7 | 144 | <7 | <7 | mg/kg | TM5/PM8/PM16 |
| Total aromatics C5-35 # | <19 | <19 | <19 | <19 | <19 | <19 | 245 | <19 | 144 | <19 | <19 | mg/kg | TM5/TM36/PM8/PM12/PM16 |
| Total aliphatics and aromatics(C5-35) | <38 | <38 | <38 | <38 | <38 | <38 | 290 | <38 | 144 | <38 | <38 | mg/kg | TM5/TM36/PM8/PM12/PM16 |
| MTBE # | <5 SV | <5 SV | <5 SV | <5 | <5 SV | <5 SV | <5 SV | <5 SV | <5 SV | <5 SV | <5 | ug/kg | TM36/PM12 |
| Benzene # | <5 SV | <5 SV | <5 SV | <5 | <5 SV | <5 SV | <5 SV | <5 SV | <5 SV | <5 SV | <5 | ug/kg | TM36/PM12 |
| Toluene # | <5 SV | <5 SV | <5 SV | <5 | <5 SV | <5 SV | <5 SV | <5 SV | <5 SV | <5 SV | <5 | ug/kg | TM36/PM12 |
| Ethylbenzene # | <5 SV | <5 SV | <5 SV | <5 | <5 SV | <5 SV | <5 SV | <5 SV | <5 SV | <5 SV | <5 | ug/kg | TM36/PM12 |
| m/p-Xylene # | <5 SV | <5 SV | <5 SV | 11 | <5 SV | <5 SV | <5 SV | <5 SV | <5 SV | <5 SV | <5 | ug/kg | TM36/PM12 |
| o-Xylene # | <5 SV | <5 SV | <5 SV | <5 | <5 SV | <5 SV | <5 SV | <5 SV | <5 SV | <5 SV | <5 | ug/kg | TM36/PM12 |
| Natural Moisture Content | 21.2 | 16.4 | 38.2 | 75.2 | 7.2 | 4.2 | 60.2 | 40.4 | 87.6 | 36.6 | <0.1 | % | PM4/PM0 |
| Hexavalent Chromium # | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | mg/kg | TM38/PM20 |
| Sulphate as SO4 (2:1 Ext) # | 0.0060 | 0.0416 | 0.0055 | 0.0450 | 0.0027 | 0.0115 | 0.0088 | 0.0284 | 0.3860 | 0.0170 | <0.0015 | g/l | TM38/PM20 |
| Chromium III | 50.9 | 92.0 | 55.5 | 79.4 | 62.4 | 54.8 | 69.5 | 54.4 | 65.9 | 64.7 | <0.5 | mg/kg | NONE/NONE |
| Free Cyanide | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | mg/kg | TM89/PM45 |
| Total Cyanide # | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | mg/kg | TM89/PM45 |
| Total Organic Carbon # | - | - | - | 2.93 | - | - | - | 0.91 | 6.20 | - | <0.02 | % | TM21/PM24 |
| Organic Matter | 0.4 | - | - | - | - | <0.2 | - | - | - | - | <0.2 | % | TM21/PM24 |
| pH # | 6.61 | 7.02 | 6.20 | 5.94 | 6.94 | 7.40 | 6.48 | 6.27 | 5.13 | 5.70 | <0.01 | pH units | TM73/PM11 |

Please see attached notes for all abbreviations and acronyms

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin
**EMT Job No:** 21/7478

**Report : Solid**

**Solids:** V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

| EMT Sample No. | 21-22 | | | | | | | | | | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | HA09 | | | | | | | | | | | | |
| Depth | 0.30 | | | | | | | | | | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V J | | | | | | | | | | | | |
| Sample Date | 13/05/2021 | | | | | | | | | | | | |
| Sample Type | Soil | | | | | | | | | | | | |
| Batch Number | 1 | | | | | | | | | | | | |
| Date of Receipt | 19/05/2021 | | | | | | | | | | | | |
| Arsenic # | 25.0 | | | | | | | | | | <0.5 | mg/kg | TM30/PM15 |
| Barium # | 111 | | | | | | | | | | <1 | mg/kg | TM30/PM15 |
| Beryllium | 1.0 | | | | | | | | | | <0.5 | mg/kg | TM30/PM15 |
| Cadmium # | <0.1 | | | | | | | | | | <0.1 | mg/kg | TM30/PM15 |
| Chromium # | 81.7 | | | | | | | | | | <0.5 | mg/kg | TM30/PM15 |
| Copper # | 20 | | | | | | | | | | <1 | mg/kg | TM30/PM15 |
| Lead # | 32 | | | | | | | | | | <5 | mg/kg | TM30/PM15 |
| Mercury # | <0.1 | | | | | | | | | | <0.1 | mg/kg | TM30/PM15 |
| Nickel # | 38.5 | | | | | | | | | | <0.7 | mg/kg | TM30/PM15 |
| Selenium # | 3 | | | | | | | | | | <1 | mg/kg | TM30/PM15 |
| Vanadium | 75 | | | | | | | | | | <1 | mg/kg | TM30/PM15 |
| Water Soluble Boron # | 0.7 | | | | | | | | | | <0.1 | mg/kg | TM74/PM32 |
| Zinc # | 105 | | | | | | | | | | <5 | mg/kg | TM30/PM15 |
| | | | | | | | | | | | | | |
| PAH MS | | | | | | | | | | | | | |
| Naphthalene # | <0.04 | | | | | | | | | | <0.04 | mg/kg | TM4/PM8 |
| Acenaphthylene | <0.03 | | | | | | | | | | <0.03 | mg/kg | TM4/PM8 |
| Acenaphthene # | <0.05 | | | | | | | | | | <0.05 | mg/kg | TM4/PM8 |
| Fluorene # | <0.04 | | | | | | | | | | <0.04 | mg/kg | TM4/PM8 |
| Phenanthrene # | <0.03 | | | | | | | | | | <0.03 | mg/kg | TM4/PM8 |
| Anthracene # | <0.04 | | | | | | | | | | <0.04 | mg/kg | TM4/PM8 |
| Fluoranthene # | <0.03 | | | | | | | | | | <0.03 | mg/kg | TM4/PM8 |
| Pyrene # | <0.03 | | | | | | | | | | <0.03 | mg/kg | TM4/PM8 |
| Benzo(a)anthracene # | <0.06 | | | | | | | | | | <0.06 | mg/kg | TM4/PM8 |
| Chrysene # | <0.02 | | | | | | | | | | <0.02 | mg/kg | TM4/PM8 |
| Benzo(bk)fluoranthene # | <0.07 | | | | | | | | | | <0.07 | mg/kg | TM4/PM8 |
| Benzo(a)pyrene # | <0.04 | | | | | | | | | | <0.04 | mg/kg | TM4/PM8 |
| Indeno(123cd)pyrene # | <0.04 | | | | | | | | | | <0.04 | mg/kg | TM4/PM8 |
| Dibenzo(ah)anthracene # | <0.04 | | | | | | | | | | <0.04 | mg/kg | TM4/PM8 |
| Benzo(ghi)perylene # | <0.04 | | | | | | | | | | <0.04 | mg/kg | TM4/PM8 |
| PAH 16 Total | <0.6 | | | | | | | | | | <0.6 | mg/kg | TM4/PM8 |
| Benzo(b)fluoranthene | <0.05 | | | | | | | | | | <0.05 | mg/kg | TM4/PM8 |
| Benzo(k)fluoranthene | <0.02 | | | | | | | | | | <0.02 | mg/kg | TM4/PM8 |
| PAH Surrogate % Recovery | 89 | | | | | | | | | | <0 | % | TM4/PM8 |

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin
**EMT Job No:** 21/7478

**Report : Solid**

**Solids:** V=60g VOC jar, J=250g glass jar, T=plastic tub

| EMT Sample No. | 21-22 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | HA09 | | | | | | | | | | | | |
| Depth | 0.30 | | | | | | | | | | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V J | | | | | | | | | | | | |
| Sample Date | 13/05/2021 | | | | | | | | | | | | |
| Sample Type | Soil | | | | | | | | | | | | |
| Batch Number | 1 | | | | | | | | | | | | |
| Date of Receipt | 19/05/2021 | | | | | | | | | | | | |

Please see attached notes for all abbreviations and acronyms

| | | | | | | | | | | | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TPH CWG | | | | | | | | | | | | | |
| **Aliphatics** | | | | | | | | | | | | | |
| >C5-C6 # | <0.1 SV | | | | | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >C6-C8 # | <0.1 SV | | | | | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >C8-C10 | <0.1 SV | | | | | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >C10-C12 # | <0.2 | | | | | | | | | | <0.2 | mg/kg | TM5/PM8/PM16 |
| >C12-C16 # | <4 | | | | | | | | | | <4 | mg/kg | TM5/PM8/PM16 |
| >C16-C21 # | <7 | | | | | | | | | | <7 | mg/kg | TM5/PM8/PM16 |
| >C21-C35 # | <7 | | | | | | | | | | <7 | mg/kg | TM5/PM8/PM16 |
| Total aliphatics C5-35 | <19 | | | | | | | | | | <19 | mg/kg | TM5/TM36/PM8/PM12/PM16 |
| **Aromatics** | | | | | | | | | | | | | |
| >C5-EC7 # | <0.1 SV | | | | | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >EC7-EC8 # | <0.1 SV | | | | | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >EC8-EC10 # | <0.1 SV | | | | | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >EC10-EC12 # | <0.2 | | | | | | | | | | <0.2 | mg/kg | TM5/PM8/PM16 |
| >EC12-EC16 # | <4 | | | | | | | | | | <4 | mg/kg | TM5/PM8/PM16 |
| >EC16-EC21 # | <7 | | | | | | | | | | <7 | mg/kg | TM5/PM8/PM16 |
| >EC21-EC35 # | <7 | | | | | | | | | | <7 | mg/kg | TM5/PM8/PM16 |
| Total aromatics C5-35 # | <19 | | | | | | | | | | <19 | mg/kg | TM5/TM36/PM8/PM12/PM16 |
| Total aliphatics and aromatics(C5-35) | <38 | | | | | | | | | | <38 | mg/kg | TM5/TM36/PM8/PM12/PM16 |
| | | | | | | | | | | | | | |
| MTBE # | <5 SV | | | | | | | | | | <5 | ug/kg | TM36/PM12 |
| Benzene # | <5 SV | | | | | | | | | | <5 | ug/kg | TM36/PM12 |
| Toluene # | <5 SV | | | | | | | | | | <5 | ug/kg | TM36/PM12 |
| Ethylbenzene # | <5 SV | | | | | | | | | | <5 | ug/kg | TM36/PM12 |
| m/p-Xylene # | <5 SV | | | | | | | | | | <5 | ug/kg | TM36/PM12 |
| o-Xylene # | <5 SV | | | | | | | | | | <5 | ug/kg | TM36/PM12 |
| | | | | | | | | | | | | | |
| Natural Moisture Content | 36.5 | | | | | | | | | | <0.1 | % | PM4/PM0 |
| | | | | | | | | | | | | | |
| Hexavalent Chromium # | <0.3 | | | | | | | | | | <0.3 | mg/kg | TM38/PM20 |
| Sulphate as SO4 (2:1 Ext) # | 0.0128 | | | | | | | | | | <0.0015 | g/l | TM38/PM20 |
| Chromium III | 81.7 | | | | | | | | | | <0.5 | mg/kg | NONE/NONE |
| | | | | | | | | | | | | | |
| Free Cyanide | <0.5 | | | | | | | | | | <0.5 | mg/kg | TM89/PM45 |
| Total Cyanide # | <0.5 | | | | | | | | | | <0.5 | mg/kg | TM89/PM45 |
| | | | | | | | | | | | | | |
| Total Organic Carbon # | - | | | | | | | | | | <0.02 | % | TM21/PM24 |
| Organic Matter | 2.2 | | | | | | | | | | <0.2 | % | TM21/PM24 |
| | | | | | | | | | | | | | |
| pH # | 6.64 | | | | | | | | | | <0.01 | pH units | TM73/PM11 |

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin

**Note:**

Asbestos Screen analysis is carried out in accordance with our documented in-house methods PM042 and TM065 and HSG 248 by Stereo and Polarised Light Microscopy using Dispersion Staining Techniques and is covered by our UKAS accreditation. Detailed Gravimetric Quantification and PCOM Fibre Analysis is carried out in accordance with our documented in-house methods PM042 and TM131 and HSG 248 using Stereo and Polarised Light Microscopy and Phase Contrast Optical Microscopy (PCOM). Samples are retained for not less than 6 months from the date of analysis unless specifically requested.

Opinions, including ACM type and Asbestos level less than 0.1%, lie outside the scope of our UKAS accreditation.

Where the sample is not taken by a Element Materials Technology consultant, Element Materials Technology cannot be responsible for inaccurate or unrepresentative sampling.

| EMT Job No. | Batch | Sample ID | Depth | EMT Sample No. | Date Of Analysis | Analysis | Result |
|---|---|---|---|---|---|---|---|
| 21/7478 | 1 | WS01 | 0.50 | 2 | 24/05/2021 | **General Description (Bulk Analysis)** | Soil/Stone |
| | | | | | 24/05/2021 | **Asbestos Fibres** | NAD |
| | | | | | 24/05/2021 | **Asbestos ACM** | NAD |
| | | | | | 24/05/2021 | **Asbestos Type** | NAD |
| | | | | | 24/05/2021 | **Asbestos Level Screen** | NAD |
| 21/7478 | 1 | WS04 | 0.90 | 4 | 24/05/2021 | **General Description (Bulk Analysis)** | Soil/Stone |
| | | | | | 24/05/2021 | **Asbestos Fibres** | NAD |
| | | | | | 24/05/2021 | **Asbestos ACM** | NAD |
| | | | | | 24/05/2021 | **Asbestos Type** | NAD |
| | | | | | 24/05/2021 | **Asbestos Level Screen** | NAD |
| 21/7478 | 1 | HA05 | 0.30 | 6 | 24/05/2021 | **General Description (Bulk Analysis)** | Soil/Stone |
| | | | | | 24/05/2021 | **Asbestos Fibres** | NAD |
| | | | | | 24/05/2021 | **Asbestos ACM** | NAD |
| | | | | | 24/05/2021 | **Asbestos Type** | NAD |
| | | | | | 24/05/2021 | **Asbestos Level Screen** | NAD |

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin

| EMT Job No. | Batch | Sample ID | Depth | EMT Sample No. | Analysis | Reason |
|---|---|---|---|---|---|---|
| No deviating sample report results for job 21/7478 | | | | | | |

**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.:*** 21/7478

**SOILS**

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

**WATERS**

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

**DEVIATING SAMPLES**

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

**SURROGATES**

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

**DILUTIONS**

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

**BLANKS**

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

**NOTE**

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

**REPORTS FROM THE SOUTH AFRICA LABORATORY**

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

**Measurement Uncertainty**

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

**ABBREVIATIONS and ACRONYMS USED**

| | |
|---|---|
| # | ISO17025 (UKAS Ref No. 4225) accredited - UK. |
| SA | ISO17025 (SANAS Ref No.T0729) accredited - South Africa |
| B | Indicates analyte found in associated method blank. |
| DR | Dilution required. |
| M | MCERTS accredited. |
| NA | Not applicable |
| NAD | No Asbestos Detected. |
| ND | None Detected (usually refers to VOC and/SVOC TICs). |
| NDP | No Determination Possible |
| SS | Calibrated against a single substance |
| SV | Surrogate recovery outside performance criteria. This may be due to a matrix effect. |
| W | Results expressed on as received basis. |
| + | AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page. |
| >> | Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher, this result is not accredited. |
| * | Analysis subcontracted to an Element Materials Technology approved laboratory. |
| AD | Samples are dried at 35°C ±5°C |
| CO | Suspected carry over |
| LOD/LOR | Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS |
| ME | Matrix Effect |
| NFD | No Fibres Detected |
| BS | AQC Sample |
| LB | Blank Sample |
| N | Client Sample |
| TB | Trip Blank Sample |
| OC | Outside Calibration Range |

**EMT Job No:** 21/7478

| Test Method No. | Description | Prep Method No. (if appropriate) | Description | ISO 17025 (UKAS/SANAS) | MCERTS (UK soils only) | Analysis done on As Received (AR) or Dried (AD) | Reported on dry weight basis |
|---|---|---|---|---|---|---|---|
| PM4 | Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465:1993(E) and BS1377-2:1990. | PM0 | No preparation is required. | | | AR | |
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM8 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required. | | | AR | Yes |
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM8 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required. | Yes | | AR | Yes |
| TM5 | Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present. | PM8/PM16 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required/Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE. | Yes | | AR | Yes |
| TM5/TM36 | please refer to TM5 and TM36 for method details | PM8/PM12/PM16 | please refer to PM8/PM16 and PM12 for method details | | | AR | Yes |
| TM5/TM36 | please refer to TM5 and TM36 for method details | PM8/PM12/PM16 | please refer to PM8/PM16 and PM12 for method details | Yes | | AR | Yes |
| TM21 | Modified BS 7755-3:1995, ISO10694:1995 Determination of Total Organic Carbon or Total Carbon by combustion in an Eltra TOC furnace/analyser in the presence of oxygen. The CO2 generated is quantified using infra-red detection. Organic Matter (SOM) calculated as per EA MCERTS Chemical Testing of Soil, March 2012 v4. | PM24 | Dried and ground solid samples are washed with hydrochloric acid, then rinsed with deionised water to remove the mineral carbon before TOC analysis. | | | AD | Yes |
| TM21 | Modified BS 7755-3:1995, ISO10694:1995 Determination of Total Organic Carbon or Total Carbon by combustion in an Eltra TOC furnace/analyser in the presence of oxygen. The CO2 generated is quantified using infra-red detection. Organic Matter (SOM) calculated as per EA MCERTS Chemical Testing of Soil, March 2012 v4. | PM24 | Dried and ground solid samples are washed with hydrochloric acid, then rinsed with deionised water to remove the mineral carbon before TOC analysis. | Yes | | AD | Yes |
| 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 | PM15 | Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground. | | | AD | Yes |
| TM30 | Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996 | PM15 | Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground. | Yes | | AD | Yes |

**EMT Job No:** 21/7478

| 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 |
|---|---|---|---|---|---|---|---|
| TM36 | Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested. | PM12 | Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis. | | | AR | Yes |
| TM36 | Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested. | PM12 | Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis. | Yes | | AR | Yes |
| TM38 | Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l | PM20 | Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker. | Yes | | AD | 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 | PM20 | Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker. | Yes | | AR | Yes |
| TM65 | Asbestos Bulk Identification method based on HSG 248 First edition (2006) | PM42 | Modified SCA Blue Book V.12 draft 2017 and WM3 1st Edition v1.1:2018. Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065. | Yes | | AR | |
| TM73 | Modified US EPA methods 150.1 (1982) and 9045D Rev. 4 - 2004) and BS1377-3:1990. Determination of pH by Metrohm automated probe analyser. | PM11 | Extraction of as received solid samples using one part solid to 2.5 parts deionised water. | Yes | | AR | No |
| TM74 | Analysis of water soluble boron (20:1 extract) by ICP-OES. | PM32 | Hot water soluble boron is extracted from dried and ground samples using a 20:1 ratio. | Yes | | AD | Yes |
| TM89 | Modified USEPA method OIA-1667 (1999). Determination of cyanide by Flow Injection Analyser. Where WAD cyanides are required a Ligand displacement step is carried out before analysis. | PM45 | As received solid samples are extracted with 1M NaOH by orbital shaker for Cyanide, Sulphide and Thiocyanate analysis. | | | AR | Yes |
| TM89 | Modified USEPA method OIA-1667 (1999). Determination of cyanide by Flow Injection Analyser. Where WAD cyanides are required a Ligand displacement step is carried out before analysis. | PM45 | As received solid samples are extracted with 1M NaOH by orbital shaker for Cyanide, Sulphide and Thiocyanate analysis. | Yes | | AR | Yes |
| NONE | No Method Code | NONE | No Method Code | | | AD | Yes |

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Duncrue Street
Belfast
Northern Ireland
BT3 9LA

| | |
|---|---|
| **Attention :** | Thomas Martin |
| **Date :** | 16th June, 2021 |
| **Your reference :** | P2288 |
| **Our reference :** | Test Report 21/7971 Batch 1 |
| **Location :** | Riverine |
| **Date samples received :** | 26th May, 2021 |
| **Status :** | Final report |
| **Issue :** | 1 |

Seven samples were received for analysis on 26th May, 2021 of which seven were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

**Authorised By:**

**Bruce Leslie**
**Project Manager**

Please include all sections of this report if it is reproduced

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin
**EMT Job No:** 21/7971

**Report : Solid**

**Solids:** V=60g VOC jar, J=250g glass jar, T=plastic tub

| EMT Sample No. | 1-2 | 3-4 | 5-6 | 7-8 | 9-10 | 11-12 | 13-14 | | | | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | WS10 | WS11 | WS12 | WS13 | WS14 | WS10 | WS12 | | | | | | |
| Depth | 0.30 | 0.40 | 0.20 | 0.50 | 0.30 | 3.10 | 1.40 | | | | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V J | V J | V J | V J | V J | V J | V J | | | | | | |
| Sample Date | 21/05/2021 | 21/05/2021 | 21/05/2021 | 21/05/2021 | 21/05/2021 | 21/05/2021 | 21/05/2021 | | | | | | |
| Sample Type | Soil | Soil | Soil | Soil | Soil | Soil | Soil | | | | | | |
| Batch Number | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | |
| Date of Receipt | 26/05/2021 | 26/05/2021 | 26/05/2021 | 26/05/2021 | 26/05/2021 | 26/05/2021 | 26/05/2021 | | | | | | |
| Arsenic # | 11.1 | 2.4 | - | 656.3 AA | 8.8 | 11.0 | 18.2 | | | | <0.5 | mg/kg | TM30/PM15 |
| Barium # | 35 | 45 | - | 362 | 55 | 58 | 502 | | | | <1 | mg/kg | TM30/PM15 |
| Beryllium | <0.5 | <0.5 | - | 1.9 | 0.5 | 1.6 | 3.0 | | | | <0.5 | mg/kg | TM30/PM15 |
| Cadmium # | <0.1 | <0.1 | - | <0.1 | <0.1 | <0.1 | 0.2 | | | | <0.1 | mg/kg | TM30/PM15 |
| Chromium # | 19.8 | 19.1 | - | 42.8 | 42.9 | 60.8 | 43.5 | | | | <0.5 | mg/kg | TM30/PM15 |
| Copper # | 17 | 22 | - | 4481 AB | 44 | 19 | 123 | | | | <1 | mg/kg | TM30/PM15 |
| Lead # | 11 | 19 | - | 848 | 17 | 17 | 1687 | | | | <5 | mg/kg | TM30/PM15 |
| Mercury # | <0.1 | <0.1 | - | 0.9 | <0.1 | <0.1 | 0.8 | | | | <0.1 | mg/kg | TM30/PM15 |
| Nickel # | 10.7 | 23.9 | - | 52.5 | 18.6 | 56.2 | 51.9 | | | | <0.7 | mg/kg | TM30/PM15 |
| Selenium # | <1 | <1 | - | <1 | <1 | 1 | <1 | | | | <1 | mg/kg | TM30/PM15 |
| Vanadium | 4 | 4 | - | 45 | 21 | 65 | 71 | | | | <1 | mg/kg | TM30/PM15 |
| Water Soluble Boron # | 0.1 | 0.1 | - | 0.9 | <0.1 | 1.2 | 2.0 | | | | <0.1 | mg/kg | TM74/PM32 |
| Zinc # | 16 | 18 | - | 178 | 67 | 96 | 406 | | | | <5 | mg/kg | TM30/PM15 |
| Arsenic | - | - | 44.2 | - | - | - | - | | | | <0.5 | mg/kg | TM30/PM62 |
| Barium | - | - | 111 | - | - | - | - | | | | <1 | mg/kg | TM30/PM62 |
| Beryllium | - | - | <0.5 | - | - | - | - | | | | <0.5 | mg/kg | TM30/PM62 |
| Cadmium | - | - | 0.2 | - | - | - | - | | | | <0.1 | mg/kg | TM30/PM62 |
| Chromium | - | - | 24.4 | - | - | - | - | | | | <0.5 | mg/kg | TM30/PM62 |
| Copper | - | - | 51711 AC | - | - | - | - | | | | <1 | mg/kg | TM30/PM62 |
| Lead | - | - | 36395 AB | - | - | - | - | | | | <5 | mg/kg | TM30/PM62 |
| Mercury | - | - | <0.1 | - | - | - | - | | | | <0.1 | mg/kg | TM30/PM62 |
| Nickel | - | - | 30.7 | - | - | - | - | | | | <0.7 | mg/kg | TM30/PM62 |
| Selenium | - | - | <1 | - | - | - | - | | | | <1 | mg/kg | TM30/PM62 |
| Vanadium | - | - | 22 | - | - | - | - | | | | <1 | mg/kg | TM30/PM62 |
| Water Soluble Boron | - | - | 0.2 | - | - | - | - | | | | <0.1 | mg/kg | TM74/PM61 |
| Zinc | - | - | 400 | - | - | - | - | | | | <5 | mg/kg | TM30/PM62 |

Please see attached notes for all abbreviations and acronyms



Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin
**EMT Job No:** 21/7971

**Report : Solid**

**Solids:** V=60g VOC jar, J=250g glass jar, T=plastic tub

| EMT Sample No. | 1-2 | 3-4 | 5-6 | 7-8 | 9-10 | 11-12 | 13-14 | | | | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | WS10 | WS11 | WS12 | WS13 | WS14 | WS10 | WS12 | | | | | | |
| Depth | 0.30 | 0.40 | 0.20 | 0.50 | 0.30 | 3.10 | 1.40 | | | | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V J | V J | V J | V J | V J | V J | V J | | | | | | |
| Sample Date | 21/05/2021 | 21/05/2021 | 21/05/2021 | 21/05/2021 | 21/05/2021 | 21/05/2021 | 21/05/2021 | | | | | | |
| Sample Type | Soil | Soil | Soil | Soil | Soil | Soil | Soil | | | | | | |
| Batch Number | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | |
| Date of Receipt | 26/05/2021 | 26/05/2021 | 26/05/2021 | 26/05/2021 | 26/05/2021 | 26/05/2021 | 26/05/2021 | | | | | | |
| PAH MS | | | | | | | | | | | | | |
| Naphthalene # | <0.04 | <0.04 | <0.04 | 0.21 | <0.04 | <0.04 | <0.04 | | | | <0.04 | mg/kg | TM4/PM8 |
| Acenaphthylene | <0.03 | <0.03 | <0.03 | 0.21 | <0.03 | <0.03 | 0.09 | | | | <0.03 | mg/kg | TM4/PM8 |
| Acenaphthene # | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | | | | <0.05 | mg/kg | TM4/PM8 |
| Fluorene # | <0.04 | <0.04 | <0.04 | 0.06 | <0.04 | <0.04 | <0.04 | | | | <0.04 | mg/kg | TM4/PM8 |
| Phenanthrene # | <0.03 | 0.03 | <0.03 | 0.73 | 0.04 | <0.03 | 0.47 | | | | <0.03 | mg/kg | TM4/PM8 |
| Anthracene # | <0.04 | <0.04 | <0.04 | 0.39 | 0.07 | <0.04 | 0.16 | | | | <0.04 | mg/kg | TM4/PM8 |
| Fluoranthene # | <0.03 | 0.09 | <0.03 | 1.92 | 0.07 | <0.03 | 1.05 | | | | <0.03 | mg/kg | TM4/PM8 |
| Pyrene # | <0.03 | 0.08 | <0.03 | 1.84 | 0.09 | <0.03 | 0.88 | | | | <0.03 | mg/kg | TM4/PM8 |
| Benzo(a)anthracene # | <0.06 | <0.06 | <0.06 | 0.99 | <0.06 | <0.06 | 0.56 | | | | <0.06 | mg/kg | TM4/PM8 |
| Chrysene # | <0.02 | 0.06 | <0.02 | 1.13 | 0.05 | <0.02 | 0.56 | | | | <0.02 | mg/kg | TM4/PM8 |
| Benzo(bk)fluoranthene # | <0.07 | 0.09 | <0.07 | 2.06 | 0.09 | <0.07 | 1.00 | | | | <0.07 | mg/kg | TM4/PM8 |
| Benzo(a)pyrene # | <0.04 | 0.04 | <0.04 | 1.02 | 0.04 | <0.04 | 0.54 | | | | <0.04 | mg/kg | TM4/PM8 |
| Indeno(123cd)pyrene # | <0.04 | <0.04 | <0.04 | 0.67 | <0.04 | <0.04 | 0.35 | | | | <0.04 | mg/kg | TM4/PM8 |
| Dibenzo(ah)anthracene # | <0.04 | <0.04 | <0.04 | 0.15 | <0.04 | <0.04 | 0.07 | | | | <0.04 | mg/kg | TM4/PM8 |
| Benzo(ghi)perylene # | <0.04 | <0.04 | <0.04 | 0.63 | <0.04 | <0.04 | 0.31 | | | | <0.04 | mg/kg | TM4/PM8 |
| PAH 16 Total | <0.6 | <0.6 | <0.6 | 12.0 | <0.6 | <0.6 | 6.0 | | | | <0.6 | mg/kg | TM4/PM8 |
| Benzo(b)fluoranthene | <0.05 | 0.06 | <0.05 | 1.48 | 0.06 | <0.05 | 0.72 | | | | <0.05 | mg/kg | TM4/PM8 |
| Benzo(k)fluoranthene | <0.02 | 0.03 | <0.02 | 0.58 | 0.03 | <0.02 | 0.28 | | | | <0.02 | mg/kg | TM4/PM8 |
| PAH Surrogate % Recovery | 92 | 92 | 94 | 98 | 93 | 95 | 94 | | | | <0 | % | TM4/PM8 |
| | | | | | | | | | | | | | |
| TPH CWG | | | | | | | | | | | | | |
| **Aliphatics** | | | | | | | | | | | | | |
| >C5-C6 # | <0.1 | <0.1 | <0.1 | <0.1 SV | <0.1 | <0.1 | <0.1 SV | | | | <0.1 | mg/kg | TM36/PM12 |
| >C6-C8 # | <0.1 | <0.1 | <0.1 | <0.1 SV | <0.1 | <0.1 | 0.1 SV | | | | <0.1 | mg/kg | TM36/PM12 |
| >C8-C10 | <0.1 | <0.1 | <0.1 | <0.1 SV | <0.1 | <0.1 | <0.1 SV | | | | <0.1 | mg/kg | TM36/PM12 |
| >C10-C12 # | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | | | | <0.2 | mg/kg | TM5/PM8/PM16 |
| >C12-C16 # | <4 | <4 | <4 | <4 | <4 | <4 | <4 | | | | <4 | mg/kg | TM5/PM8/PM16 |
| >C16-C21 # | <7 | <7 | <7 | 14 | <7 | <7 | 20 | | | | <7 | mg/kg | TM5/PM8/PM16 |
| >C21-C35 # | <7 | <7 | 44 | 122 | <7 | <7 | 130 | | | | <7 | mg/kg | TM5/PM8/PM16 |
| Total aliphatics C5-35 | <19 | <19 | 44 | 136 | <19 | <19 | 150 | | | | <19 | mg/kg | TM5/TM36/PM8/PM12/PM16 |
| **Aromatics** | | | | | | | | | | | | | |
| >C5-EC7 # | <0.1 | <0.1 | <0.1 | <0.1 SV | <0.1 | <0.1 | <0.1 SV | | | | <0.1 | mg/kg | TM36/PM12 |
| >EC7-EC8 # | <0.1 | <0.1 | <0.1 | <0.1 SV | <0.1 | <0.1 | <0.1 SV | | | | <0.1 | mg/kg | TM36/PM12 |
| >EC8-EC10 # | <0.1 | <0.1 | <0.1 | <0.1 SV | <0.1 | <0.1 | <0.1 SV | | | | <0.1 | mg/kg | TM36/PM12 |
| >EC10-EC12 # | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | | | | <0.2 | mg/kg | TM5/PM8/PM16 |
| >EC12-EC16 # | <4 | <4 | <4 | <4 | <4 | <4 | <4 | | | | <4 | mg/kg | TM5/PM8/PM16 |
| >EC16-EC21 # | <7 | <7 | <7 | 26 | <7 | <7 | 35 | | | | <7 | mg/kg | TM5/PM8/PM16 |
| >EC21-EC35 # | <7 | <7 | <7 | 151 | <7 | <7 | 191 | | | | <7 | mg/kg | TM5/PM8/PM16 |
| Total aromatics C5-35 # | <19 | <19 | <19 | 177 | <19 | <19 | 226 | | | | <19 | mg/kg | TM5/TM36/PM8/PM12/PM16 |
| Total aliphatics and aromatics(C5-35) | <38 | <38 | 44 | 313 | <38 | <38 | 376 | | | | <38 | mg/kg | TM5/TM36/PM8/PM12/PM16 |
| | | | | | | | | | | | | | |
| MTBE # | <5 | <5 | <5 | <5 SV | <5 | <5 | <5 SV | | | | <5 | ug/kg | TM36/PM12 |
| Benzene # | <5 | <5 | <5 | <5 SV | <5 | <5 | 7 SV | | | | <5 | ug/kg | TM36/PM12 |

Please see attached notes for all abbreviations and acronyms

## Element Materials Technology

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin
**EMT Job No:** 21/7971

**Report : Solid**

**Solids:** V=60g VOC jar, J=250g glass jar, T=plastic tub

| EMT Sample No. | 1-2 | 3-4 | 5-6 | 7-8 | 9-10 | 11-12 | 13-14 | | | | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | WS10 | WS11 | WS12 | WS13 | WS14 | WS10 | WS12 | | | | | | |
| Depth | 0.30 | 0.40 | 0.20 | 0.50 | 0.30 | 3.10 | 1.40 | | | | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V J | V J | V J | V J | V J | V J | V J | | | | | | |
| Sample Date | 21/05/2021 | 21/05/2021 | 21/05/2021 | 21/05/2021 | 21/05/2021 | 21/05/2021 | 21/05/2021 | | | | | | |
| Sample Type | Soil | Soil | Soil | Soil | Soil | Soil | Soil | | | | | | |
| Batch Number | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | |
| Date of Receipt | 26/05/2021 | 26/05/2021 | 26/05/2021 | 26/05/2021 | 26/05/2021 | 26/05/2021 | 26/05/2021 | | | | | | |
| Toluene # | <5 | <5 | <5 | <5 SV | <5 | <5 | <5 SV | | | | <5 | ug/kg | TM36/PM12 |
| Ethylbenzene # | <5 | <5 | <5 | <5 SV | <5 | <5 | <5 SV | | | | <5 | ug/kg | TM36/PM12 |
| m/p-Xylene # | <5 | <5 | <5 | <5 SV | <5 | <5 | <5 SV | | | | <5 | ug/kg | TM36/PM12 |
| o-Xylene # | <5 | <5 | <5 | <5 SV | <5 | <5 | <5 SV | | | | <5 | ug/kg | TM36/PM12 |
| Natural Moisture Content | 12.4 | 11.3 | 13.7 | 28.9 | 8.4 | 122.0 | 32.9 | | | | <0.1 | % | PM4/PM0 |
| Hexavalent Chromium # | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | | | | <0.3 | mg/kg | TM38/PM20 |
| Sulphate as SO4 (2:1 Ext) # | 0.1782 | 0.4555 | - | 0.0479 | 0.0099 | 0.7619 | 0.0299 | | | | <0.0015 | g/l | TM38/PM20 |
| Sulphate as SO4 (2:1 Ext) | - | - | 0.0182 | - | - | - | - | | | | <0.0015 | g/l | TM38/PM60 |
| Chromium III | 19.8 | 19.1 | - | 42.8 | 42.9 | 60.8 | 43.5 | | | | <0.5 | mg/kg | NONE/NONE |
| Chromium III | - | - | 24.4 | - | - | - | - | | | | <0.5 | mg/kg | NONE/NONE |
| Free Cyanide | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | | | | <0.5 | mg/kg | TM89/PM45 |
| Total Cyanide # | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | | | | <0.5 | mg/kg | TM89/PM45 |
| Total Organic Carbon # | - | 0.94 | NDP | - | 1.84 | 5.67 | 12.66 | | | | <0.02 | % | TM21/PM24 |
| pH # | 10.38 | 8.38 | 8.19 | 7.66 | 8.20 | 6.54 | 7.89 | | | | <0.01 | pH units | TM73/PM11 |

Please see attached notes for all abbreviations and acronyms

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin

**Note:**

Asbestos Screen analysis is carried out in accordance with our documented in-house methods PM042 and TM065 and HSG 248 by Stereo and Polarised Light Microscopy using Dispersion Staining Techniques and is covered by our UKAS accreditation. Detailed Gravimetric Quantification and PCOM Fibre Analysis is carried out in accordance with our documented in-house methods PM042 and TM131 and HSG 248 using Stereo and Polarised Light Microscopy and Phase Contrast Optical Microscopy (PCOM). Samples are retained for not less than 6 months from the date of analysis unless specifically requested.

Opinions, including ACM type and Asbestos level less than 0.1%, lie outside the scope of our UKAS accreditation.

Where the sample is not taken by a Element Materials Technology consultant, Element Materials Technology cannot be responsible for inaccurate or unrepresentative sampling.

| EMT Job No. | Batch | Sample ID | Depth | EMT Sample No. | Date Of Analysis | Analysis | Result |
|---|---|---|---|---|---|---|---|
| 21/7971 | 1 | WS10 | 0.30 | 2 | 01/06/2021 | **General Description (Bulk Analysis)** | Soil/Stone |
| | | | | | 01/06/2021 | **Asbestos Fibres** | NAD |
| | | | | | 01/06/2021 | **Asbestos ACM** | NAD |
| | | | | | 01/06/2021 | **Asbestos Type** | NAD |
| | | | | | 01/06/2021 | **Asbestos Level Screen** | NAD |
| 21/7971 | 1 | WS11 | 0.40 | 4 | 01/06/2021 | **General Description (Bulk Analysis)** | Soil/Stone |
| | | | | | 01/06/2021 | **Asbestos Fibres** | NAD |
| | | | | | 01/06/2021 | **Asbestos ACM** | NAD |
| | | | | | 01/06/2021 | **Asbestos Type** | NAD |
| | | | | | 01/06/2021 | **Asbestos Level Screen** | NAD |
| 21/7971 | 1 | WS12 | 0.20 | 6 | 01/06/2021 | **General Description (Bulk Analysis)** | Soil/Stone |
| | | | | | 01/06/2021 | **Asbestos Fibres** | Fibre Bundles |
| | | | | | 01/06/2021 | **Asbestos Fibres (2)** | Fibre Bundles |
| | | | | | 01/06/2021 | **Asbestos ACM** | Asbestos Insulating Board Debris |
| | | | | | 01/06/2021 | **Asbestos ACM (2)** | Asbestos Insulating Board Debris |
| | | | | | 01/06/2021 | **Asbestos Type** | Amosite |
| | | | | | 01/06/2021 | **Asbestos Type (2)** | Chrysotile |
| | | | | | 01/06/2021 | **Asbestos Level Screen** | Asbestos level cannot be determined from Screen. Quantification required. |
| | | | | | 09/06/2021 | **Total ACM Gravimetric Quantification (% Asb)** | <0.001 (mass %) |
| | | | | | 09/06/2021 | **Total Detailed Gravimetric Quantification (% Asb)** | 0.019 (mass %) |
| | | | | | 09/06/2021 | **Total Gravimetric Quantification (ACM + Detailed) (% Asb)** | 0.019 (mass %) |
| | | | | | 16/06/2021 | **Asbestos PCOM Quantification (Fibres)** | 0.001 (mass %) |
| | | | | | 16/06/2021 | **Asbestos Gravimetric & PCOM Total** | 0.020 (mass %) |
| 21/7971 | 1 | WS13 | 0.50 | 8 | 01/06/2021 | **General Description (Bulk Analysis)** | Soil/Stone |
| | | | | | 01/06/2021 | **Asbestos Fibres** | NAD |
| | | | | | 01/06/2021 | **Asbestos ACM** | NAD |
| | | | | | 01/06/2021 | **Asbestos Type** | NAD |
| | | | | | 01/06/2021 | **Asbestos Level Screen** | NAD |
| 21/7971 | 1 | WS14 | 0.30 | 10 | 01/06/2021 | **General Description (Bulk Analysis)** | Soil/Stone |
| | | | | | 01/06/2021 | **Asbestos Fibres** | NAD |
| | | | | | 01/06/2021 | **Asbestos ACM** | NAD |
| | | | | | 01/06/2021 | **Asbestos Type** | NAD |
| | | | | | 01/06/2021 | **Asbestos Level Screen** | NAD |

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin

| EMT Job No. | Batch | Sample ID | Depth | EMT Sample No. | Date Of Analysis | Analysis | Result |
|---|---|---|---|---|---|---|---|
| 21/7971 | 1 | WS12 | 1.40 | 14 | 01/06/2021 | **General Description (Bulk Analysis)** | Soil/Stone |
| | | | | | 01/06/2021 | **Asbestos Fibres** | NAD |
| | | | | | 01/06/2021 | **Asbestos ACM** | NAD |
| | | | | | 01/06/2021 | **Asbestos Type** | NAD |
| | | | | | 01/06/2021 | **Asbestos Level Screen** | NAD |

**Client Name:** MCL Consulting

**Reference:** P2288

**Location:** Riverine

**Contact:** Thomas Martin

**Matrix : Solid**

| EMT Job No. | Batch | Sample ID | Depth | EMT Sample No. | Method No. | NDP Reason |
|---|---|---|---|---|---|---|
| 21/7971 | 1 | WS12 | 0.20 | 5-6 | TM21/PM24 | Asbestos detected in sample |

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin

| EMT Job No. | Batch | Sample ID | Depth | EMT Sample No. | Analysis | Reason |
|---|---|---|---|---|---|---|
| No deviating sample report results for job 21/7971 | | | | | | |

**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.:*** 21/7971

**SOILS**

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

**WATERS**

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

**DEVIATING SAMPLES**

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

**SURROGATES**

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

**DILUTIONS**

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

**BLANKS**

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

**NOTE**

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

**REPORTS FROM THE SOUTH AFRICA LABORATORY**

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

**Measurement Uncertainty**

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

**ABBREVIATIONS and ACRONYMS USED**

| | |
|---|---|
| # | ISO17025 (UKAS Ref No. 4225) accredited - UK. |
| SA | ISO17025 (SANAS Ref No.T0729) accredited - South Africa |
| B | Indicates analyte found in associated method blank. |
| DR | Dilution required. |
| M | MCERTS accredited. |
| NA | Not applicable |
| NAD | No Asbestos Detected. |
| ND | None Detected (usually refers to VOC and/SVOC TICs). |
| NDP | No Determination Possible |
| SS | Calibrated against a single substance |
| SV | Surrogate recovery outside performance criteria. This may be due to a matrix effect. |
| W | Results expressed on as received basis. |
| + | AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page. |
| >> | Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher, this result is not accredited. |
| * | Analysis subcontracted to an Element Materials Technology approved laboratory. |
| AD | Samples are dried at 35°C ±5°C |
| CO | Suspected carry over |
| LOD/LOR | Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS |
| ME | Matrix Effect |
| NFD | No Fibres Detected |
| BS | AQC Sample |
| LB | Blank Sample |
| N | Client Sample |
| TB | Trip Blank Sample |
| OC | Outside Calibration Range |
| AA | x5 Dilution |

| | |
|---|---|
| AB | x20 Dilution |
| AC | x500 Dilution |

**EMT Job No:** 21/7971

| Test Method No. | Description | Prep Method No. (if appropriate) | Description | ISO 17025 (UKAS/SANAS) | MCERTS (UK soils only) | Analysis done on As Received (AR) or Dried (AD) | Reported on dry weight basis |
|---|---|---|---|---|---|---|---|
| PM4 | Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465:1993(E) and BS1377-2:1990. | PM0 | No preparation is required. | | | AR | |
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM8 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required. | | | AR | Yes |
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM8 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required. | Yes | | AR | Yes |
| TM5 | Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present. | PM8/PM16 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required/Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE. | Yes | | AR | Yes |
| TM5/TM36 | please refer to TM5 and TM36 for method details | PM8/PM12/PM16 | please refer to PM8/PM16 and PM12 for method details | | | AR | Yes |
| TM5/TM36 | please refer to TM5 and TM36 for method details | PM8/PM12/PM16 | please refer to PM8/PM16 and PM12 for method details | Yes | | AR | Yes |
| TM21 | Modified BS 7755-3:1995, ISO10694:1995 Determination of Total Organic Carbon or Total Carbon by combustion in an Eltra TOC furnace/analyser in the presence of oxygen. The CO2 generated is quantified using infra-red detection. Organic Matter (SOM) calculated as per EA MCERTS Chemical Testing of Soil, March 2012 v4. | PM24 | Dried and ground solid samples are washed with hydrochloric acid, then rinsed with deionised water to remove the mineral carbon before TOC analysis. | Yes | | AD | Yes |
| 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 | PM15 | Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground. | | | AD | Yes |
| TM30 | Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996 | PM15 | Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground. | Yes | | AD | Yes |
| TM30 | Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996 | PM62 | Acid digestion of as received solid samples using Aqua Regia refluxed at 112.5 °C. | | | AR | Yes |

**EMT Job No:** 21/7971

| 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 |
|---|---|---|---|---|---|---|---|
| TM36 | Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested. | PM12 | Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis. | | | AR | Yes |
| TM36 | Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested. | PM12 | Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis. | Yes | | AR | Yes |
| TM38 | Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l | PM20 | Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker. | Yes | | AD | 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 | PM20 | Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker. | Yes | | AR | Yes |
| 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 | PM60 | As received solid samples are extracted with deionised water in a 2:1 ratio of water to solid. | | | AR | Yes |
| TM65 | Asbestos Bulk Identification method based on HSG 248 First edition (2006) | PM42 | Modified SCA Blue Book V.12 draft 2017 and WM3 1st Edition v1.1:2018. Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065. | Yes | | AR | |
| TM73 | Modified US EPA methods 150.1 (1982) and 9045D Rev. 4 - 2004) and BS1377-3:1990. Determination of pH by Metrohm automated probe analyser. | PM11 | Extraction of as received solid samples using one part solid to 2.5 parts deionised water. | Yes | | AR | No |
| TM74 | Analysis of water soluble boron (20:1 extract) by ICP-OES. | PM32 | Hot water soluble boron is extracted from dried and ground samples using a 20:1 ratio. | Yes | | AD | Yes |
| TM74 | Analysis of water soluble boron (20:1 extract) by ICP-OES. | PM61 | As received solid samples are extracted with hot water in a 20:1 ratio of water to soil ready for analysis by ICP. | | | AR | Yes |
| TM89 | Modified USEPA method OIA-1667 (1999). Determination of cyanide by Flow Injection Analyser. Where WAD cyanides are required a Ligand displacement step is carried out before analysis. | PM45 | As received solid samples are extracted with 1M NaOH by orbital shaker for Cyanide, Sulphide and Thiocyanate analysis. | | | AR | Yes |

**EMT Job No:** 21/7971

| 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 |
|---|---|---|---|---|---|---|---|
| TM89 | Modified USEPA method OIA-1667 (1999). Determination of cyanide by Flow Injection Analyser. Where WAD cyanides are required a Ligand displacement step is carried out before analysis. | PM45 | As received solid samples are extracted with 1M NaOH by orbital shaker for Cyanide, Sulphide and Thiocyanate analysis. | Yes | | AR | Yes |
| TM131 | Quantification of Asbestos Fibres and ACM based on HSG248 First edition:2006, HSG 264 Second edition:2012, HSE Contract Research Report No.83/1996, MDHS 87:1998, WM3 1st Edition v1.1:2018 | PM42 | Modified SCA Blue Book V.12 draft 2017 and WM3 1st Edition v1.1:2018. Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065. | Yes | | AR | Yes |
| NONE | No Method Code | NONE | No Method Code | | | AD | Yes |
| NONE | No Method Code | NONE | No Method Code | | | AR | Yes |
| | | | | | | | |
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| | |
|---|---|
| **Attention :** | Thomas Martin |
| **Date :** | 11th June, 2021 |
| **Your reference :** | P2288 |
| **Our reference :** | Test Report 21/8319 Batch 1 |
| **Location :** | Riverine |
| **Date samples received :** | 2nd June, 2021 |
| **Status :** | Final report |
| **Issue :** | 1 |

Ten samples were received for analysis on 2nd June, 2021 of which ten 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:**

**Bruce Leslie**
**Project Manager**

Please include all sections of this report if it is reproduced

## Element Materials Technology

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin
**EMT Job No:** 21/8319

**Report : Solid**

**Solids:** V=60g VOC jar, J=250g glass jar, T=plastic tub

| EMT Sample No. | 1-2 | 3-4 | 5-6 | 7-8 | 9-10 | 11-12 | 13-14 | 15-16 | 17-18 | 19-20 | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | HA10 | HA13 | HA14 | HA16 | HA21 | HA24 | HA25 | HA13 | HA24 | HA25 | | | |
| Depth | 0.20 | 0.10 | 0.20 | 0.30 | 0.30 | 0.20 | 0.40 | 1.60 | 1.50 | 1.80 | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V J | V J | V J | V J | V J | V J | V J | V J | V J | V J | | | |
| Sample Date | 27/05/2021 | 27/05/2021 | 27/05/2021 | 27/05/2021 | 27/05/2021 | 27/05/2021 | 27/05/2021 | 27/05/2021 | 27/05/2021 | 27/05/2021 | | | |
| Sample Type | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil | | | |
| Batch Number | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| Date of Receipt | 02/06/2021 | 02/06/2021 | 02/06/2021 | 02/06/2021 | 02/06/2021 | 02/06/2021 | 02/06/2021 | 02/06/2021 | 02/06/2021 | 02/06/2021 | | | |
| Arsenic # | 13.6 | 16.0 | 9.5 | 17.5 | 14.9 | 12.1 | 9.4 | 15.6 | 11.0 | 10.2 | <0.5 | mg/kg | TM30/PM15 |
| Barium # | 80 | 149 | 120 | 118 | 118 | 77 | 52 | 126 | 73 | 62 | <1 | mg/kg | TM30/PM15 |
| Beryllium | <0.5 | 0.8 | 0.8 | 0.8 | 0.5 | <0.5 | <0.5 | 0.8 | <0.5 | <0.5 | <0.5 | mg/kg | TM30/PM15 |
| Cadmium # | 0.2 | 0.1 | 0.2 | 0.4 | 0.3 | <0.1 | <0.1 | 0.2 | <0.1 | <0.1 | <0.1 | mg/kg | TM30/PM15 |
| Chromium # | 27.3 | 55.7 | 51.4 | 67.4 | 29.3 | 42.7 | 28.2 | 60.5 | 27.4 | 44.4 | <0.5 | mg/kg | TM30/PM15 |
| Copper # | 19 | 42 | 52 | 43 | 22 | 22 | 16 | 47 | 17 | 20 | <1 | mg/kg | TM30/PM15 |
| Lead # | 30 | 56 | 42 | 90 | 27 | 12 | 16 | 117 | 20 | 16 | <5 | mg/kg | TM30/PM15 |
| Mercury # | <0.1 | 0.2 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 0.2 | <0.1 | <0.1 | <0.1 | mg/kg | TM30/PM15 |
| Nickel # | 18.4 | 30.9 | 27.3 | 28.5 | 23.7 | 20.8 | 15.5 | 29.6 | 18.7 | 18.4 | <0.7 | mg/kg | TM30/PM15 |
| Selenium # | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | mg/kg | TM30/PM15 |
| Vanadium | 21 | 37 | 27 | 36 | 28 | 24 | 19 | 43 | 22 | 21 | <1 | mg/kg | TM30/PM15 |
| Water Soluble Boron # | 0.3 | 0.4 | 0.6 | 0.4 | 0.3 | 0.5 | 0.1 | 1.0 | 0.1 | 0.1 | <0.1 | mg/kg | TM74/PM32 |
| Zinc # | 73 | 109 | 137 | 321 | 102 | 59 | 50 | 143 | 61 | 55 | <5 | mg/kg | TM30/PM15 |
| PAH MS | | | | | | | | | | | | | |
| Naphthalene # | <0.04 | <0.04 | <0.04 | 0.05 | <0.04 | <0.04 | <0.04 | 0.14 | <0.04 | <0.04 | <0.04 | mg/kg | TM4/PM8 |
| Acenaphthylene | <0.03 | <0.03 | <0.03 | 0.13 | <0.03 | <0.03 | <0.03 | 0.08 | <0.03 | <0.03 | <0.03 | mg/kg | TM4/PM8 |
| Acenaphthene # | <0.05 | <0.05 | <0.05 | 0.20 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | mg/kg | TM4/PM8 |
| Fluorene # | <0.04 | <0.04 | <0.04 | 0.19 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | mg/kg | TM4/PM8 |
| Phenanthrene # | 0.10 | 0.13 | 0.12 | 1.62 | <0.03 | <0.03 | <0.03 | 0.51 | <0.03 | <0.03 | <0.03 | mg/kg | TM4/PM8 |
| Anthracene # | <0.04 | <0.04 | <0.04 | 0.59 | <0.04 | <0.04 | <0.04 | 0.22 | <0.04 | <0.04 | <0.04 | mg/kg | TM4/PM8 |
| Fluoranthene # | 0.27 | 0.40 | 0.14 | 2.73 | 0.16 | <0.03 | <0.03 | 1.13 | 0.04 | <0.03 | <0.03 | mg/kg | TM4/PM8 |
| Pyrene # | 0.26 | 0.38 | 0.14 | 2.09 | 0.14 | <0.03 | <0.03 | 0.98 | 0.05 | <0.03 | <0.03 | mg/kg | TM4/PM8 |
| Benzo(a)anthracene # | 0.18 | 0.24 | 0.10 | 1.05 | 0.13 | <0.06 | <0.06 | 0.78 | <0.06 | <0.06 | <0.06 | mg/kg | TM4/PM8 |
| Chrysene # | 0.17 | 0.24 | 0.11 | 1.08 | 0.12 | <0.02 | <0.02 | 0.85 | 0.02 | <0.02 | <0.02 | mg/kg | TM4/PM8 |
| Benzo(bk)fluoranthene # | 0.30 | 0.47 | 0.17 | 1.90 | 0.25 | <0.07 | <0.07 | 1.95 | <0.07 | <0.07 | <0.07 | mg/kg | TM4/PM8 |
| Benzo(a)pyrene # | 0.17 | 0.22 | 0.07 | 1.03 | 0.13 | <0.04 | <0.04 | 1.13 | <0.04 | <0.04 | <0.04 | mg/kg | TM4/PM8 |
| Indeno(123cd)pyrene # | 0.10 | 0.17 | 0.06 | 0.61 | 0.09 | <0.04 | <0.04 | 0.90 | <0.04 | <0.04 | <0.04 | mg/kg | TM4/PM8 |
| Dibenzo(ah)anthracene # | <0.04 | <0.04 | <0.04 | 0.17 | <0.04 | <0.04 | <0.04 | 0.31 | <0.04 | <0.04 | <0.04 | mg/kg | TM4/PM8 |
| Benzo(ghi)perylene # | 0.11 | 0.15 | 0.06 | 0.59 | 0.09 | <0.04 | <0.04 | 0.93 | <0.04 | <0.04 | <0.04 | mg/kg | TM4/PM8 |
| PAH 16 Total | 1.7 | 2.4 | 1.0 | 14.0 | 1.1 | <0.6 | <0.6 | 9.9 | <0.6 | <0.6 | <0.6 | mg/kg | TM4/PM8 |
| Benzo(b)fluoranthene | 0.22 | 0.34 | 0.12 | 1.37 | 0.18 | <0.05 | <0.05 | 1.40 | <0.05 | <0.05 | <0.05 | mg/kg | TM4/PM8 |
| Benzo(k)fluoranthene | 0.08 | 0.13 | 0.05 | 0.53 | 0.07 | <0.02 | <0.02 | 0.55 | <0.02 | <0.02 | <0.02 | mg/kg | TM4/PM8 |
| PAH Surrogate % Recovery | 102 | 96 | 95 | 101 | 94 | 91 | 101 | 95 | 101 | 100 | <0 | % | TM4/PM8 |

Please see attached notes for all abbreviations and acronyms

## Element Materials Technology

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin
**EMT Job No:** 21/8319

**Report : Solid**

**Solids:** V=60g VOC jar, J=250g glass jar, T=plastic tub

| EMT Sample No. | 1-2 | 3-4 | 5-6 | 7-8 | 9-10 | 11-12 | 13-14 | 15-16 | 17-18 | 19-20 | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | HA10 | HA13 | HA14 | HA16 | HA21 | HA24 | HA25 | HA13 | HA24 | HA25 | | | |
| Depth | 0.20 | 0.10 | 0.20 | 0.30 | 0.30 | 0.20 | 0.40 | 1.60 | 1.50 | 1.80 | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V J | V J | V J | V J | V J | V J | V J | V J | V J | V J | | | |
| Sample Date | 27/05/2021 | 27/05/2021 | 27/05/2021 | 27/05/2021 | 27/05/2021 | 27/05/2021 | 27/05/2021 | 27/05/2021 | 27/05/2021 | 27/05/2021 | | | |
| Sample Type | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil | | | |
| Batch Number | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| Date of Receipt | 02/06/2021 | 02/06/2021 | 02/06/2021 | 02/06/2021 | 02/06/2021 | 02/06/2021 | 02/06/2021 | 02/06/2021 | 02/06/2021 | 02/06/2021 | | | |
| TPH CWG | | | | | | | | | | | | | |
| **Aliphatics** | | | | | | | | | | | | | |
| >C5-C6 # | <0.1 | <0.1 | 0.2 SV | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 SV | <0.1 | <0.1 | <0.1 | mg/kg | TM36/PM12 |
| >C6-C8 # | <0.1 | <0.1 | <0.1 SV | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 SV | <0.1 | <0.1 | <0.1 | mg/kg | TM36/PM12 |
| >C8-C10 | <0.1 | <0.1 | <0.1 SV | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 SV | <0.1 | <0.1 | <0.1 | mg/kg | TM36/PM12 |
| >C10-C12 # | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | mg/kg | TM5/PM8/PM16 |
| >C12-C16 # | <4 | <4 | <4 | <4 | <4 | <4 | <4 | <4 | <4 | <4 | <4 | mg/kg | TM5/PM8/PM16 |
| >C16-C21 # | <7 | 15 | <7 | <7 | <7 | <7 | <7 | <7 | <7 | <7 | <7 | mg/kg | TM5/PM8/PM16 |
| >C21-C35 # | <7 | 50 | 49 | 32 | <7 | <7 | <7 | 89 | <7 | <7 | <7 | mg/kg | TM5/PM8/PM16 |
| Total aliphatics C5-35 | <19 | 65 | 49 | 32 | <19 | <19 | <19 | 89 | <19 | <19 | <19 | mg/kg | TM5/TM36/PM8/PM12/PM16 |
| **Aromatics** | | | | | | | | | | | | | |
| >C5-EC7 # | <0.1 | <0.1 | <0.1 SV | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 SV | <0.1 | <0.1 | <0.1 | mg/kg | TM36/PM12 |
| >EC7-EC8 # | <0.1 | <0.1 | <0.1 SV | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 SV | <0.1 | <0.1 | <0.1 | mg/kg | TM36/PM12 |
| >EC8-EC10 # | <0.1 | <0.1 | <0.1 SV | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 SV | <0.1 | <0.1 | <0.1 | mg/kg | TM36/PM12 |
| >EC10-EC12 # | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | mg/kg | TM5/PM8/PM16 |
| >EC12-EC16 # | <4 | <4 | <4 | <4 | <4 | <4 | <4 | <4 | <4 | <4 | <4 | mg/kg | TM5/PM8/PM16 |
| >EC16-EC21 # | <7 | <7 | 11 | <7 | <7 | <7 | <7 | 23 | <7 | <7 | <7 | mg/kg | TM5/PM8/PM16 |
| >EC21-EC35 # | <7 | 124 | 149 | 110 | <7 | <7 | <7 | 178 | <7 | <7 | <7 | mg/kg | TM5/PM8/PM16 |
| Total aromatics C5-35 # | <19 | 124 | 160 | 110 | <19 | <19 | <19 | 201 | <19 | <19 | <19 | mg/kg | TM5/TM36/PM8/PM12/PM16 |
| Total aliphatics and aromatics(C5-35) | <38 | 189 | 209 | 142 | <38 | <38 | <38 | 290 | <38 | <38 | <38 | mg/kg | TM5/TM36/PM8/PM12/PM16 |
| MTBE # | <5 | <5 | <5 SV | <5 | <5 | <5 | <5 | <5 SV | <5 | <5 | <5 | ug/kg | TM36/PM12 |
| Benzene # | <5 | <5 | <5 SV | <5 | <5 | <5 | <5 | <5 SV | <5 | <5 | <5 | ug/kg | TM36/PM12 |
| Toluene # | <5 | <5 | <5 SV | <5 | <5 | <5 | <5 | <5 SV | <5 | <5 | <5 | ug/kg | TM36/PM12 |
| Ethylbenzene # | <5 | <5 | <5 SV | <5 | <5 | <5 | <5 | <5 SV | <5 | <5 | <5 | ug/kg | TM36/PM12 |
| m/p-Xylene # | <5 | <5 | <5 SV | <5 | <5 | <5 | <5 | <5 SV | <5 | <5 | <5 | ug/kg | TM36/PM12 |
| o-Xylene # | <5 | <5 | <5 SV | <5 | <5 | <5 | <5 | <5 SV | <5 | <5 | <5 | ug/kg | TM36/PM12 |
| Natural Moisture Content | 23.2 | 39.3 | 19.0 | 18.8 | 31.2 | 18.7 | 15.0 | 36.6 | 20.0 | 16.7 | <0.1 | % | PM4/PM0 |
| Hexavalent Chromium # | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | mg/kg | TM38/PM20 |
| Sulphate as SO4 (2:1 Ext) # | 0.0046 | 0.0204 | 0.0049 | 0.0105 | 0.0077 | 0.0067 | 0.0568 | 0.0035 | 0.0251 | 0.0068 | <0.0015 | g/l | TM38/PM20 |
| Chromium III | 27.3 | 55.7 | 51.4 | 67.4 | 29.3 | 42.7 | 28.2 | 60.5 | 27.4 | 44.4 | <0.5 | mg/kg | NONE/NONE |
| Free Cyanide | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | mg/kg | TM89/PM45 |
| Total Cyanide # | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | mg/kg | TM89/PM45 |
| Total Organic Carbon # | 1.25 | - | 6.35 | 3.55 | - | - | 0.41 | 8.23 | 0.40 | - | <0.02 | % | TM21/PM24 |
| pH # | 5.56 | 7.48 | 7.68 | 7.52 | 5.78 | 6.41 | 6.02 | 6.88 | 6.13 | 6.74 | <0.01 | pH units | TM73/PM11 |

Please see attached notes for all abbreviations and acronyms



Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin

**Note:**

Asbestos Screen analysis is carried out in accordance with our documented in-house methods PM042 and TM065 and HSG 248 by Stereo and Polarised Light Microscopy using Dispersion Staining Techniques and is covered by our UKAS accreditation. Detailed Gravimetric Quantification and PCOM Fibre Analysis is carried out in accordance with our documented in-house methods PM042 and TM131 and HSG 248 using Stereo and Polarised Light Microscopy and Phase Contrast Optical Microscopy (PCOM). Samples are retained for not less than 6 months from the date of analysis unless specifically requested.

Opinions, including ACM type and Asbestos level less than 0.1%, lie outside the scope of our UKAS accreditation.

Where the sample is not taken by a Element Materials Technology consultant, Element Materials Technology cannot be responsible for inaccurate or unrepresentative sampling.

| EMT Job No. | Batch | Sample ID | Depth | EMT Sample No. | Date Of Analysis | Analysis | Result |
|---|---|---|---|---|---|---|---|
| 21/8319 | 1 | HA13 | 0.10 | 4 | 09/06/2021 | **General Description (Bulk Analysis)** | soil |
| | | | | | 09/06/2021 | **Asbestos Fibres** | NAD |
| | | | | | 09/06/2021 | **Asbestos ACM** | NAD |
| | | | | | 09/06/2021 | **Asbestos Type** | NAD |
| | | | | | 09/06/2021 | **Asbestos Level Screen** | NAD |
| | | | | | | | |
| 21/8319 | 1 | HA14 | 0.20 | 6 | 09/06/2021 | **General Description (Bulk Analysis)** | soil |
| | | | | | 09/06/2021 | **Asbestos Fibres** | NAD |
| | | | | | 09/06/2021 | **Asbestos ACM** | NAD |
| | | | | | 09/06/2021 | **Asbestos Type** | NAD |
| | | | | | 09/06/2021 | **Asbestos Level Screen** | NAD |
| | | | | | | | |
| 21/8319 | 1 | HA24 | 0.20 | 12 | 09/06/2021 | **General Description (Bulk Analysis)** | soil |
| | | | | | 09/06/2021 | **Asbestos Fibres** | NAD |
| | | | | | 09/06/2021 | **Asbestos ACM** | NAD |
| | | | | | 09/06/2021 | **Asbestos Type** | NAD |
| | | | | | 09/06/2021 | **Asbestos Level Screen** | NAD |

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin

| EMT Job No. | Batch | Sample ID | Depth | EMT Sample No. | Analysis | Reason |
|---|---|---|---|---|---|---|
| No deviating sample report results for job 21/8319 | | | | | | |

**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.**


Please include all sections of this report if it is reproduced

# NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

***EMT Job No.:*** 21/8319

**SOILS**

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

**WATERS**

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

**DEVIATING SAMPLES**

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

**SURROGATES**

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

**DILUTIONS**

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

**BLANKS**

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

**NOTE**

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

**REPORTS FROM THE SOUTH AFRICA LABORATORY**

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

**Measurement Uncertainty**

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

**ABBREVIATIONS and ACRONYMS USED**

| | |
|---|---|
| # | ISO17025 (UKAS Ref No. 4225) accredited - UK. |
| SA | ISO17025 (SANAS Ref No.T0729) accredited - South Africa |
| B | Indicates analyte found in associated method blank. |
| DR | Dilution required. |
| M | MCERTS accredited. |
| NA | Not applicable |
| NAD | No Asbestos Detected. |
| ND | None Detected (usually refers to VOC and/SVOC TICs). |
| NDP | No Determination Possible |
| SS | Calibrated against a single substance |
| SV | Surrogate recovery outside performance criteria. This may be due to a matrix effect. |
| W | Results expressed on as received basis. |
| + | AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page. |
| >> | Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher, this result is not accredited. |
| * | Analysis subcontracted to an Element Materials Technology approved laboratory. |
| AD | Samples are dried at 35°C ±5°C |
| CO | Suspected carry over |
| LOD/LOR | Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS |
| ME | Matrix Effect |
| NFD | No Fibres Detected |
| BS | AQC Sample |
| LB | Blank Sample |
| N | Client Sample |
| TB | Trip Blank Sample |
| OC | Outside Calibration Range |

**EMT Job No:** 21/8319

| Test Method No. | Description | Prep Method No. (if appropriate) | Description | ISO 17025 (UKAS/SANAS) | MCERTS (UK soils only) | Analysis done on As Received (AR) or Dried (AD) | Reported on dry weight basis |
|---|---|---|---|---|---|---|---|
| PM4 | Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465:1993(E) and BS1377-2:1990. | PM0 | No preparation is required. | | | AR | |
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM8 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required. | | | AR | Yes |
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM8 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required. | Yes | | AR | Yes |
| TM5 | Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present. | PM8/PM16 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required/Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE. | Yes | | AR | Yes |
| TM5/TM36 | please refer to TM5 and TM36 for method details | PM8/PM12/PM16 | please refer to PM8/PM16 and PM12 for method details | | | AR | Yes |
| TM5/TM36 | please refer to TM5 and TM36 for method details | PM8/PM12/PM16 | please refer to PM8/PM16 and PM12 for method details | Yes | | AR | Yes |
| TM21 | Modified BS 7755-3:1995, ISO10694:1995 Determination of Total Organic Carbon or Total Carbon by combustion in an Eltra TOC furnace/analyser in the presence of oxygen. The CO2 generated is quantified using infra-red detection. Organic Matter (SOM) calculated as per EA MCERTS Chemical Testing of Soil, March 2012 v4. | PM24 | Dried and ground solid samples are washed with hydrochloric acid, then rinsed with deionised water to remove the mineral carbon before TOC analysis. | Yes | | AD | Yes |
| 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 | PM15 | Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground. | | | AD | Yes |
| TM30 | Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996 | PM15 | Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground. | Yes | | AD | Yes |
| TM36 | Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested. | PM12 | Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis. | | | AR | Yes |

**EMT Job No:** 21/8319

| 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 |
|---|---|---|---|---|---|---|---|
| TM36 | Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested. | PM12 | Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis. | Yes | | AR | Yes |
| TM38 | Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l | PM20 | Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker. | Yes | | AD | 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 | PM20 | Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker. | Yes | | AR | Yes |
| TM65 | Asbestos Bulk Identification method based on HSG 248 First edition (2006) | PM42 | Modified SCA Blue Book V.12 draft 2017 and WM3 1st Edition v1.1:2018. Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065. | Yes | | AR | |
| TM73 | Modified US EPA methods 150.1 (1982) and 9045D Rev. 4 - 2004) and BS1377-3:1990. Determination of pH by Metrohm automated probe analyser. | PM11 | Extraction of as received solid samples using one part solid to 2.5 parts deionised water. | Yes | | AR | No |
| TM74 | Analysis of water soluble boron (20:1 extract) by ICP-OES. | PM32 | Hot water soluble boron is extracted from dried and ground samples using a 20:1 ratio. | Yes | | AD | Yes |
| TM89 | Modified USEPA method OIA-1667 (1999). Determination of cyanide by Flow Injection Analyser. Where WAD cyanides are required a Ligand displacement step is carried out before analysis. | PM45 | As received solid samples are extracted with 1M NaOH by orbital shaker for Cyanide, Sulphide and Thiocyanate analysis. | | | AR | Yes |
| TM89 | Modified USEPA method OIA-1667 (1999). Determination of cyanide by Flow Injection Analyser. Where WAD cyanides are required a Ligand displacement step is carried out before analysis. | PM45 | As received solid samples are extracted with 1M NaOH by orbital shaker for Cyanide, Sulphide and Thiocyanate analysis. | Yes | | AR | Yes |
| NONE | No Method Code | NONE | No Method Code | | | AD | Yes |
| | | | | | | | |

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| | |
|---|---|
| **Attention :** | Thomas Martin |
| **Date :** | 28th June, 2021 |
| **Your reference :** | P2288 |
| **Our reference :** | Test Report 21/9394 Batch 1 |
| **Location :** | Riverine |
| **Date samples received :** | 21st June, 2021 |
| **Status :** | Final report |
| **Issue :** | 1 |

Fifteen samples were received for analysis on 21st June, 2021 of which fifteen 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:**

**Bruce Leslie**
**Project Manager**

Please include all sections of this report if it is reproduced

## Element Materials Technology

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin
**EMT Job No:** 21/9394

**Report : Solid**

**Solids:** V=60g VOC jar, J=250g glass jar, T=plastic tub

| EMT Sample No. | 1-2 | 3-4 | 5-6 | 7-8 | 9-10 | 11-12 | 13-14 | 15-16 | 17-18 | 19-20 | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | WS15 | WS16 | WS17 | WS19 | WS20 | WS21 | WS22 | WS15 | WS16 | WS17 | | | |
| Depth | 0.30 | 0.50 | 0.20 | 0.30 | 0.10 | 0.30 | 0.80 | 1.80 | 1.30 | 1.60 | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V J | V J | V J | V J | V J | V J | V J | V J | V J | V J | | | |
| Sample Date | 15/06/2021 | 15/06/2021 | 15/06/2021 | 15/06/2021 | 15/06/2021 | 16/06/2021 | 16/06/2021 | 15/06/2021 | 15/06/2021 | 15/06/2021 | | | |
| Sample Type | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil | | | |
| Batch Number | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| Date of Receipt | 21/06/2021 | 21/06/2021 | 21/06/2021 | 21/06/2021 | 21/06/2021 | 21/06/2021 | 21/06/2021 | 21/06/2021 | 21/06/2021 | 21/06/2021 | | | |
| Arsenic # | 66.8 | 8.5 | 24.3 | 19.4 | 49.2 | 28.4 | 9.4 | 59.9 | 29.3 | 23.3 | <0.5 | mg/kg | TM30/PM15 |
| Barium # | 795 | 39 | 399 | 68 | 855 | 53 | 68 | 317 | 82 | 283 | <1 | mg/kg | TM30/PM15 |
| Beryllium | 6.2 | <0.5 | 3.5 | 0.8 | 5.0 | <0.5 | 1.0 | 6.8 | 1.0 | 3.5 | <0.5 | mg/kg | TM30/PM15 |
| Cadmium # | 3.8 | <0.1 | 1.4 | <0.1 | 0.8 | <0.1 | 0.1 | 0.9 | 0.2 | 0.6 | <0.1 | mg/kg | TM30/PM15 |
| Chromium # | 62.0 | 43.5 | 50.6 | 59.0 | 45.2 | 48.7 | 35.7 | 71.4 | 53.6 | 44.7 | <0.5 | mg/kg | TM30/PM15 |
| Copper # | 223 | 18 | 168 | 19 | 198 | 21 | 39 | 167 | 21 | 3339$_{AD}$ | <1 | mg/kg | TM30/PM15 |
| Lead # | 222 | 19 | 1773 | 20 | 287 | 11 | 63 | 145 | 28 | 398 | <5 | mg/kg | TM30/PM15 |
| Mercury # | <0.1 | <0.1 | 0.4 | <0.1 | <0.1 | <0.1 | <0.1 | 0.1 | <0.1 | <0.1 | <0.1 | mg/kg | TM30/PM15 |
| Nickel # | 89.6 | 17.1 | 67.4 | 23.9 | 91.4 | 26.7 | 31.7 | 102.8 | 49.5 | 276.7$_{AB}$ | <0.7 | mg/kg | TM30/PM15 |
| Selenium # | 3 | <1 | 2 | <1 | 3 | <1 | <1 | 3 | 1 | 1 | <1 | mg/kg | TM30/PM15 |
| Vanadium | 94 | 23 | 143 | 67 | 98 | 23 | 29 | 110 | 53 | 67 | <1 | mg/kg | TM30/PM15 |
| Water Soluble Boron # | 1.6 | 0.1 | 1.8 | 0.5 | 2.4 | 0.1 | 0.3 | 4.8 | <0.1 | 1.6 | <0.1 | mg/kg | TM74/PM32 |
| Zinc # | 985 | 60 | 1332 | 51 | 839 | 53 | 96 | 909 | 84 | 576 | <5 | mg/kg | TM30/PM15 |
| | | | | | | | | | | | | | |
| PAH MS | | | | | | | | | | | | | |
| Naphthalene # | <0.04 | <0.04 | 0.22 | <0.04 | 0.22 | <0.04 | 0.06 | <0.04 | <0.04 | 0.15 | <0.04 | mg/kg | TM4/PM8 |
| Acenaphthylene | <0.03 | <0.03 | 0.51 | <0.03 | 0.22 | <0.03 | <0.03 | <0.03 | <0.03 | 0.07 | <0.03 | mg/kg | TM4/PM8 |
| Acenaphthene # | <0.05 | <0.05 | 0.10 | <0.05 | <0.05 | <0.05 | 0.07 | <0.05 | <0.05 | <0.05 | <0.05 | mg/kg | TM4/PM8 |
| Fluorene # | <0.04 | <0.04 | 0.19 | <0.04 | 0.08 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | mg/kg | TM4/PM8 |
| Phenanthrene # | 0.10 | <0.03 | 2.51 | <0.03 | 1.11 | <0.03 | 0.21 | <0.03 | <0.03 | 0.55 | <0.03 | mg/kg | TM4/PM8 |
| Anthracene # | <0.04 | <0.04 | 0.94 | <0.04 | 0.40 | <0.04 | 0.06 | <0.04 | <0.04 | 0.16 | <0.04 | mg/kg | TM4/PM8 |
| Fluoranthene # | 0.31 | <0.03 | 9.44 | <0.03 | 3.51 | <0.03 | 0.43 | 0.15 | <0.03 | 1.10 | <0.03 | mg/kg | TM4/PM8 |
| Pyrene # | 0.28 | <0.03 | 7.84 | <0.03 | 2.89 | <0.03 | 0.36 | 0.14 | <0.03 | 0.89 | <0.03 | mg/kg | TM4/PM8 |
| Benzo(a)anthracene # | 0.21 | <0.06 | 5.86 | <0.06 | 2.40 | <0.06 | 0.21 | 0.11 | <0.06 | 0.66 | <0.06 | mg/kg | TM4/PM8 |
| Chrysene # | 0.21 | <0.02 | 6.00 | <0.02 | 2.22 | <0.02 | 0.24 | 0.14 | <0.02 | 0.64 | <0.02 | mg/kg | TM4/PM8 |
| Benzo(bk)fluoranthene # | 0.45 | <0.07 | 13.27 | <0.07 | 4.73 | <0.07 | 0.43 | 0.25 | <0.07 | 1.28 | <0.07 | mg/kg | TM4/PM8 |
| Benzo(a)pyrene # | 0.23 | <0.04 | 6.68 | <0.04 | 2.47 | <0.04 | 0.23 | 0.12 | <0.04 | 0.61 | <0.04 | mg/kg | TM4/PM8 |
| Indeno(123cd)pyrene # | 0.17 | <0.04 | 4.98 | <0.04 | 1.87 | <0.04 | 0.17 | 0.08 | <0.04 | 0.46 | <0.04 | mg/kg | TM4/PM8 |
| Dibenzo(ah)anthracene # | <0.04 | <0.04 | 1.00 | <0.04 | 0.51 | <0.04 | <0.04 | <0.04 | <0.04 | 0.09 | <0.04 | mg/kg | TM4/PM8 |
| Benzo(ghi)perylene # | 0.16 | <0.04 | 4.72 | <0.04 | 1.73 | <0.04 | 0.16 | 0.09 | <0.04 | 0.42 | <0.04 | mg/kg | TM4/PM8 |
| PAH 16 Total | 2.1 | <0.6 | 64.3 | <0.6 | 24.4 | <0.6 | 2.6 | 1.1 | <0.6 | 7.1 | <0.6 | mg/kg | TM4/PM8 |
| Benzo(b)fluoranthene | 0.32 | <0.05 | 9.55 | <0.05 | 3.41 | <0.05 | 0.31 | 0.18 | <0.05 | 0.92 | <0.05 | mg/kg | TM4/PM8 |
| Benzo(k)fluoranthene | 0.13 | <0.02 | 3.72 | <0.02 | 1.32 | <0.02 | 0.12 | 0.07 | <0.02 | 0.36 | <0.02 | mg/kg | TM4/PM8 |
| PAH Surrogate % Recovery | 102 | 95 | 93 | 93 | 95 | 94 | 97 | 93 | 92 | 92 | <0 | % | TM4/PM8 |

Please see attached notes for all abbreviations and acronyms



Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

## Element Materials Technology

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin
**EMT Job No:** 21/9394

**Report : Solid**

**Solids:** V=60g VOC jar, J=250g glass jar, T=plastic tub

| EMT Sample No. | 1-2 | 3-4 | 5-6 | 7-8 | 9-10 | 11-12 | 13-14 | 15-16 | 17-18 | 19-20 | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | WS15 | WS16 | WS17 | WS19 | WS20 | WS21 | WS22 | WS15 | WS16 | WS17 | | | |
| Depth | 0.30 | 0.50 | 0.20 | 0.30 | 0.10 | 0.30 | 0.80 | 1.80 | 1.30 | 1.60 | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V J | V J | V J | V J | V J | V J | V J | V J | V J | V J | | | |
| Sample Date | 15/06/2021 | 15/06/2021 | 15/06/2021 | 15/06/2021 | 15/06/2021 | 16/06/2021 | 16/06/2021 | 15/06/2021 | 15/06/2021 | 15/06/2021 | | | |
| Sample Type | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil | | | |
| Batch Number | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| Date of Receipt | 21/06/2021 | 21/06/2021 | 21/06/2021 | 21/06/2021 | 21/06/2021 | 21/06/2021 | 21/06/2021 | 21/06/2021 | 21/06/2021 | 21/06/2021 | | | |
| TPH CWG | | | | | | | | | | | | | |
| **Aliphatics** | | | | | | | | | | | | | |
| >C5-C6 # | <0.1 SV | <0.1 | <0.1 SV | <0.1 | <0.1 SV | <0.1 | <0.1 | <0.1 | <0.1 SV | <0.1 SV | <0.1 | mg/kg | TM36/PM12 |
| >C6-C8 # | <0.1 SV | <0.1 | <0.1 SV | <0.1 | <0.1 SV | <0.1 | <0.1 | <0.1 | <0.1 SV | <0.1 SV | <0.1 | mg/kg | TM36/PM12 |
| >C8-C10 | <0.1 SV | <0.1 | <0.1 SV | <0.1 | <0.1 SV | <0.1 | <0.1 | <0.1 | <0.1 SV | <0.1 SV | <0.1 | mg/kg | TM36/PM12 |
| >C10-C12 # | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | mg/kg | TM5/PM8/PM16 |
| >C12-C16 # | <4 | <4 | <4 | <4 | <4 | <4 | <4 | <4 | <4 | <4 | <4 | mg/kg | TM5/PM8/PM16 |
| >C16-C21 # | <7 | <7 | 12 | <7 | 14 | <7 | 9 | 31 | <7 | 22 | <7 | mg/kg | TM5/PM8/PM16 |
| >C21-C35 # | <7 | <7 | 74 | 28 | 97 | <7 | 25 | 103 | 41 | 149 | <7 | mg/kg | TM5/PM8/PM16 |
| Total aliphatics C5-35 | <19 | <19 | 86 | 28 | 111 | <19 | 34 | 134 | 41 | 171 | <19 | mg/kg | TM5/TM36/PM8/PM12/PM16 |
| **Aromatics** | | | | | | | | | | | | | |
| >C5-EC7 # | <0.1 SV | <0.1 | <0.1 SV | <0.1 | <0.1 SV | <0.1 | <0.1 | <0.1 | <0.1 SV | <0.1 SV | <0.1 | mg/kg | TM36/PM12 |
| >EC7-EC8 # | <0.1 SV | <0.1 | <0.1 SV | <0.1 | <0.1 SV | <0.1 | <0.1 | <0.1 | <0.1 SV | <0.1 SV | <0.1 | mg/kg | TM36/PM12 |
| >EC8-EC10 # | <0.1 SV | <0.1 | <0.1 SV | <0.1 | <0.1 SV | <0.1 | <0.1 | <0.1 | <0.1 SV | <0.1 SV | <0.1 | mg/kg | TM36/PM12 |
| >EC10-EC12 # | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | mg/kg | TM5/PM8/PM16 |
| >EC12-EC16 # | <4 | <4 | 10 | <4 | <4 | <4 | <4 | <4 | <4 | <4 | <4 | mg/kg | TM5/PM8/PM16 |
| >EC16-EC21 # | <7 | <7 | 104 | <7 | 38 | <7 | 9 | 85 | <7 | 19 | <7 | mg/kg | TM5/PM8/PM16 |
| >EC21-EC35 # | <7 | <7 | 448 | 142 | 299 | <7 | 42 | 324 | 125 | 137 | <7 | mg/kg | TM5/PM8/PM16 |
| Total aromatics C5-35 # | <19 | <19 | 562 | 142 | 337 | <19 | 51 | 409 | 125 | 156 | <19 | mg/kg | TM5/TM36/PM8/PM12/PM16 |
| Total aliphatics and aromatics(C5-35) | <38 | <38 | 648 | 170 | 448 | <38 | 85 | 543 | 166 | 327 | <38 | mg/kg | TM5/TM36/PM8/PM12/PM16 |
| MTBE # | <5 SV | <5 | <5 SV | <5 | <5 SV | <5 | <5 | <5 | <5 SV | <5 SV | <5 | ug/kg | TM36/PM12 |
| Benzene # | <5 SV | <5 | <5 SV | <5 | <5 SV | <5 | <5 | <5 | <5 SV | <5 SV | <5 | ug/kg | TM36/PM12 |
| Toluene # | <5 SV | <5 | <5 SV | <5 | <5 SV | <5 | <5 | <5 | <5 SV | <5 SV | <5 | ug/kg | TM36/PM12 |
| Ethylbenzene # | <5 SV | <5 | <5 SV | <5 | <5 SV | <5 | <5 | <5 | <5 SV | <5 SV | <5 | ug/kg | TM36/PM12 |
| m/p-Xylene # | <5 SV | <5 | <5 SV | <5 | <5 SV | <5 | <5 | <5 | <5 SV | <5 SV | <5 | ug/kg | TM36/PM12 |
| o-Xylene # | <5 SV | <5 | <5 SV | <5 | <5 SV | <5 | <5 | <5 | <5 SV | <5 SV | <5 | ug/kg | TM36/PM12 |
| Natural Moisture Content | 42.1 | 18.3 | 38.8 | 49.5 | 37.2 | 8.1 | 12.5 | 53.7 | 86.6 | 48.9 | <0.1 | % | PM4/PM0 |
| Hexavalent Chromium # | <3.0 AC | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <3.0 AC | <0.3 | <0.3 | mg/kg | TM38/PM20 |
| Sulphate as SO4 (2:1 Ext) # | 0.0656 | 0.0096 | 0.0227 | 0.0233 | 0.1181 | 0.0105 | 0.0210 | 0.0994 | 1.6729 | 0.0485 | <0.0015 | g/l | TM38/PM20 |
| Chromium III | 62.0 | 43.5 | 50.6 | 59.0 | 45.2 | 48.7 | 35.7 | 71.4 | 53.6 | 44.7 | <0.5 | mg/kg | NONE/NONE |
| Free Cyanide | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | mg/kg | TM89/PM45 |
| Total Cyanide # | 3.1 AA | <0.5 | 38.0 AB | <0.5 | 0.8 | <0.5 | <0.5 | 1.2 | <0.5 | 5.4 AB | <0.5 | mg/kg | TM89/PM45 |
| Total Organic Carbon # | 26.41 | - | 18.84 | - | - | 0.40 | 2.22 | - | 7.72 | - | <0.02 | % | TM21/PM24 |
| pH # | 7.13 | 6.17 | 6.71 | 4.85 | 6.88 | 8.58 | 8.32 | 7.67 | 4.94 | 7.18 | <0.01 | pH units | TM73/PM11 |

Please see attached notes for all abbreviations and acronyms



Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin
**EMT Job No:** 21/9394

**Report : Solid**

**Solids:** V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

| EMT Sample No. | 21-22 | 23-24 | 25-26 | 27-28 | 29-30 | | | | | | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | WS20 | WS20 | WS21 | WS22 | WS19 | | | | | | | | |
| Depth | 1.70 | 3.80 | 2.10 | 2.80 | 1.30 | | | | | | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V J | V J | V J | V J | V J | | | | | | | | |
| Sample Date | 15/06/2021 | 15/06/2021 | 16/06/2021 | 16/06/2021 | <> | | | | | | | | |
| Sample Type | Soil | Soil | Soil | Soil | Soil | | | | | | | | |
| Batch Number | 1 | 1 | 1 | 1 | 1 | | | | | | | | |
| Date of Receipt | 21/06/2021 | 21/06/2021 | 21/06/2021 | 21/06/2021 | 21/06/2021 | | | | | | | | |
| Arsenic # | 50.1 | 19.5 | 3.4 | 12.2 | 9.3 | | | | | | <0.5 | mg/kg | TM30/PM15 |
| Barium # | 568 | 65 | 63 | 67 | 55 | | | | | | <1 | mg/kg | TM30/PM15 |
| Beryllium | 6.0 | 1.3 | 0.6 | 0.5 | 1.1 | | | | | | <0.5 | mg/kg | TM30/PM15 |
| Cadmium # | 0.4 | 0.2 | <0.1 | <0.1 | <0.1 | | | | | | <0.1 | mg/kg | TM30/PM15 |
| Chromium # | 45.9 | 60.0 | 73.8 | 45.4 | 53.9 | | | | | | <0.5 | mg/kg | TM30/PM15 |
| Copper # | 149 | 20 | 27 | 17 | 16 | | | | | | <1 | mg/kg | TM30/PM15 |
| Lead # | 428 | 20 | 9 | 18 | 17 | | | | | | <5 | mg/kg | TM30/PM15 |
| Mercury # | <0.1 | 0.1 | <0.1 | <0.1 | <0.1 | | | | | | <0.1 | mg/kg | TM30/PM15 |
| Nickel # | 67.4 | 49.1 | 47.6 | 16.9 | 30.3 | | | | | | <0.7 | mg/kg | TM30/PM15 |
| Selenium # | 4 | 2 | <1 | <1 | <1 | | | | | | <1 | mg/kg | TM30/PM15 |
| Vanadium | 70 | 62 | 39 | 32 | 53 | | | | | | <1 | mg/kg | TM30/PM15 |
| Water Soluble Boron # | 4.6 | 1.5 | <0.1 | 0.4 | 0.9 | | | | | | <0.1 | mg/kg | TM74/PM32 |
| Zinc # | 328 | 133 | 66 | 60 | 58 | | | | | | <5 | mg/kg | TM30/PM15 |
| | | | | | | | | | | | | | |
| PAH MS | | | | | | | | | | | | | |
| Naphthalene # | 0.42 | <0.04 | <0.04 | <0.04 | <0.04 | | | | | | <0.04 | mg/kg | TM4/PM8 |
| Acenaphthylene | 0.33 | <0.03 | <0.03 | <0.03 | <0.03 | | | | | | <0.03 | mg/kg | TM4/PM8 |
| Acenaphthene # | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | | | | | | <0.05 | mg/kg | TM4/PM8 |
| Fluorene # | 0.23 | <0.04 | <0.04 | <0.04 | <0.04 | | | | | | <0.04 | mg/kg | TM4/PM8 |
| Phenanthrene # | 4.27 | <0.03 | <0.03 | <0.03 | <0.03 | | | | | | <0.03 | mg/kg | TM4/PM8 |
| Anthracene # | 0.27 | <0.04 | <0.04 | <0.04 | <0.04 | | | | | | <0.04 | mg/kg | TM4/PM8 |
| Fluoranthene # | 4.70 | <0.03 | <0.03 | <0.03 | <0.03 | | | | | | <0.03 | mg/kg | TM4/PM8 |
| Pyrene # | 3.72 | <0.03 | <0.03 | <0.03 | <0.03 | | | | | | <0.03 | mg/kg | TM4/PM8 |
| Benzo(a)anthracene # | 1.28 | <0.06 | <0.06 | <0.06 | <0.06 | | | | | | <0.06 | mg/kg | TM4/PM8 |
| Chrysene # | 1.81 | <0.02 | <0.02 | <0.02 | <0.02 | | | | | | <0.02 | mg/kg | TM4/PM8 |
| Benzo(bk)fluoranthene # | 3.26 | <0.07 | <0.07 | <0.07 | <0.07 | | | | | | <0.07 | mg/kg | TM4/PM8 |
| Benzo(a)pyrene # | 1.67 | <0.04 | <0.04 | <0.04 | <0.04 | | | | | | <0.04 | mg/kg | TM4/PM8 |
| Indeno(123cd)pyrene # | 1.21 | <0.04 | <0.04 | <0.04 | <0.04 | | | | | | <0.04 | mg/kg | TM4/PM8 |
| Dibenzo(ah)anthracene # | 0.23 | <0.04 | <0.04 | <0.04 | <0.04 | | | | | | <0.04 | mg/kg | TM4/PM8 |
| Benzo(ghi)perylene # | 1.11 | <0.04 | <0.04 | <0.04 | <0.04 | | | | | | <0.04 | mg/kg | TM4/PM8 |
| PAH 16 Total | 24.5 | <0.6 | <0.6 | <0.6 | <0.6 | | | | | | <0.6 | mg/kg | TM4/PM8 |
| Benzo(b)fluoranthene | 2.35 | <0.05 | <0.05 | <0.05 | <0.05 | | | | | | <0.05 | mg/kg | TM4/PM8 |
| Benzo(k)fluoranthene | 0.91 | <0.02 | <0.02 | <0.02 | <0.02 | | | | | | <0.02 | mg/kg | TM4/PM8 |
| PAH Surrogate % Recovery | 91 | 95 | 97 | 96 | 95 | | | | | | <0 | % | TM4/PM8 |



Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

## Element Materials Technology

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin
**EMT Job No:** 21/9394

**Report : Solid**

**Solids:** V=60g VOC jar, J=250g glass jar, T=plastic tub

| EMT Sample No. | 21-22 | 23-24 | 25-26 | 27-28 | 29-30 | | | | | | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | WS20 | WS20 | WS21 | WS22 | WS19 | | | | | | | | |
| Depth | 1.70 | 3.80 | 2.10 | 2.80 | 1.30 | | | | | | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V J | V J | V J | V J | V J | | | | | | | | |
| Sample Date | 15/06/2021 | 15/06/2021 | 16/06/2021 | 16/06/2021 | <> | | | | | | | | |
| Sample Type | Soil | Soil | Soil | Soil | Soil | | | | | | | | |
| Batch Number | 1 | 1 | 1 | 1 | 1 | | | | | | | | |
| Date of Receipt | 21/06/2021 | 21/06/2021 | 21/06/2021 | 21/06/2021 | 21/06/2021 | | | | | | | | |
| TPH CWG | | | | | | | | | | | | | |
| **Aliphatics** | | | | | | | | | | | | | |
| >C5-C6 # | <0.1 SV | <0.1 SV | <0.1 | <0.1 | <0.1 SV | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >C6-C8 # | <0.1 SV | <0.1 SV | <0.1 | <0.1 | <0.1 SV | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >C8-C10 | <0.1 SV | <0.1 SV | <0.1 | <0.1 | <0.1 SV | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >C10-C12 # | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | | | | | | <0.2 | mg/kg | TM5/PM8/PM16 |
| >C12-C16 # | <4 | <4 | <4 | <4 | <4 | | | | | | <4 | mg/kg | TM5/PM8/PM16 |
| >C16-C21 # | 23 | <7 | <7 | <7 | <7 | | | | | | <7 | mg/kg | TM5/PM8/PM16 |
| >C21-C35 # | 130 | 20 | <7 | <7 | 35 | | | | | | <7 | mg/kg | TM5/PM8/PM16 |
| Total aliphatics C5-35 | 153 | 20 | <19 | <19 | 35 | | | | | | <19 | mg/kg | TM5/TM36/PM8/PM12/PM16 |
| **Aromatics** | | | | | | | | | | | | | |
| >C5-EC7 # | <0.1 SV | <0.1 SV | <0.1 | <0.1 | <0.1 SV | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >EC7-EC8 # | <0.1 SV | <0.1 SV | <0.1 | <0.1 | <0.1 SV | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >EC8-EC10 # | <0.1 SV | <0.1 SV | <0.1 | <0.1 | <0.1 SV | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >EC10-EC12 # | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | | | | | | <0.2 | mg/kg | TM5/PM8/PM16 |
| >EC12-EC16 # | <4 | <4 | <4 | <4 | <4 | | | | | | <4 | mg/kg | TM5/PM8/PM16 |
| >EC16-EC21 # | 38 | <7 | <7 | <7 | <7 | | | | | | <7 | mg/kg | TM5/PM8/PM16 |
| >EC21-EC35 # | 254 | 27 | <7 | <7 | 111 | | | | | | <7 | mg/kg | TM5/PM8/PM16 |
| Total aromatics C5-35 # | 292 | 27 | <19 | <19 | 111 | | | | | | <19 | mg/kg | TM5/TM36/PM8/PM12/PM16 |
| Total aliphatics and aromatics(C5-35) | 445 | 47 | <38 | <38 | 146 | | | | | | <38 | mg/kg | TM5/TM36/PM8/PM12/PM16 |
| MTBE # | <5 SV | <5 SV | <5 | <5 | <5 SV | | | | | | <5 | ug/kg | TM36/PM12 |
| Benzene # | <5 SV | <5 SV | <5 | <5 | <5 SV | | | | | | <5 | ug/kg | TM36/PM12 |
| Toluene # | <5 SV | <5 SV | <5 | <5 | <5 SV | | | | | | <5 | ug/kg | TM36/PM12 |
| Ethylbenzene # | <5 SV | <5 SV | <5 | <5 | <5 SV | | | | | | <5 | ug/kg | TM36/PM12 |
| m/p-Xylene # | <5 SV | <5 SV | <5 | <5 | <5 SV | | | | | | <5 | ug/kg | TM36/PM12 |
| o-Xylene # | <5 SV | <5 SV | <5 | <5 | <5 SV | | | | | | <5 | ug/kg | TM36/PM12 |
| Natural Moisture Content | 35.9 | 82.2 | 5.7 | 23.5 | 153.3 | | | | | | <0.1 | % | PM4/PM0 |
| Hexavalent Chromium # | <0.3 | <0.3 | <0.3 | <0.3 | <3.0 AC | | | | | | <0.3 | mg/kg | TM38/PM20 |
| Sulphate as SO4 (2:1 Ext) # | 1.3372 | 0.1301 | 0.0101 | 0.0156 | 0.1443 | | | | | | <0.0015 | g/l | TM38/PM20 |
| Chromium III | 45.9 | 60.0 | 73.8 | 45.4 | 53.9 | | | | | | <0.5 | mg/kg | NONE/NONE |
| Free Cyanide | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | | | | | | <0.5 | mg/kg | TM89/PM45 |
| Total Cyanide # | 4.6 | <0.5 | <0.5 | <0.5 | <0.5 | | | | | | <0.5 | mg/kg | TM89/PM45 |
| Total Organic Carbon # | - | 4.81 | 0.10 | 0.37 | - | | | | | | <0.02 | % | TM21/PM24 |
| pH # | 7.08 | 6.89 | 8.02 | 7.70 | 6.37 | | | | | | <0.01 | pH units | TM73/PM11 |

Please see attached notes for all abbreviations and acronyms



Please include all sections of this report if it is reproduced

All solid results are expressed on a dry weight basis unless stated otherwise.

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin

**Note:**

Asbestos Screen analysis is carried out in accordance with our documented in-house methods PM042 and TM065 and HSG 248 by Stereo and Polarised Light Microscopy using Dispersion Staining Techniques and is covered by our UKAS accreditation. Detailed Gravimetric Quantification and PCOM Fibre Analysis is carried out in accordance with our documented in-house methods PM042 and TM131 and HSG 248 using Stereo and Polarised Light Microscopy and Phase Contrast Optical Microscopy (PCOM). Samples are retained for not less than 6 months from the date of analysis unless specifically requested.

Opinions, including ACM type and Asbestos level less than 0.1%, lie outside the scope of our UKAS accreditation.

Where the sample is not taken by a Element Materials Technology consultant, Element Materials Technology cannot be responsible for inaccurate or unrepresentative sampling.

| EMT Job No. | Batch | Sample ID | Depth | EMT Sample No. | Date Of Analysis | Analysis | Result |
|---|---|---|---|---|---|---|---|
| 21/9394 | 1 | WS15 | 0.30 | 2 | 23/06/2021 | **General Description (Bulk Analysis)** | soil/stones |
| | | | | | 23/06/2021 | **Asbestos Fibres** | NAD |
| | | | | | 23/06/2021 | **Asbestos ACM** | NAD |
| | | | | | 23/06/2021 | **Asbestos Type** | NAD |
| | | | | | 23/06/2021 | **Asbestos Level Screen** | NAD |
| 21/9394 | 1 | WS16 | 0.50 | 4 | 23/06/2021 | **General Description (Bulk Analysis)** | Soil/Stones |
| | | | | | 23/06/2021 | **Asbestos Fibres** | NAD |
| | | | | | 23/06/2021 | **Asbestos ACM** | NAD |
| | | | | | 23/06/2021 | **Asbestos Type** | NAD |
| | | | | | 23/06/2021 | **Asbestos Level Screen** | NAD |
| 21/9394 | 1 | WS17 | 0.20 | 6 | 23/06/2021 | **General Description (Bulk Analysis)** | soil/stones |
| | | | | | 23/06/2021 | **Asbestos Fibres** | NAD |
| | | | | | 23/06/2021 | **Asbestos ACM** | NAD |
| | | | | | 23/06/2021 | **Asbestos Type** | NAD |
| | | | | | 23/06/2021 | **Asbestos Level Screen** | NAD |
| 21/9394 | 1 | WS19 | 0.30 | 8 | 23/06/2021 | **General Description (Bulk Analysis)** | soil/stones |
| | | | | | 23/06/2021 | **Asbestos Fibres** | NAD |
| | | | | | 23/06/2021 | **Asbestos ACM** | NAD |
| | | | | | 23/06/2021 | **Asbestos Type** | NAD |
| | | | | | 23/06/2021 | **Asbestos Level Screen** | NAD |
| 21/9394 | 1 | WS20 | 0.10 | 10 | 23/06/2021 | **General Description (Bulk Analysis)** | soil/stones |
| | | | | | 23/06/2021 | **Asbestos Fibres** | NAD |
| | | | | | 23/06/2021 | **Asbestos ACM** | NAD |
| | | | | | 23/06/2021 | **Asbestos Type** | NAD |
| | | | | | 23/06/2021 | **Asbestos Level Screen** | NAD |
| 21/9394 | 1 | WS21 | 0.30 | 12 | 23/06/2021 | **General Description (Bulk Analysis)** | soil/stones |
| | | | | | 23/06/2021 | **Asbestos Fibres** | NAD |
| | | | | | 23/06/2021 | **Asbestos ACM** | NAD |
| | | | | | 23/06/2021 | **Asbestos Type** | NAD |
| | | | | | 23/06/2021 | **Asbestos Level Screen** | NAD |
| 21/9394 | 1 | WS22 | 0.80 | 14 | 23/06/2021 | **General Description (Bulk Analysis)** | soil/stones |
| | | | | | 23/06/2021 | **Asbestos Fibres** | NAD |
| | | | | | 23/06/2021 | **Asbestos ACM** | NAD |

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin

| EMT Job No. | Batch | Sample ID | Depth | EMT Sample No. | Date Of Analysis | Analysis | Result |
|---|---|---|---|---|---|---|---|
| 21/9394 | 1 | WS22 | 0.80 | 14 | 23/06/2021 | **Asbestos Type** | NAD |
| | | | | | 23/06/2021 | **Asbestos Level Screen** | NAD |
| 21/9394 | 1 | WS16 | 1.30 | 18 | 23/06/2021 | **General Description (Bulk Analysis)** | soil |
| | | | | | 23/06/2021 | **Asbestos Fibres** | NAD |
| | | | | | 23/06/2021 | **Asbestos ACM** | NAD |
| | | | | | 23/06/2021 | **Asbestos Type** | NAD |
| | | | | | 23/06/2021 | **Asbestos Level Screen** | NAD |
| 21/9394 | 1 | WS17 | 1.60 | 20 | 23/06/2021 | **General Description (Bulk Analysis)** | soil |
| | | | | | 23/06/2021 | **Asbestos Fibres** | NAD |
| | | | | | 23/06/2021 | **Asbestos ACM** | NAD |
| | | | | | 23/06/2021 | **Asbestos Type** | NAD |
| | | | | | 23/06/2021 | **Asbestos Level Screen** | NAD |
| 21/9394 | 1 | WS21 | 2.10 | 26 | 23/06/2021 | **General Description (Bulk Analysis)** | soil |
| | | | | | 23/06/2021 | **Asbestos Fibres** | NAD |
| | | | | | 23/06/2021 | **Asbestos ACM** | NAD |
| | | | | | 23/06/2021 | **Asbestos Type** | NAD |
| | | | | | 23/06/2021 | **Asbestos Level Screen** | NAD |

**Client Name:** MCL Consulting

**Reference:** P2288

**Location:** Riverine

**Contact:** Thomas Martin

**Matrix : Solid**

| EMT Job No. | Batch | Sample ID | Depth | EMT Sample No. | Analysis | Reason |
|---|---|---|---|---|---|---|
| 21/9394 | 1 | WS19 | 1.30 | 29-30 | All analyses | No sampling date given |

**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.:*** 21/9394

**SOILS**

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

**WATERS**

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

**DEVIATING SAMPLES**

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

**SURROGATES**

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

**DILUTIONS**

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

**BLANKS**

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

**NOTE**

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

**REPORTS FROM THE SOUTH AFRICA LABORATORY**

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

**Measurement Uncertainty**

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

**ABBREVIATIONS and ACRONYMS USED**

| | |
|---|---|
| # | ISO17025 (UKAS Ref No. 4225) accredited - UK. |
| SA | ISO17025 (SANAS Ref No.T0729) accredited - South Africa |
| B | Indicates analyte found in associated method blank. |
| DR | Dilution required. |
| M | MCERTS accredited. |
| NA | Not applicable |
| NAD | No Asbestos Detected. |
| ND | None Detected (usually refers to VOC and/SVOC TICs). |
| NDP | No Determination Possible |
| SS | Calibrated against a single substance |
| SV | Surrogate recovery outside performance criteria. This may be due to a matrix effect. |
| W | Results expressed on as received basis. |
| + | AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page. |
| >> | Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher, this result is not accredited. |
| * | Analysis subcontracted to an Element Materials Technology approved laboratory. |
| AD | Samples are dried at 35°C ±5°C |
| CO | Suspected carry over |
| LOD/LOR | Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS |
| ME | Matrix Effect |
| NFD | No Fibres Detected |
| BS | AQC Sample |
| LB | Blank Sample |
| N | Client Sample |
| TB | Trip Blank Sample |
| OC | Outside Calibration Range |
| AA | x3 Dilution |

| | |
|---|---|
| AB | x5 Dilution |
| AC | x10 Dilution |
| AD | x20 Dilution |

**EMT Job No:** 21/9394

| Test Method No. | Description | Prep Method No. (if appropriate) | Description | ISO 17025 (UKAS/SANAS) | MCERTS (UK soils only) | Analysis done on As Received (AR) or Dried (AD) | Reported on dry weight basis |
|---|---|---|---|---|---|---|---|
| PM4 | Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465:1993(E) and BS1377-2:1990. | PM0 | No preparation is required. | | | AR | |
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM8 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required. | | | AR | Yes |
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM8 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required. | Yes | | AR | Yes |
| TM5 | Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present. | PM8/PM16 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required/Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE. | Yes | | AR | Yes |
| TM5/TM36 | please refer to TM5 and TM36 for method details | PM8/PM12/PM16 | please refer to PM8/PM16 and PM12 for method details | | | AR | Yes |
| TM5/TM36 | please refer to TM5 and TM36 for method details | PM8/PM12/PM16 | please refer to PM8/PM16 and PM12 for method details | Yes | | AR | Yes |
| TM21 | Modified BS 7755-3:1995, ISO10694:1995 Determination of Total Organic Carbon or Total Carbon by combustion in an Eltra TOC furnace/analyser in the presence of oxygen. The CO2 generated is quantified using infra-red detection. Organic Matter (SOM) calculated as per EA MCERTS Chemical Testing of Soil, March 2012 v4. | PM24 | Dried and ground solid samples are washed with hydrochloric acid, then rinsed with deionised water to remove the mineral carbon before TOC analysis. | Yes | | AD | Yes |
| 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 | PM15 | Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground. | | | AD | Yes |
| TM30 | Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996 | PM15 | Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground. | Yes | | AD | Yes |
| TM36 | Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested. | PM12 | Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis. | | | AR | Yes |

**EMT Job No:** 21/9394

| 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 |
|---|---|---|---|---|---|---|---|
| TM36 | Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested. | PM12 | Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis. | Yes | | AR | Yes |
| TM38 | Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l | PM20 | Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker. | Yes | | AD | 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 | PM20 | Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker. | Yes | | AR | Yes |
| TM65 | Asbestos Bulk Identification method based on HSG 248 First edition (2006) | PM42 | Modified SCA Blue Book V.12 draft 2017 and WM3 1st Edition v1.1:2018. Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065. | Yes | | AR | |
| TM73 | Modified US EPA methods 150.1 (1982) and 9045D Rev. 4 - 2004) and BS1377-3:1990. Determination of pH by Metrohm automated probe analyser. | PM11 | Extraction of as received solid samples using one part solid to 2.5 parts deionised water. | Yes | | AR | No |
| TM74 | Analysis of water soluble boron (20:1 extract) by ICP-OES. | PM32 | Hot water soluble boron is extracted from dried and ground samples using a 20:1 ratio. | Yes | | AD | Yes |
| TM89 | Modified USEPA method OIA-1667 (1999). Determination of cyanide by Flow Injection Analyser. Where WAD cyanides are required a Ligand displacement step is carried out before analysis. | PM45 | As received solid samples are extracted with 1M NaOH by orbital shaker for Cyanide, Sulphide and Thiocyanate analysis. | | | AR | Yes |
| TM89 | Modified USEPA method OIA-1667 (1999). Determination of cyanide by Flow Injection Analyser. Where WAD cyanides are required a Ligand displacement step is carried out before analysis. | PM45 | As received solid samples are extracted with 1M NaOH by orbital shaker for Cyanide, Sulphide and Thiocyanate analysis. | Yes | | AR | Yes |
| NONE | No Method Code | NONE | No Method Code | | | AD | Yes |
| | | | | | | | |

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Duncrue Street
Belfast
Northern Ireland
BT3 9LA

| | |
|---|---|
| **Attention :** | Thomas Martin |
| **Date :** | 19th July, 2021 |
| **Your reference :** | P2288 |
| **Our reference :** | Test Report 21/10549 Batch 1 |
| **Location :** | Riverine |
| **Date samples received :** | 12th July, 2021 |
| **Status :** | Final report |
| **Issue :** | 1 |

Four samples were received for analysis on 12th July, 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:**

**Phil Sommerton BSc**
**Senior Project Manager**

Please include all sections of this report if it is reproduced

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin

**Note:**

Asbestos Screen analysis is carried out in accordance with our documented in-house methods PM042 and TM065 and HSG 248 by Stereo and Polarised Light Microscopy using Dispersion Staining Techniques and is covered by our UKAS accreditation. Detailed Gravimetric Quantification and PCOM Fibre Analysis is carried out in accordance with our documented in-house methods PM042 and TM131 and HSG 248 using Stereo and Polarised Light Microscopy and Phase Contrast Optical Microscopy (PCOM). Samples are retained for not less than 6 months from the date of analysis unless specifically requested.

Opinions, including ACM type and Asbestos level less than 0.1%, lie outside the scope of our UKAS accreditation.

Where the sample is not taken by a Element Materials Technology consultant, Element Materials Technology cannot be responsible for inaccurate or unrepresentative sampling.

| EMT Job No. | Batch | Sample ID | Depth | EMT Sample No. | Date Of Analysis | Analysis | Result |
|---|---|---|---|---|---|---|---|
| 21/10549 | 1 | WS12 A | 0.20 | 2 | 14/07/2021 | **General Description (Bulk Analysis)** | soil/stone |
| | | | | | 14/07/2021 | **Asbestos Fibres** | NAD |
| | | | | | 14/07/2021 | **Asbestos ACM** | NAD |
| | | | | | 14/07/2021 | **Asbestos Type** | NAD |
| | | | | | 14/07/2021 | **Asbestos Level Screen** | NAD |
| 21/10549 | 1 | WS12 B | 0.40 | 4 | 14/07/2021 | **General Description (Bulk Analysis)** | soil/stone |
| | | | | | 14/07/2021 | **Asbestos Fibres** | NAD |
| | | | | | 14/07/2021 | **Asbestos ACM** | NAD |
| | | | | | 14/07/2021 | **Asbestos Type** | NAD |
| | | | | | 14/07/2021 | **Asbestos Level Screen** | NAD |
| 21/10549 | 1 | WS12 C | 0.30 | 6 | 14/07/2021 | **General Description (Bulk Analysis)** | soil/stone |
| | | | | | 14/07/2021 | **Asbestos Fibres** | NAD |
| | | | | | 14/07/2021 | **Asbestos ACM** | NAD |
| | | | | | 14/07/2021 | **Asbestos Type** | NAD |
| | | | | | 14/07/2021 | **Asbestos Level Screen** | NAD |
| 21/10549 | 1 | WS12 D | 0.50 | 8 | 14/07/2021 | **General Description (Bulk Analysis)** | soil/stone |
| | | | | | 14/07/2021 | **Asbestos Fibres** | Free Fibres |
| | | | | | 14/07/2021 | **Asbestos ACM** | NAD |
| | | | | | 14/07/2021 | **Asbestos Type** | Amosite |
| | | | | | 14/07/2021 | **Asbestos Level Screen** | less than 0.1% |

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin

| EMT Job No. | Batch | Sample ID | Depth | EMT Sample No. | Analysis | Reason |
|---|---|---|---|---|---|---|
| No deviating sample report results for job 21/10549 | | | | | | |

**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.:*** 21/10549

**SOILS**

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

**WATERS**

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

**DEVIATING SAMPLES**

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

**SURROGATES**

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

**DILUTIONS**

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

**BLANKS**

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

**NOTE**

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

**REPORTS FROM THE SOUTH AFRICA LABORATORY**

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

**Measurement Uncertainty**

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

**ABBREVIATIONS and ACRONYMS USED**

| | |
|---|---|
| # | ISO17025 (UKAS Ref No. 4225) accredited - UK. |
| SA | ISO17025 (SANAS Ref No.T0729) accredited - South Africa |
| B | Indicates analyte found in associated method blank. |
| DR | Dilution required. |
| M | MCERTS accredited. |
| NA | Not applicable |
| NAD | No Asbestos Detected. |
| ND | None Detected (usually refers to VOC and/SVOC TICs). |
| NDP | No Determination Possible |
| SS | Calibrated against a single substance |
| SV | Surrogate recovery outside performance criteria. This may be due to a matrix effect. |
| W | Results expressed on as received basis. |
| + | AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page. |
| >> | Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher, this result is not accredited. |
| * | Analysis subcontracted to an Element Materials Technology approved laboratory. |
| AD | Samples are dried at 35°C ±5°C |
| CO | Suspected carry over |
| LOD/LOR | Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS |
| ME | Matrix Effect |
| NFD | No Fibres Detected |
| BS | AQC Sample |
| LB | Blank Sample |
| N | Client Sample |
| TB | Trip Blank Sample |
| OC | Outside Calibration Range |

**EMT Job No:** 21/10549

| Test Method No. | Description | Prep Method No. (if appropriate) | Description | ISO 17025 (UKAS/SANAS) | MCERTS (UK soils only) | Analysis done on As Received (AR) or Dried (AD) | Reported on dry weight basis |
|---|---|---|---|---|---|---|---|
| TM65 | Asbestos Bulk Identification method based on HSG 248 First edition (2006) | PM42 | Modified SCA Blue Book V.12 draft 2017 and WM3 1st Edition v1.1:2018. Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065. | Yes | | AR | |
| TM131 | Quantification of Asbestos Fibres and ACM based on HSG248 First edition:2006, HSG 264 Second edition:2012, HSE Contract Research Report No.83/1996, MDHS 87:1998, WM3 1st Edition v1.1:2018 | PM42 | Modified SCA Blue Book V.12 draft 2017 and WM3 1st Edition v1.1:2018. Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065. | Yes | | AR | Yes |
| | | | | | | | |
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| | |
|---|---|
| **Attention :** | Thomas Martin |
| **Date :** | 30th July, 2021 |
| **Your reference :** | P2288 |
| **Our reference :** | Test Report 21/10549 Batch 1 |
| **Location :** | Riverine |
| **Date samples received :** | 12th July, 2021 |
| **Status :** | Final report |
| **Issue :** | 1 |

Four samples were received for analysis on 12th July, 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**

Please include all sections of this report if it is reproduced

Element Materials Technology Environmental UK Limited
Registered in England and Wales
Registered Office: 10 Lower Grosvenor Place, London, SW1W 0EN
Company Registration No: 11371415

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin

**Note:**

Asbestos Screen analysis is carried out in accordance with our documented in-house methods PM042 and TM065 and HSG 248 by Stereo and Polarised Light Microscopy using Dispersion Staining Techniques and is covered by our UKAS accreditation. Detailed Gravimetric Quantification and PCOM Fibre Analysis is carried out in accordance with our documented in-house methods PM042 and TM131 and HSG 248 using Stereo and Polarised Light Microscopy and Phase Contrast Optical Microscopy (PCOM). Samples are retained for not less than 6 months from the date of analysis unless specifically requested.

Opinions, including ACM type and Asbestos level less than 0.1%, lie outside the scope of our UKAS accreditation.

Where the sample is not taken by a Element Materials Technology consultant, Element Materials Technology cannot be responsible for inaccurate or unrepresentative sampling.

| EMT Job No. | Batch | Sample ID | Depth | EMT Sample No. | Date Of Analysis | Analysis | Result |
|---|---|---|---|---|---|---|---|
| 21/10549 | 1 | WS12 A | 0.20 | 2 | 14/07/2021 | **General Description (Bulk Analysis)** | soil/stone |
| | | | | | 14/07/2021 | **Asbestos Fibres** | NAD |
| | | | | | 14/07/2021 | **Asbestos ACM** | NAD |
| | | | | | 14/07/2021 | **Asbestos Type** | NAD |
| | | | | | 14/07/2021 | **Asbestos Level Screen** | NAD |
| 21/10549 | 1 | WS12 B | 0.40 | 4 | 14/07/2021 | **General Description (Bulk Analysis)** | soil/stone |
| | | | | | 14/07/2021 | **Asbestos Fibres** | NAD |
| | | | | | 14/07/2021 | **Asbestos ACM** | NAD |
| | | | | | 14/07/2021 | **Asbestos Type** | NAD |
| | | | | | 14/07/2021 | **Asbestos Level Screen** | NAD |
| 21/10549 | 1 | WS12 C | 0.30 | 6 | 14/07/2021 | **General Description (Bulk Analysis)** | soil/stone |
| | | | | | 14/07/2021 | **Asbestos Fibres** | NAD |
| | | | | | 14/07/2021 | **Asbestos ACM** | NAD |
| | | | | | 14/07/2021 | **Asbestos Type** | NAD |
| | | | | | 14/07/2021 | **Asbestos Level Screen** | NAD |
| 21/10549 | 1 | WS12 D | 0.50 | 8 | 14/07/2021 | **General Description (Bulk Analysis)** | soil/stone |
| | | | | | 14/07/2021 | **Asbestos Fibres** | Free Fibres |
| | | | | | 14/07/2021 | **Asbestos ACM** | NAD |
| | | | | | 14/07/2021 | **Asbestos Type** | Amosite |
| | | | | | 14/07/2021 | **Asbestos Level Screen** | less than 0.1% |
| | | | | | 27/07/2021 | **Total ACM Gravimetric Quantification (% Asb)** | <0.001 (mass %) |
| | | | | | 27/07/2021 | **Total Detailed Gravimetric Quantification (% Asb)** | <0.001 (mass %) |
| | | | | | 27/07/2021 | **Total Gravimetric Quantification (ACM + Detailed) (% Asb)** | <0.001 (mass %) |
| | | | | | 30/07/2021 | **Asbestos PCOM Quantification (Fibres)** | <0.001 (mass %) |
| | | | | | 30/07/2021 | **Asbestos Gravimetric & PCOM Total** | <0.001 (mass %) |

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin

| EMT Job No. | Batch | Sample ID | Depth | EMT Sample No. | Analysis | Reason |
|---|---|---|---|---|---|---|
| No deviating sample report results for job 21/10549 | | | | | | |

**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.:*** 21/10549

**SOILS**

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

**WATERS**

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

**DEVIATING SAMPLES**

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

**SURROGATES**

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

**DILUTIONS**

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

**BLANKS**

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

**NOTE**

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

**REPORTS FROM THE SOUTH AFRICA LABORATORY**

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

**Measurement Uncertainty**

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

**ABBREVIATIONS and ACRONYMS USED**

| | |
|---|---|
| # | ISO17025 (UKAS Ref No. 4225) accredited - UK. |
| SA | ISO17025 (SANAS Ref No.T0729) accredited - South Africa |
| B | Indicates analyte found in associated method blank. |
| DR | Dilution required. |
| M | MCERTS accredited. |
| NA | Not applicable |
| NAD | No Asbestos Detected. |
| ND | None Detected (usually refers to VOC and/SVOC TICs). |
| NDP | No Determination Possible |
| SS | Calibrated against a single substance |
| SV | Surrogate recovery outside performance criteria. This may be due to a matrix effect. |
| W | Results expressed on as received basis. |
| + | AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page. |
| >> | Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher. |
| * | Analysis subcontracted to an Element Materials Technology approved laboratory. |
| AD | Samples are dried at 35°C ±5°C |
| CO | Suspected carry over |
| LOD/LOR | Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS |
| ME | Matrix Effect |
| NFD | No Fibres Detected |
| BS | AQC Sample |
| LB | Blank Sample |
| N | Client Sample |
| TB | Trip Blank Sample |

| | |
|---|---|
| OC | Outside Calibration Range |

**EMT Job No:** 21/10549

| Test Method No. | Description | Prep Method No. (if appropriate) | Description | ISO 17025 (UKAS/SANAS) | MCERTS (UK soils only) | Analysis done on As Received (AR) or Dried (AD) | Reported on dry weight basis |
|---|---|---|---|---|---|---|---|
| TM65 | Asbestos Bulk Identification method based on HSG 248 First edition (2006) | PM42 | Modified SCA Blue Book V.12 draft 2017 and WM3 1st Edition v1.1:2018. Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065. | Yes | | AR | |
| TM131 | Quantification of Asbestos Fibres and ACM based on HSG248 First edition:2006, HSG 264 Second edition:2012, HSE Contract Research Report No.83/1996, MDHS 87:1998, WM3 1st Edition v1.1:2018 | PM42 | Modified SCA Blue Book V.12 draft 2017 and WM3 1st Edition v1.1:2018. Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065. | Yes | | AR | Yes |
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| | |
|---|---|
| **Attention :** | Thomas Martin |
| **Date :** | 19th July, 2021 |
| **Your reference :** | P2288 |
| **Our reference :** | Test Report 21/10551 Batch 1 |
| **Location :** | Riverine |
| **Date samples received :** | 12th July, 2021 |
| **Status :** | Final report |
| **Issue :** | 1 |

Two samples were received for analysis on 12th July, 2021 of which two were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

**Authorised By:**

**Phil Sommerton BSc**
**Senior Project Manager**

Please include all sections of this report if it is reproduced

## Element Materials Technology

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin
**EMT Job No:** 21/10551

**Report : Solid**

**Solids:** V=60g VOC jar, J=250g glass jar, T=plastic tub

| EMT Sample No. | 1-2 | 3-4 | | | | | | | | | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | WS23 | WS23 | | | | | | | | | | | |
| Depth | 0.30 | 1.20 | | | | | | | | | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V J | V J | | | | | | | | | | | |
| Sample Date | 08/07/2021 | 08/07/2021 | | | | | | | | | | | |
| Sample Type | Soil | Soil | | | | | | | | | | | |
| Batch Number | 1 | 1 | | | | | | | | | | | |
| Date of Receipt | 12/07/2021 | 12/07/2021 | | | | | | | | | | | |
| Arsenic # | 16.2 | 20.5 | | | | | | | | | <0.5 | mg/kg | TM30/PM15 |
| Barium # | 94 | 115 | | | | | | | | | <1 | mg/kg | TM30/PM15 |
| Beryllium | 0.7 | 1.4 | | | | | | | | | <0.5 | mg/kg | TM30/PM15 |
| Cadmium # | <0.1 | <0.1 | | | | | | | | | <0.1 | mg/kg | TM30/PM15 |
| Chromium # | 59.9 | 83.1 | | | | | | | | | <0.5 | mg/kg | TM30/PM15 |
| Copper # | 21 | 22 | | | | | | | | | <1 | mg/kg | TM30/PM15 |
| Lead # | 35 | 20 | | | | | | | | | <5 | mg/kg | TM30/PM15 |
| Mercury # | <0.1 | <0.1 | | | | | | | | | <0.1 | mg/kg | TM30/PM15 |
| Nickel # | 20.6 | 38.3 | | | | | | | | | <0.7 | mg/kg | TM30/PM15 |
| Selenium # | 2 | 1 | | | | | | | | | <1 | mg/kg | TM30/PM15 |
| Vanadium | 47 | 78 | | | | | | | | | <1 | mg/kg | TM30/PM15 |
| Water Soluble Boron # | 0.4 | 0.5 | | | | | | | | | <0.1 | mg/kg | TM74/PM32 |
| Zinc # | 76 | 97 | | | | | | | | | <5 | mg/kg | TM30/PM15 |
| | | | | | | | | | | | | | |
| PAH MS | | | | | | | | | | | | | |
| Naphthalene # | <0.04 | <0.04 | | | | | | | | | <0.04 | mg/kg | TM4/PM8 |
| Acenaphthylene | <0.03 | <0.03 | | | | | | | | | <0.03 | mg/kg | TM4/PM8 |
| Acenaphthene # | <0.05 | <0.05 | | | | | | | | | <0.05 | mg/kg | TM4/PM8 |
| Fluorene # | <0.04 | <0.04 | | | | | | | | | <0.04 | mg/kg | TM4/PM8 |
| Phenanthrene # | <0.03 | <0.03 | | | | | | | | | <0.03 | mg/kg | TM4/PM8 |
| Anthracene # | <0.04 | <0.04 | | | | | | | | | <0.04 | mg/kg | TM4/PM8 |
| Fluoranthene # | 0.09 | <0.03 | | | | | | | | | <0.03 | mg/kg | TM4/PM8 |
| Pyrene # | 0.08 | <0.03 | | | | | | | | | <0.03 | mg/kg | TM4/PM8 |
| Benzo(a)anthracene # | <0.06 | <0.06 | | | | | | | | | <0.06 | mg/kg | TM4/PM8 |
| Chrysene # | 0.05 | <0.02 | | | | | | | | | <0.02 | mg/kg | TM4/PM8 |
| Benzo(bk)fluoranthene # | <0.07 | <0.07 | | | | | | | | | <0.07 | mg/kg | TM4/PM8 |
| Benzo(a)pyrene # | <0.04 | <0.04 | | | | | | | | | <0.04 | mg/kg | TM4/PM8 |
| Indeno(123cd)pyrene # | <0.04 | <0.04 | | | | | | | | | <0.04 | mg/kg | TM4/PM8 |
| Dibenzo(ah)anthracene # | <0.04 | <0.04 | | | | | | | | | <0.04 | mg/kg | TM4/PM8 |
| Benzo(ghi)perylene # | <0.04 | <0.04 | | | | | | | | | <0.04 | mg/kg | TM4/PM8 |
| PAH 16 Total | <0.6 | <0.6 | | | | | | | | | <0.6 | mg/kg | TM4/PM8 |
| Benzo(b)fluoranthene | <0.05 | <0.05 | | | | | | | | | <0.05 | mg/kg | TM4/PM8 |
| Benzo(k)fluoranthene | <0.02 | <0.02 | | | | | | | | | <0.02 | mg/kg | TM4/PM8 |
| PAH Surrogate % Recovery | 99 | 99 | | | | | | | | | <0 | % | TM4/PM8 |

Please see attached notes for all abbreviations and acronyms

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin
**EMT Job No:** 21/10551

**Report : Solid**

**Solids:** V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

| EMT Sample No. | 1-2 | 3-4 | | | | | | | | | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | WS23 | WS23 | | | | | | | | | | | |
| Depth | 0.30 | 1.20 | | | | | | | | | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V J | V J | | | | | | | | | | | |
| Sample Date | 08/07/2021 | 08/07/2021 | | | | | | | | | | | |
| Sample Type | Soil | Soil | | | | | | | | | | | |
| Batch Number | 1 | 1 | | | | | | | | | | | |
| Date of Receipt | 12/07/2021 | 12/07/2021 | | | | | | | | | | | |
| TPH CWG | | | | | | | | | | | | | |
| **Aliphatics** | | | | | | | | | | | | | |
| >C5-C6 # | <0.1 | <0.1 | | | | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >C6-C8 # | <0.1 | <0.1 | | | | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >C8-C10 | <0.1 | <0.1 | | | | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >C10-C12 # | <0.2 | <0.2 | | | | | | | | | <0.2 | mg/kg | TM5/PM8/PM16 |
| >C12-C16 # | <4 | <4 | | | | | | | | | <4 | mg/kg | TM5/PM8/PM16 |
| >C16-C21 # | <7 | <7 | | | | | | | | | <7 | mg/kg | TM5/PM8/PM16 |
| >C21-C35 # | <7 | <7 | | | | | | | | | <7 | mg/kg | TM5/PM8/PM16 |
| Total aliphatics C5-35 | <19 | <19 | | | | | | | | | <19 | mg/kg | TM5/TM36/PM8/PM12/PM16 |
| **Aromatics** | | | | | | | | | | | | | |
| >C5-EC7 # | <0.1 | <0.1 | | | | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >EC7-EC8 # | <0.1 | <0.1 | | | | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >EC8-EC10 # | <0.1 | <0.1 | | | | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >EC10-EC12 # | <0.2 | <0.2 | | | | | | | | | <0.2 | mg/kg | TM5/PM8/PM16 |
| >EC12-EC16 # | <4 | <4 | | | | | | | | | <4 | mg/kg | TM5/PM8/PM16 |
| >EC16-EC21 # | <7 | <7 | | | | | | | | | <7 | mg/kg | TM5/PM8/PM16 |
| >EC21-EC35 # | <7 | <7 | | | | | | | | | <7 | mg/kg | TM5/PM8/PM16 |
| Total aromatics C5-35 # | <19 | <19 | | | | | | | | | <19 | mg/kg | TM5/TM36/PM8/PM12/PM16 |
| Total aliphatics and aromatics(C5-35) | <38 | <38 | | | | | | | | | <38 | mg/kg | TM5/TM36/PM8/PM12/PM16 |
| MTBE # | <5 | <5 | | | | | | | | | <5 | ug/kg | TM36/PM12 |
| Benzene # | <5 | <5 | | | | | | | | | <5 | ug/kg | TM36/PM12 |
| Toluene # | <5 | <5 | | | | | | | | | <5 | ug/kg | TM36/PM12 |
| Ethylbenzene # | <5 | <5 | | | | | | | | | <5 | ug/kg | TM36/PM12 |
| m/p-Xylene # | <5 | <5 | | | | | | | | | <5 | ug/kg | TM36/PM12 |
| o-Xylene # | <5 | <5 | | | | | | | | | <5 | ug/kg | TM36/PM12 |
| Natural Moisture Content | 25.0 | 48.8 | | | | | | | | | <0.1 | % | PM4/PM0 |
| Hexavalent Chromium # | <0.3 | <0.3 | | | | | | | | | <0.3 | mg/kg | TM38/PM20 |
| Sulphate as SO4 (2:1 Ext) # | 0.0031 | 0.0093 | | | | | | | | | <0.0015 | g/l | TM38/PM20 |
| Chromium III | 59.9 | 83.1 | | | | | | | | | <0.5 | mg/kg | NONE/NONE |
| Free Cyanide | <0.5 | <0.5 | | | | | | | | | <0.5 | mg/kg | TM89/PM45 |
| Total Cyanide # | <1.5 AA | <0.5 | | | | | | | | | <0.5 | mg/kg | TM89/PM45 |
| pH # | 6.31 | 6.07 | | | | | | | | | <0.01 | pH units | TM73/PM11 |

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin

| EMT Job No. | Batch | Sample ID | Depth | EMT Sample No. | Analysis | Reason |
|---|---|---|---|---|---|---|
| No deviating sample report results for job 21/10551 | | | | | | |

**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.:*** 21/10551

**SOILS**

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

**WATERS**

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

**DEVIATING SAMPLES**

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

**SURROGATES**

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

**DILUTIONS**

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

**BLANKS**

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

**NOTE**

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

**REPORTS FROM THE SOUTH AFRICA LABORATORY**

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

**Measurement Uncertainty**

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

**ABBREVIATIONS and ACRONYMS USED**

| | |
|---|---|
| # | ISO17025 (UKAS Ref No. 4225) accredited - UK. |
| SA | ISO17025 (SANAS Ref No.T0729) accredited - South Africa |
| B | Indicates analyte found in associated method blank. |
| DR | Dilution required. |
| M | MCERTS accredited. |
| NA | Not applicable |
| NAD | No Asbestos Detected. |
| ND | None Detected (usually refers to VOC and/SVOC TICs). |
| NDP | No Determination Possible |
| SS | Calibrated against a single substance |
| SV | Surrogate recovery outside performance criteria. This may be due to a matrix effect. |
| W | Results expressed on as received basis. |
| + | AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page. |
| >> | Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher, this result is not accredited. |
| * | Analysis subcontracted to an Element Materials Technology approved laboratory. |
| AD | Samples are dried at 35°C ±5°C |
| CO | Suspected carry over |
| LOD/LOR | Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS |
| ME | Matrix Effect |
| NFD | No Fibres Detected |
| BS | AQC Sample |
| LB | Blank Sample |
| N | Client Sample |
| TB | Trip Blank Sample |
| OC | Outside Calibration Range |
| AA | x3 Dilution |

**EMT Job No:** 21/10551

| Test Method No. | Description | Prep Method No. (if appropriate) | Description | ISO 17025 (UKAS/SANAS) | MCERTS (UK soils only) | Analysis done on As Received (AR) or Dried (AD) | Reported on dry weight basis |
|---|---|---|---|---|---|---|---|
| PM4 | Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465:1993(E) and BS1377-2:1990. | PM0 | No preparation is required. | | | AR | |
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM8 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required. | | | AR | Yes |
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM8 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required. | Yes | | AR | Yes |
| TM5 | Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present. | PM8/PM16 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required/Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE. | Yes | | AR | Yes |
| TM5/TM36 | please refer to TM5 and TM36 for method details | PM8/PM12/PM16 | please refer to PM8/PM16 and PM12 for method details | | | AR | Yes |
| TM5/TM36 | please refer to TM5 and TM36 for method details | PM8/PM12/PM16 | please refer to PM8/PM16 and PM12 for method details | Yes | | AR | Yes |
| TM30 | Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996 | PM15 | Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground. | | | AD | Yes |
| TM30 | Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996 | PM15 | Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground. | Yes | | AD | Yes |
| TM36 | Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested. | PM12 | Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis. | | | AR | Yes |
| TM36 | Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested. | PM12 | Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis. | Yes | | AR | Yes |

**EMT Job No:** 21/10551

| 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 |
|---|---|---|---|---|---|---|---|
| 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 | PM20 | Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker. | Yes | | AD | 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 | PM20 | Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker. | Yes | | AR | Yes |
| TM73 | Modified US EPA methods 150.1 (1982) and 9045D Rev. 4 - 2004) and BS1377-3:1990. Determination of pH by Metrohm automated probe analyser. | PM11 | Extraction of as received solid samples using one part solid to 2.5 parts deionised water. | Yes | | AR | No |
| TM74 | Analysis of water soluble boron (20:1 extract) by ICP-OES. | PM32 | Hot water soluble boron is extracted from dried and ground samples using a 20:1 ratio. | Yes | | AD | Yes |
| TM89 | Modified USEPA method OIA-1667 (1999). Determination of cyanide by Flow Injection Analyser. Where WAD cyanides are required a Ligand displacement step is carried out before analysis. | PM45 | As received solid samples are extracted with 1M NaOH by orbital shaker for Cyanide, Sulphide and Thiocyanate analysis. | | | AR | Yes |
| TM89 | Modified USEPA method OIA-1667 (1999). Determination of cyanide by Flow Injection Analyser. Where WAD cyanides are required a Ligand displacement step is carried out before analysis. | PM45 | As received solid samples are extracted with 1M NaOH by orbital shaker for Cyanide, Sulphide and Thiocyanate analysis. | Yes | | AR | Yes |
| NONE | No Method Code | NONE | No Method Code | | | AD | Yes |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

# APPENDIX F: Groundwater and Surface Water Laboratory Data

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Duncrue Street
Belfast
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BT3 9LA

| | |
|---|---|
| **Attention :** | Thomas Martin |
| **Date :** | 11th June, 2021 |
| **Your reference :** | P2288 |
| **Our reference :** | Test Report 21/8216 Batch 1 |
| **Location :** | Riverine |
| **Date samples received :** | 1st June, 2021 |
| **Status :** | Final report |
| **Issue :** | 1 |

Fifteen samples were received for analysis on 1st June, 2021 of which fifteen 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**

Please include all sections of this report if it is reproduced

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin
**EMT Job No:** 21/8216

**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. | 1-4 | 5-8 | 9-12 | 13-16 | 17-20 | 21-24 | 25-28 | 29-32 | 33-36 | 37-41 | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | WS02 | WS06 | WS07 | WS09 | WS10 | WS11 | WS12 | WS13 | WS14 | SW1 | | | |
| Depth | | | | | | | | | | | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V P G | V P G | V P G | V P G | V P G | V P G | V P G | V P G | V P G | V P BOD G | | | |
| Sample Date | 27/05/2021 | 27/05/2021 | 26/05/2021 | 26/05/2021 | 26/05/2021 | 26/05/2021 | 26/05/2021 | 26/05/2021 | 26/05/2021 | 26/05/2021 | | | |
| Sample Type | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Surface Water | | | |
| Batch Number | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| Date of Receipt | 01/06/2021 | 01/06/2021 | 01/06/2021 | 01/06/2021 | 01/06/2021 | 01/06/2021 | 01/06/2021 | 01/06/2021 | 01/06/2021 | 01/06/2021 | | | |
| Dissolved Arsenic # | 32.4 | 19.2 | 1.3 | 2.3 | 2.4 | 2.7 | 1.5 | 3.8 | 5.1 | 1.0 | <0.9 | ug/l | TM170/PM14 |
| Dissolved Barium # | 130.6 | 103.0 | 47.3 | 16.5 | 215.1 | 95.5 | 98.9 | 111.3 | 133.0 | 74.6 | <1.8 | ug/l | TM170/PM14 |
| Dissolved Beryllium # | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | ug/l | TM170/PM14 |
| Dissolved Boron # | 14 | <12 | 27 | 26 | 69 | 44 | 49 | 23 | 35 | 59 | <12 | ug/l | TM170/PM14 |
| Dissolved Cadmium # | 0.06 | <0.03 | <0.03 | 0.03 | <0.03 | <0.03 | 0.13 | 0.13 | <0.03 | <0.03 | <0.03 | ug/l | TM170/PM14 |
| Total Dissolved Chromium # | 0.4 | <0.2 | 1.6 | 8.9 | 0.6 | <0.2 | <0.2 | 1.3 | 1.2 | 0.3 | <0.2 | ug/l | TM170/PM14 |
| Dissolved Copper # | <1 | <1 | 3 | 12 | <1 | <1 | 5 | 18 | <1 | 5 | <1 | ug/l | TM170/PM14 |
| Dissolved Lead # | <0.4 | <0.4 | 0.4 | 2.1 | <0.4 | 0.6 | 20.5 | 12.6 | 0.4 | <0.4 | <0.4 | ug/l | TM170/PM14 |
| Dissolved Mercury # | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | ug/l | TM170/PM14 |
| Dissolved Nickel # | 97.9 | 34.2 | 4.3 | 7.6 | 3.6 | 2.2 | 4.2 | 9.1 | 7.9 | 8.7 | <0.2 | ug/l | TM170/PM14 |
| Dissolved Selenium # | <1.2 | <1.2 | <1.2 | 1.3 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | ug/l | TM170/PM14 |
| Dissolved Vanadium # | 2.9 | <0.6 | 3.1 | 4.1 | <0.6 | 0.8 | 8.1 | 0.6 | 1.0 | <0.6 | <0.6 | ug/l | TM170/PM14 |
| Dissolved Zinc # | 103.6 | 16.5 | 8.1 | 24.9 | 4.0 | 2.2 | 23.7 | 134.7 | 14.0 | 29.1 | <1.5 | ug/l | TM170/PM14 |
| | | | | | | | | | | | | | |
| Total Hardness Dissolved (as CaCO3) | 114 | 58 | 133 | 34 | 300 | 321 | 489 | 192 | 153 | 244 | <1 | mg/l | TM30/PM14 |
| | | | | | | | | | | | | | |
| PAH MS | | | | | | | | | | | | | |
| Naphthalene # | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | ug/l | TM4/PM30 |
| Acenaphthylene # | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | ug/l | TM4/PM30 |
| Acenaphthene # | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | 0.014 | <0.013 | <0.013 | ug/l | TM4/PM30 |
| Fluorene # | <0.014 | <0.014 | <0.014 | <0.014 | <0.014 | <0.014 | <0.014 | <0.014 | <0.014 | <0.014 | <0.014 | ug/l | TM4/PM30 |
| Phenanthrene # | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | 0.021 | <0.011 | 0.036 | 0.012 | <0.011 | ug/l | TM4/PM30 |
| Anthracene # | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | 0.031 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | ug/l | TM4/PM30 |
| Fluoranthene # | <0.012 | <0.012 | <0.012 | <0.012 | <0.012 | 0.045 | 0.051 | <0.012 | 0.061 | 0.047 | <0.012 | ug/l | TM4/PM30 |
| Pyrene # | 0.030 | <0.013 | <0.013 | <0.013 | <0.013 | 0.053 | 0.051 | <0.013 | 0.072 | 0.153 | <0.013 | ug/l | TM4/PM30 |
| Benzo(a)anthracene # | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 | 0.023 | 0.027 | <0.015 | 0.027 | 0.020 | <0.015 | ug/l | TM4/PM30 |
| Chrysene # | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | 0.032 | 0.027 | <0.011 | 0.036 | 0.046 | <0.011 | ug/l | TM4/PM30 |
| Benzo(bk)fluoranthene # | <0.018 | <0.018 | <0.018 | <0.018 | <0.018 | 0.063 | 0.069 | <0.018 | 0.031 | 0.077 | <0.018 | ug/l | TM4/PM30 |
| Benzo(a)pyrene # | <0.016 | <0.016 | <0.016 | <0.016 | <0.016 | 0.029 | 0.035 | <0.016 | <0.016 | 0.025 | <0.016 | ug/l | TM4/PM30 |
| Indeno(123cd)pyrene # | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | 0.016 | 0.022 | <0.011 | <0.011 | 0.024 | <0.011 | ug/l | TM4/PM30 |
| Dibenzo(ah)anthracene # | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | ug/l | TM4/PM30 |
| Benzo(ghi)perylene # | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | 0.016 | 0.027 | <0.011 | <0.011 | 0.034 | <0.011 | ug/l | TM4/PM30 |
| PAH 16 Total # | <0.195 | <0.195 | <0.195 | <0.195 | <0.195 | 0.308 | 0.330 | <0.195 | 0.277 | 0.438 | <0.195 | ug/l | TM4/PM30 |
| Benzo(b)fluoranthene | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.05 | 0.05 | <0.01 | 0.02 | 0.06 | <0.01 | ug/l | TM4/PM30 |
| Benzo(k)fluoranthene | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.02 | 0.02 | <0.01 | <0.01 | 0.02 | <0.01 | ug/l | TM4/PM30 |
| PAH Surrogate % Recovery | 86 | 87 | 85 | 97 | 85 | 81 | 82 | 82 | 83 | 91 | <0 | % | TM4/PM30 |
| | | | | | | | | | | | | | |
| MTBE # | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | ug/l | TM36/PM12 |
| Benzene # | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | ug/l | TM36/PM12 |
| Toluene # | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | ug/l | TM36/PM12 |
| Ethylbenzene # | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | ug/l | TM36/PM12 |
| m/p-Xylene # | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | ug/l | TM36/PM12 |
| o-Xylene # | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | ug/l | TM36/PM12 |

Please see attached notes for all abbreviations and acronyms

## Element Materials Technology

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin
**EMT Job No:** 21/8216

**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. | 1-4 | 5-8 | 9-12 | 13-16 | 17-20 | 21-24 | 25-28 | 29-32 | 33-36 | 37-41 | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | WS02 | WS06 | WS07 | WS09 | WS10 | WS11 | WS12 | WS13 | WS14 | SW1 | | | |
| Depth | | | | | | | | | | | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V P G | V P G | V P G | V P G | V P G | V P G | V P G | V P G | V P G | V P BOD G | | | |
| Sample Date | 27/05/2021 | 27/05/2021 | 26/05/2021 | 26/05/2021 | 26/05/2021 | 26/05/2021 | 26/05/2021 | 26/05/2021 | 26/05/2021 | 26/05/2021 | | | |
| Sample Type | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Surface Water | | | |
| Batch Number | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| Date of Receipt | 01/06/2021 | 01/06/2021 | 01/06/2021 | 01/06/2021 | 01/06/2021 | 01/06/2021 | 01/06/2021 | 01/06/2021 | 01/06/2021 | 01/06/2021 | | | |
| EPH (C8-C40) # | - | - | - | - | - | - | - | - | - | - | <10 | ug/l | TM5/PM30 |
| TPH CWG | | | | | | | | | | | | | |
| **Aliphatics** | | | | | | | | | | | | | |
| >C5-C6 # | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | ug/l | TM36/PM12 |
| >C6-C8 # | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | ug/l | TM36/PM12 |
| >C8-C10 # | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | ug/l | TM36/PM12 |
| >C10-C12 # | <5 | <5 | <5 | <10 AA | <5 | <5 | <5 | <5 | <5 | <5 | <5 | ug/l | TM5/PM16/PM30 |
| >C12-C16 # | <10 | <10 | <10 | <20 AA | <10 | <10 | <10 | <10 | <10 | <10 | <10 | ug/l | TM5/PM16/PM30 |
| >C16-C21 # | <10 | <10 | <10 | <20 AA | <10 | <10 | <10 | <10 | <10 | <10 | <10 | ug/l | TM5/PM16/PM30 |
| >C21-C35 # | <10 | <10 | <10 | <20 AA | <10 | <10 | <10 | <10 | <10 | <10 | <10 | ug/l | TM5/PM16/PM30 |
| Total aliphatics C5-35 # | <10 | <10 | <10 | <20 AA | <10 | <10 | <10 | <10 | <10 | <10 | <10 | ug/l | TM5/TM36/PM12/PM16/PM30 |
| **Aromatics** | | | | | | | | | | | | | |
| >C5-EC7 # | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | ug/l | TM36/PM12 |
| >EC7-EC8 # | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | ug/l | TM36/PM12 |
| >EC8-EC10 # | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | ug/l | TM36/PM12 |
| >EC10-EC12 # | <5 | <5 | <5 | <10 AA | <5 | <5 | <5 | <5 | <5 | <5 | <5 | ug/l | TM5/PM16/PM30 |
| >EC12-EC16 # | <10 | <10 | <10 | <20 AA | <10 | <10 | <10 | <10 | <10 | <10 | <10 | ug/l | TM5/PM16/PM30 |
| >EC16-EC21 # | <10 | <10 | <10 | <20 AA | <10 | <10 | <10 | <10 | <10 | <10 | <10 | ug/l | TM5/PM16/PM30 |
| >EC21-EC35 # | <10 | <10 | <10 | <20 AA | <10 | <10 | <10 | <10 | <10 | <10 | <10 | ug/l | TM5/PM16/PM30 |
| Total aromatics C5-35 # | <10 | <10 | <10 | <20 AA | <10 | <10 | <10 | <10 | <10 | <10 | <10 | ug/l | TM5/TM36/PM12/PM16/PM30 |
| Total aliphatics and aromatics(C5-35) # | <10 | <10 | <10 | <20 AA | <10 | <10 | <10 | <10 | <10 | <10 | <10 | ug/l | TM5/TM36/PM12/PM16/PM30 |
| Sulphate as SO4 # | 99.0 | 35.1 | 7.1 | <0.5 | 81.0 | 94.0 | 29.3 | <0.5 | 3.6 | 58.1 | <0.5 | mg/l | TM38/PM0 |
| Free Cyanide # | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | mg/l | TM89/PM0 |
| Total Cyanide # | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | mg/l | TM89/PM0 |
| Hexavalent Chromium | <6 | <6 | <6 | <6 | <6 | <6 | <6 | <6 | <6 | <6 | <6 | ug/l | TM38/PM0 |
| Total Dissolved Chromium III | <6 | <6 | <6 | 9 | <6 | <6 | <6 | <6 | <6 | <6 | <6 | ug/l | NONE/NONE |
| Thiocyanate | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | 0.06 | 0.05 | <0.02 | <0.02 | mg/l | TM107/PM0 |
| BOD (Settled) # | - | - | - | - | - | - | - | - | - | <1 | <1 | mg/l | TM58/PM0 |
| Electrical Conductivity @25C # | 329 | 164 | 439 | 142 | 790 | 664 | 844 | 542 | 522 | 687 | <2 | uS/cm | TM76/PM0 |
| pH # | 5.61 | 5.80 | 6.50 | 5.77 | 7.02 | 7.34 | 7.65 | 6.60 | 6.53 | 7.59 | <0.01 | pH units | TM73/PM0 |
| Total Suspended Solids # | 33200 | 21848 | 5948 | 9232 | 11272 | 21386 | 14598 | 1636 | 38748 | 505 | <10 | mg/l | TM37/PM0 |

Please see attached notes for all abbreviations and acronyms



Please include all sections of this report if it is reproduced

All solid results are expressed on a dry weight basis unless stated otherwise.

## Element Materials Technology

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin
**EMT Job No:** 21/8216

**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. | 42-46 | 47-51 | 52-56 | 57-61 | 62-64 | | | | | | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | SW2 | SW3 | SW4 | SW5 | HA08 | | | | | | | | |
| Depth | | | | | | | | | | | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V P BOD G | V P BOD G | V P BOD G | V P BOD G | V P | | | | | | | | |
| Sample Date | 26/05/2021 | 26/05/2021 | 27/05/2021 | 27/05/2021 | 27/05/2021 | | | | | | | | |
| Sample Type | Surface Water | Surface Water | Surface Water | Surface Water | Ground Water | | | | | | | | |
| Batch Number | 1 | 1 | 1 | 1 | 1 | | | | | | | | |
| Date of Receipt | 01/06/2021 | 01/06/2021 | 01/06/2021 | 01/06/2021 | 01/06/2021 | | | | | | | | |
| Dissolved Arsenic # | <0.9 | <0.9 | <0.9 | <0.9 | 2.6 | | | | | | <0.9 | ug/l | TM170/PM14 |
| Dissolved Barium # | 71.0 | 37.4 | 19.1 | 21.0 | 285.3 | | | | | | <1.8 | ug/l | TM170/PM14 |
| Dissolved Beryllium # | <0.5 | <0.5 | <0.5 | <0.5 | 0.9 | | | | | | <0.5 | ug/l | TM170/PM14 |
| Dissolved Boron # | 27 | <12 | 20 | 20 | 26 | | | | | | <12 | ug/l | TM170/PM14 |
| Dissolved Cadmium # | <0.03 | <0.03 | <0.03 | <0.03 | 0.66 | | | | | | <0.03 | ug/l | TM170/PM14 |
| Total Dissolved Chromium # | <0.2 | 2.4 | 0.4 | 0.4 | 1.6 | | | | | | <0.2 | ug/l | TM170/PM14 |
| Dissolved Copper # | 3 | 3 | 3 | 2 | 3 | | | | | | <1 | ug/l | TM170/PM14 |
| Dissolved Lead # | <0.4 | <0.4 | <0.4 | <0.4 | 2.1 | | | | | | <0.4 | ug/l | TM170/PM14 |
| Dissolved Mercury # | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | | | | | | <0.5 | ug/l | TM170/PM14 |
| Dissolved Nickel # | 3.4 | 1.2 | 2.5 | 3.5 | 76.5 | | | | | | <0.2 | ug/l | TM170/PM14 |
| Dissolved Selenium # | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | | | | | | <1.2 | ug/l | TM170/PM14 |
| Dissolved Vanadium # | <0.6 | 1.3 | <0.6 | <0.6 | <0.6 | | | | | | <0.6 | ug/l | TM170/PM14 |
| Dissolved Zinc # | 3.8 | 7.1 | 9.9 | 7.4 | 533.1 AC | | | | | | <1.5 | ug/l | TM170/PM14 |
| Total Hardness Dissolved (as CaCO3) | 208 | 54 | 174 | 168 | - | | | | | | <1 | mg/l | TM30/PM14 |
| PAH MS | | | | | | | | | | | | | |
| Naphthalene # | <0.1 | <0.1 | <0.1 | <0.1 | - | | | | | | <0.1 | ug/l | TM4/PM30 |
| Acenaphthylene # | <0.013 | <0.013 | <0.013 | <0.013 | - | | | | | | <0.013 | ug/l | TM4/PM30 |
| Acenaphthene # | <0.013 | <0.013 | <0.013 | <0.013 | - | | | | | | <0.013 | ug/l | TM4/PM30 |
| Fluorene # | <0.014 | <0.014 | <0.014 | <0.014 | - | | | | | | <0.014 | ug/l | TM4/PM30 |
| Phenanthrene # | <0.011 | <0.011 | <0.011 | <0.011 | - | | | | | | <0.011 | ug/l | TM4/PM30 |
| Anthracene # | <0.013 | <0.013 | <0.013 | <0.013 | - | | | | | | <0.013 | ug/l | TM4/PM30 |
| Fluoranthene # | 0.016 | <0.012 | <0.012 | 0.048 | - | | | | | | <0.012 | ug/l | TM4/PM30 |
| Pyrene # | 0.022 | <0.013 | <0.013 | 0.082 | - | | | | | | <0.013 | ug/l | TM4/PM30 |
| Benzo(a)anthracene # | <0.015 | <0.015 | <0.015 | 0.023 | - | | | | | | <0.015 | ug/l | TM4/PM30 |
| Chrysene # | <0.011 | <0.011 | <0.011 | 0.032 | - | | | | | | <0.011 | ug/l | TM4/PM30 |
| Benzo(bk)fluoranthene # | <0.018 | <0.018 | <0.018 | 0.049 | - | | | | | | <0.018 | ug/l | TM4/PM30 |
| Benzo(a)pyrene # | <0.016 | <0.016 | <0.016 | 0.016 | - | | | | | | <0.016 | ug/l | TM4/PM30 |
| Indeno(123cd)pyrene # | <0.011 | <0.011 | <0.011 | <0.011 | - | | | | | | <0.011 | ug/l | TM4/PM30 |
| Dibenzo(ah)anthracene # | <0.01 | <0.01 | <0.01 | <0.01 | - | | | | | | <0.01 | ug/l | TM4/PM30 |
| Benzo(ghi)perylene # | <0.011 | <0.011 | <0.011 | <0.011 | - | | | | | | <0.011 | ug/l | TM4/PM30 |
| PAH 16 Total # | <0.195 | <0.195 | <0.195 | 0.250 | - | | | | | | <0.195 | ug/l | TM4/PM30 |
| Benzo(b)fluoranthene | <0.01 | <0.01 | <0.01 | 0.04 | - | | | | | | <0.01 | ug/l | TM4/PM30 |
| Benzo(k)fluoranthene | <0.01 | <0.01 | <0.01 | 0.01 | - | | | | | | <0.01 | ug/l | TM4/PM30 |
| PAH Surrogate % Recovery | 79 | 84 | 79 | 76 | - | | | | | | <0 | % | TM4/PM30 |
| MTBE # | <5 | <5 | <5 | <5 | - | | | | | | <5 | ug/l | TM36/PM12 |
| Benzene # | <5 | <5 | <5 | <5 | - | | | | | | <5 | ug/l | TM36/PM12 |
| Toluene # | <5 | <5 | <5 | <5 | - | | | | | | <5 | ug/l | TM36/PM12 |
| Ethylbenzene # | <5 | <5 | <5 | <5 | - | | | | | | <5 | ug/l | TM36/PM12 |
| m/p-Xylene # | <5 | <5 | <5 | <5 | - | | | | | | <5 | ug/l | TM36/PM12 |
| o-Xylene # | <5 | <5 | <5 | <5 | - | | | | | | <5 | ug/l | TM36/PM12 |

Please see attached notes for all abbreviations and acronyms

## Element Materials Technology

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin
**EMT Job No:** 21/8216

**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. | 42-46 | 47-51 | 52-56 | 57-61 | 62-64 | | | | | | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | SW2 | SW3 | SW4 | SW5 | HA08 | | | | | | | | |
| Depth | | | | | | | | | | | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V P BOD G | V P BOD G | V P BOD G | V P BOD G | V P | | | | | | | | |
| Sample Date | 26/05/2021 | 26/05/2021 | 27/05/2021 | 27/05/2021 | 27/05/2021 | | | | | | | | |
| Sample Type | Surface Water | Surface Water | Surface Water | Surface Water | Ground Water | | | | | | | | |
| Batch Number | 1 | 1 | 1 | 1 | 1 | | | | | | | | |
| Date of Receipt | 01/06/2021 | 01/06/2021 | 01/06/2021 | 01/06/2021 | 01/06/2021 | | | | | | | | |
| EPH (C8-C40) # | - | - | - | - | <30 AB | | | | | | <10 | ug/l | TM5/PM30 |
| TPH CWG | | | | | | | | | | | | | |
| **Aliphatics** | | | | | | | | | | | | | |
| >C5-C6 # | <10 | <10 | <10 | <10 | - | | | | | | <10 | ug/l | TM36/PM12 |
| >C6-C8 # | <10 | <10 | <10 | <10 | - | | | | | | <10 | ug/l | TM36/PM12 |
| >C8-C10 # | <10 | <10 | <10 | <10 | - | | | | | | <10 | ug/l | TM36/PM12 |
| >C10-C12 # | <5 | <5 | <5 | <5 | - | | | | | | <5 | ug/l | TM5/PM16/PM30 |
| >C12-C16 # | <10 | <10 | <10 | <10 | - | | | | | | <10 | ug/l | TM5/PM16/PM30 |
| >C16-C21 # | <10 | <10 | <10 | <10 | - | | | | | | <10 | ug/l | TM5/PM16/PM30 |
| >C21-C35 # | <10 | <10 | <10 | <10 | - | | | | | | <10 | ug/l | TM5/PM16/PM30 |
| Total aliphatics C5-35 # | <10 | <10 | <10 | <10 | - | | | | | | <10 | ug/l | TM5/TM36/PM12/PM16/PM30 |
| **Aromatics** | | | | | | | | | | | | | |
| >C5-EC7 # | <10 | <10 | <10 | <10 | - | | | | | | <10 | ug/l | TM36/PM12 |
| >EC7-EC8 # | <10 | <10 | <10 | <10 | - | | | | | | <10 | ug/l | TM36/PM12 |
| >EC8-EC10 # | <10 | <10 | <10 | <10 | - | | | | | | <10 | ug/l | TM36/PM12 |
| >EC10-EC12 # | <5 | <5 | <5 | <5 | - | | | | | | <5 | ug/l | TM5/PM16/PM30 |
| >EC12-EC16 # | <10 | <10 | <10 | <10 | - | | | | | | <10 | ug/l | TM5/PM16/PM30 |
| >EC16-EC21 # | <10 | <10 | <10 | <10 | - | | | | | | <10 | ug/l | TM5/PM16/PM30 |
| >EC21-EC35 # | <10 | <10 | <10 | <10 | - | | | | | | <10 | ug/l | TM5/PM16/PM30 |
| Total aromatics C5-35 # | <10 | <10 | <10 | <10 | - | | | | | | <10 | ug/l | TM5/TM36/PM12/PM16/PM30 |
| Total aliphatics and aromatics(C5-35) # | <10 | <10 | <10 | <10 | - | | | | | | <10 | ug/l | TM5/TM36/PM12/PM16/PM30 |
| Sulphate as SO4 # | 29.6 | 5.2 | 14.5 | 15.2 | - | | | | | | <0.5 | mg/l | TM38/PM0 |
| Free Cyanide # | <0.01 | <0.01 | <0.01 | <0.01 | - | | | | | | <0.01 | mg/l | TM89/PM0 |
| Total Cyanide # | <0.01 | <0.01 | <0.01 | <0.01 | - | | | | | | <0.01 | mg/l | TM89/PM0 |
| Hexavalent Chromium | <6 | <6 | <6 | <6 | - | | | | | | <6 | ug/l | TM38/PM0 |
| Total Dissolved Chromium III | <6 | <6 | <6 | <6 | - | | | | | | <6 | ug/l | NONE/NONE |
| Thiocyanate | <0.02 | <0.02 | <0.02 | <0.02 | - | | | | | | <0.02 | mg/l | TM107/PM0 |
| BOD (Settled) # | <1 | <1 | 1 | 2 | - | | | | | | <1 | mg/l | TM58/PM0 |
| Electrical Conductivity @25C # | 510 | 155 | 614 | 610 | - | | | | | | <2 | uS/cm | TM76/PM0 |
| pH # | 7.98 | 7.61 | 7.69 | 7.52 | - | | | | | | <0.01 | pH units | TM73/PM0 |
| Total Suspended Solids # | 22 | 55 | 14 | 725 | - | | | | | | <10 | mg/l | TM37/PM0 |

Please see attached notes for all abbreviations and acronyms



Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

**Client Name:** MCL Consulting

**Reference:** P2288

**Location:** Riverine

**Contact:** Thomas Martin

**Matrix : Liquid**

| EMT Job No. | Batch | Sample ID | Depth | EMT Sample No. | Analysis | Reason |
|---|---|---|---|---|---|---|
| 21/8216 | 1 | SW1 | | 37-41 | BOD | Sample holding time exceeded |
| 21/8216 | 1 | SW2 | | 42-46 | BOD | Sample holding time exceeded |
| 21/8216 | 1 | SW3 | | 47-51 | BOD | Sample holding time exceeded |
| 21/8216 | 1 | SW4 | | 52-56 | BOD | Sample holding time exceeded |
| 21/8216 | 1 | SW5 | | 57-61 | BOD | 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.**



Please include all sections of this report if it is reproduced

# NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

***EMT Job No.:*** 21/8216

**SOILS**

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

**WATERS**

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

**DEVIATING SAMPLES**

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

**SURROGATES**

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

**DILUTIONS**

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

**BLANKS**

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

**NOTE**

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

**REPORTS FROM THE SOUTH AFRICA LABORATORY**

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

**Measurement Uncertainty**

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

**ABBREVIATIONS and ACRONYMS USED**

| | |
|---|---|
| # | ISO17025 (UKAS Ref No. 4225) accredited - UK. |
| SA | ISO17025 (SANAS Ref No.T0729) accredited - South Africa |
| B | Indicates analyte found in associated method blank. |
| DR | Dilution required. |
| M | MCERTS accredited. |
| NA | Not applicable |
| NAD | No Asbestos Detected. |
| ND | None Detected (usually refers to VOC and/SVOC TICs). |
| NDP | No Determination Possible |
| SS | Calibrated against a single substance |
| SV | Surrogate recovery outside performance criteria. This may be due to a matrix effect. |
| W | Results expressed on as received basis. |
| + | AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page. |
| >> | Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher, this result is not accredited. |
| * | Analysis subcontracted to an Element Materials Technology approved laboratory. |
| AD | Samples are dried at 35°C ±5°C |
| CO | Suspected carry over |
| LOD/LOR | Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS |
| ME | Matrix Effect |
| NFD | No Fibres Detected |
| BS | AQC Sample |
| LB | Blank Sample |
| N | Client Sample |
| TB | Trip Blank Sample |

| | |
|---|---|
| OC | Outside Calibration Range |
| AA | x2 Dilution |
| AB | x3 Dilution |
| AC | x5 Dilution |

**EMT Job No:** 21/8216

| 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 |
|---|---|---|---|---|---|---|---|
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM30 | Water samples are extracted with solvent using a magnetic stirrer to create a vortex. | | | | |
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM30 | Water samples are extracted with solvent using a magnetic stirrer to create a vortex. | Yes | | | |
| TM5 | Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present. | PM16/PM30 | Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE/Water samples are extracted with solvent using a magnetic stirrer to create a vortex. | Yes | | | |
| TM5 | Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present. | PM30 | Water samples are extracted with solvent using a magnetic stirrer to create a vortex. | Yes | | | |
| TM5/TM36 | please refer to TM5 and TM36 for method details | PM12/PM16/PM30 | please refer to PM16/PM30 and PM12 for method details | Yes | | | |
| TM30 | Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 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 | | | | |
| TM36 | Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested. | PM12 | Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis. | Yes | | | |
| TM37 | Modified methods - TSS: USEPA 160.2 (1983), EN872:2005 and APHA SMEWW 2540D:1999 22nd Edition; VSS: USEPA 1684 (Jan 2001), USEPA 160.4 (1971) and SMEWW 2540E:1999 22nd Edition. Gravimetric determination of Total Suspended Solids (TSS) and Volatile Suspended Solids (VSS). Sample is filtered through a 1.5um pore size glass fibre filter and the resulting residue is dried and weighed at 105°C for TSS and 550°C for VSS. | PM0 | No preparation is required. | 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 | | | |

**EMT Job No:** 21/8216

| 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 |
|---|---|---|---|---|---|---|---|
| TM58 | APHA SMEWW 5210B:1999 22nd Edition. Comparible with ISO 5815:1989. Measurement of Biochemical Oxygen Demand. When cBOD (Carbonaceous BOD) is requested a nitrification inhibitor is added which prevents the oxidation of reduced forms of nitrogen, such as am | 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 | | | |
| TM76 | Modified US EPA method 120.1 (1982). Determination of Specific Conductance by Metrohm automated probe analyser. | PM0 | No preparation is required. | Yes | | | |
| TM89 | Modified USEPA method OIA-1667 (1999). Determination of cyanide by Flow Injection Analyser. Where WAD cyanides are required a Ligand displacement step is carried out before analysis. | PM0 | No preparation is required. | Yes | | | |
| TM107 | Determination of Sulphide/Thiocyanate by Skalar Continuous Flow Analyser | PM0 | No preparation is required. | | | | |
| TM170 | Determination of Trace Metals by ICP-MS (Inductively Coupled Plasma – Mass Spectrometry): Modified USEPA Method 200.8, Rev. 5.4, 1994; Modified EPA Method 6020A, Rev.1, Feb 2007; Modified BS EN ISO 17294-2:2016 | 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 | | | |
| NONE | No Method Code | NONE | No Method Code | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

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| | |
|---|---|
| **Attention :** | Thomas Martin |
| **Date :** | 14th July, 2021 |
| **Your reference :** | P2288 |
| **Our reference :** | Test Report 21/10245 Batch 1 |
| **Location :** | Riverine |
| **Date samples received :** | 6th July, 2021 |
| **Status :** | Final report |
| **Issue :** | 1 |

Five samples were received for analysis on 6th July, 2021 of which five 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:**

**Bruce Leslie**
**Project Manager**

Please include all sections of this report if it is reproduced

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin
**EMT Job No:** 21/10245

**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. | 1-5 | 6-10 | 11-15 | 16-20 | 21-25 | | | | | | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | WS15 | WS16 | WS17 | WS19 | WS20 | | | | | | | | |
| Depth | | | | | | | | | | | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V P G | V P G | V P G | V P G | V P G | | | | | | | | |
| Sample Date | 02/07/2021 10:00 | 02/07/2021 10:20 | 02/07/2021 10:40 | 02/07/2021 11:00 | 02/07/2021 11:20 | | | | | | | | |
| Sample Type | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | | | | | | | | |
| Batch Number | 1 | 1 | 1 | 1 | 1 | | | | | | | | |
| Date of Receipt | 06/07/2021 | 06/07/2021 | 06/07/2021 | 06/07/2021 | 06/07/2021 | | | | | | | | |
| Dissolved Arsenic # | 13.5 | 3.6 | 7.5 | 2.5 | 6.6 | | | | | | <0.9 | ug/l | TM170/PM14 |
| Dissolved Barium # | 489.0 | 56.3 | 242.8 | 149.1 | 227.0 | | | | | | <1.8 | ug/l | TM170/PM14 |
| Dissolved Beryllium # | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | | | | | | <0.5 | ug/l | TM170/PM14 |
| Dissolved Boron # | 212 | 18 | 117 | 24 | 300 | | | | | | <12 | ug/l | TM170/PM14 |
| Dissolved Cadmium # | <0.03 | <0.03 | <0.03 | 0.07 | <0.03 | | | | | | <0.03 | ug/l | TM170/PM14 |
| Total Dissolved Chromium # | <0.2 | <0.2 | <0.2 | 0.8 | <0.2 | | | | | | <0.2 | ug/l | TM170/PM14 |
| Dissolved Copper # | <1 | <1 | <1 | 15 | <1 | | | | | | <1 | ug/l | TM170/PM14 |
| Dissolved Lead # | <0.4 | <0.4 | <0.4 | 1.5 | <0.4 | | | | | | <0.4 | ug/l | TM170/PM14 |
| Dissolved Mercury # | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | | | | | | <0.5 | ug/l | TM170/PM14 |
| Dissolved Nickel # | 5.5 | 3.8 | 9.5 | 9.8 | 4.1 | | | | | | <0.2 | ug/l | TM170/PM14 |
| Dissolved Selenium # | <1.2 | <1.2 | <1.2 | <1.2 | <1.2 | | | | | | <1.2 | ug/l | TM170/PM14 |
| Dissolved Vanadium # | <0.6 | <0.6 | 1.3 | 1.4 | 1.6 | | | | | | <0.6 | ug/l | TM170/PM14 |
| Dissolved Zinc # | <1.5 | 6.0 | 29.6 | 18.4 | 2.7 | | | | | | <1.5 | ug/l | TM170/PM14 |
| Total Hardness Dissolved (as CaCO3) | 375 | 73 | 482 | 148 | $841_{AA}$ | | | | | | <1 | mg/l | TM30/PM14 |
| PAH MS | | | | | | | | | | | | | |
| Naphthalene # | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | | | | | | <0.1 | ug/l | TM4/PM30 |
| Acenaphthylene # | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | | | | | | <0.013 | ug/l | TM4/PM30 |
| Acenaphthene # | <0.013 | 0.078 | 0.041 | <0.013 | 0.028 | | | | | | <0.013 | ug/l | TM4/PM30 |
| Fluorene # | <0.014 | 0.037 | 0.028 | <0.014 | 0.014 | | | | | | <0.014 | ug/l | TM4/PM30 |
| Phenanthrene # | <0.011 | 0.037 | 0.168 | <0.011 | 0.027 | | | | | | <0.011 | ug/l | TM4/PM30 |
| Anthracene # | <0.013 | <0.013 | 0.032 | <0.013 | <0.013 | | | | | | <0.013 | ug/l | TM4/PM30 |
| Fluoranthene # | <0.012 | 0.024 | 0.280 | <0.012 | 0.111 | | | | | | <0.012 | ug/l | TM4/PM30 |
| Pyrene # | <0.013 | 0.018 | 0.231 | <0.013 | 0.097 | | | | | | <0.013 | ug/l | TM4/PM30 |
| Benzo(a)anthracene # | <0.015 | <0.015 | 0.114 | <0.015 | 0.032 | | | | | | <0.015 | ug/l | TM4/PM30 |
| Chrysene # | <0.011 | <0.011 | 0.122 | <0.011 | 0.027 | | | | | | <0.011 | ug/l | TM4/PM30 |
| Benzo(bk)fluoranthene # | <0.018 | <0.018 | 0.185 | <0.018 | 0.036 | | | | | | <0.018 | ug/l | TM4/PM30 |
| Benzo(a)pyrene # | <0.016 | <0.016 | 0.100 | <0.016 | 0.019 | | | | | | <0.016 | ug/l | TM4/PM30 |
| Indeno(123cd)pyrene # | <0.011 | <0.011 | 0.055 | <0.011 | <0.011 | | | | | | <0.011 | ug/l | TM4/PM30 |
| Dibenzo(ah)anthracene # | <0.01 | <0.01 | 0.01 | <0.01 | <0.01 | | | | | | <0.01 | ug/l | TM4/PM30 |
| Benzo(ghi)perylene # | <0.011 | <0.011 | 0.045 | <0.011 | <0.011 | | | | | | <0.011 | ug/l | TM4/PM30 |
| PAH 16 Total # | <0.195 | <0.195 | 1.411 | <0.195 | 0.391 | | | | | | <0.195 | ug/l | TM4/PM30 |
| Benzo(b)fluoranthene | <0.01 | <0.01 | 0.13 | <0.01 | 0.03 | | | | | | <0.01 | ug/l | TM4/PM30 |
| Benzo(k)fluoranthene | <0.01 | <0.01 | 0.05 | <0.01 | 0.01 | | | | | | <0.01 | ug/l | TM4/PM30 |
| PAH Surrogate % Recovery | 80 | 83 | 87 | 84 | 86 | | | | | | <0 | % | TM4/PM30 |
| MTBE # | <5 | <5 | <5 | <5 | <5 | | | | | | <5 | ug/l | TM36/PM12 |
| Benzene # | <5 | <5 | <5 | <5 | <5 | | | | | | <5 | ug/l | TM36/PM12 |
| Toluene # | <5 | <5 | <5 | <5 | <5 | | | | | | <5 | ug/l | TM36/PM12 |
| Ethylbenzene # | <5 | <5 | <5 | <5 | <5 | | | | | | <5 | ug/l | TM36/PM12 |
| m/p-Xylene # | <5 | <5 | <5 | <5 | <5 | | | | | | <5 | ug/l | TM36/PM12 |
| o-Xylene # | <5 | <5 | <5 | <5 | <5 | | | | | | <5 | ug/l | TM36/PM12 |



Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin
**EMT Job No:** 21/10245

**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. | 1-5 | 6-10 | 11-15 | 16-20 | 21-25 | | | | | | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | WS15 | WS16 | WS17 | WS19 | WS20 | | | | | | | | |
| Depth | | | | | | | | | | | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V P G | V P G | V P G | V P G | V P G | | | | | | | | |
| Sample Date | 02/07/2021 10:00 | 02/07/2021 10:20 | 02/07/2021 10:40 | 02/07/2021 11:00 | 02/07/2021 11:20 | | | | | | | | |
| Sample Type | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | | | | | | | | |
| Batch Number | 1 | 1 | 1 | 1 | 1 | | | | | | | | |
| Date of Receipt | 06/07/2021 | 06/07/2021 | 06/07/2021 | 06/07/2021 | 06/07/2021 | | | | | | | | |
| TPH CWG | | | | | | | | | | | | | |
| **Aliphatics** | | | | | | | | | | | | | |
| >C5-C6 # | <10 | <10 | <10 | <10 | <10 | | | | | | <10 | ug/l | TM36/PM12 |
| >C6-C8 # | <10 | <10 | <10 | <10 | <10 | | | | | | <10 | ug/l | TM36/PM12 |
| >C8-C10 # | <10 | <10 | <10 | <10 | <10 | | | | | | <10 | ug/l | TM36/PM12 |
| >C10-C12 # | <5 | <5 | <5 | <5 | <5 | | | | | | <5 | ug/l | TM5/PM16/PM30 |
| >C12-C16 # | <10 | <10 | <10 | <10 | <10 | | | | | | <10 | ug/l | TM5/PM16/PM30 |
| >C16-C21 # | <10 | <10 | <10 | <10 | <10 | | | | | | <10 | ug/l | TM5/PM16/PM30 |
| >C21-C35 # | <10 | <10 | <10 | <10 | <10 | | | | | | <10 | ug/l | TM5/PM16/PM30 |
| Total aliphatics C5-35 # | <10 | <10 | <10 | <10 | <10 | | | | | | <10 | ug/l | TM5/TM36/PM12/PM16/PM30 |
| **Aromatics** | | | | | | | | | | | | | |
| >C5-EC7 # | <10 | <10 | <10 | <10 | <10 | | | | | | <10 | ug/l | TM36/PM12 |
| >EC7-EC8 # | <10 | <10 | <10 | <10 | <10 | | | | | | <10 | ug/l | TM36/PM12 |
| >EC8-EC10 # | <10 | <10 | <10 | <10 | <10 | | | | | | <10 | ug/l | TM36/PM12 |
| >EC10-EC12 # | <5 | <5 | <5 | <5 | <5 | | | | | | <5 | ug/l | TM5/PM16/PM30 |
| >EC12-EC16 # | <10 | <10 | <10 | <10 | <10 | | | | | | <10 | ug/l | TM5/PM16/PM30 |
| >EC16-EC21 # | <10 | <10 | <10 | <10 | <10 | | | | | | <10 | ug/l | TM5/PM16/PM30 |
| >EC21-EC35 # | <10 | <10 | <10 | <10 | <10 | | | | | | <10 | ug/l | TM5/PM16/PM30 |
| Total aromatics C5-35 # | <10 | <10 | <10 | <10 | <10 | | | | | | <10 | ug/l | TM5/TM36/PM12/PM16/PM30 |
| Total aliphatics and aromatics(C5-35) # | <10 | <10 | <10 | <10 | <10 | | | | | | <10 | ug/l | TM5/TM36/PM12/PM16/PM30 |
| Sulphate as SO4 # | 10.7 | 6.6 | 20.9 | 15.7 | 73.3 | | | | | | <0.5 | mg/l | TM38/PM0 |
| Free Cyanide # | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | | | | | <0.01 | mg/l | TM89/PM0 |
| Total Cyanide # | <0.01 | <0.01 | 0.01 | 0.02 | <0.01 | | | | | | <0.01 | mg/l | TM89/PM0 |
| Hexavalent Chromium | <6 | <6 | <6 | <6 | <6 | | | | | | <6 | ug/l | TM38/PM0 |
| Total Dissolved Chromium III | <6 | <6 | <6 | <6 | <6 | | | | | | <6 | ug/l | NONE/NONE |
| Thiocyanate | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | | | | | | <0.02 | mg/l | TM107/PM0 |
| Electrical Conductivity @25C # | 792 | 212 | 843 | 480 | 1339 | | | | | | <2 | uS/cm | TM76/PM0 |
| pH # | 6.90 | 6.37 | 6.94 | 6.37 | 7.11 | | | | | | <0.01 | pH units | TM73/PM0 |
| Total Suspended Solids # | 10508 | 15064 | 10884 | 1467 | 9294 | | | | | | <10 | mg/l | TM37/PM0 |

Please see attached notes for all abbreviations and acronyms



Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin

| EMT Job No. | Batch | Sample ID | Depth | EMT Sample No. | Analysis | Reason |
|---|---|---|---|---|---|---|
| No deviating sample report results for job 21/10245 | | | | | | |

**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.:*** 21/10245

**SOILS**

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

**WATERS**

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

**DEVIATING SAMPLES**

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

**SURROGATES**

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

**DILUTIONS**

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

**BLANKS**

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

**NOTE**

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

**REPORTS FROM THE SOUTH AFRICA LABORATORY**

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

**Measurement Uncertainty**

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

**ABBREVIATIONS and ACRONYMS USED**

| | |
|---|---|
| # | ISO17025 (UKAS Ref No. 4225) accredited - UK. |
| SA | ISO17025 (SANAS Ref No.T0729) accredited - South Africa |
| B | Indicates analyte found in associated method blank. |
| DR | Dilution required. |
| M | MCERTS accredited. |
| NA | Not applicable |
| NAD | No Asbestos Detected. |
| ND | None Detected (usually refers to VOC and/SVOC TICs). |
| NDP | No Determination Possible |
| SS | Calibrated against a single substance |
| SV | Surrogate recovery outside performance criteria. This may be due to a matrix effect. |
| W | Results expressed on as received basis. |
| + | AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page. |
| >> | Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher, this result is not accredited. |
| * | Analysis subcontracted to an Element Materials Technology approved laboratory. |
| AD | Samples are dried at 35°C ±5°C |
| CO | Suspected carry over |
| LOD/LOR | Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS |
| ME | Matrix Effect |
| NFD | No Fibres Detected |
| BS | AQC Sample |
| LB | Blank Sample |
| N | Client Sample |
| TB | Trip Blank Sample |
| OC | Outside Calibration Range |
| AA | x5 Dilution |

**EMT Job No:** 21/10245

| 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 |
|---|---|---|---|---|---|---|---|
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM30 | Water samples are extracted with solvent using a magnetic stirrer to create a vortex. | | | | |
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM30 | Water samples are extracted with solvent using a magnetic stirrer to create a vortex. | Yes | | | |
| TM5 | Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present. | PM16/PM30 | Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE/Water samples are extracted with solvent using a magnetic stirrer to create a vortex. | Yes | | | |
| TM5/TM36 | please refer to TM5 and TM36 for method details | PM12/PM16/PM30 | please refer to PM16/PM30 and PM12 for method details | Yes | | | |
| TM30 | Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 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 | | | | |
| TM36 | Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested. | PM12 | Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis. | Yes | | | |
| TM37 | Modified methods - TSS: USEPA 160.2 (1985), EN872:2005 and APHA SMEWW 2540D:1999 22nd Edition; VSS: USEPA 1684 (Jan 2001), USEPA 160.4 (1971) and SMEWW 2540E:1999 22nd Edition. Gravimetric determination of Total Suspended Solids (TSS) and Volatile Suspended Solids (VSS). Sample is filtered through a 1.5um pore size glass fibre filter and the resulting residue is dried and weighed at 105°C for TSS and 550°C for VSS. | PM0 | No preparation is required. | 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 | | | |

**EMT Job No:** 21/10245

| 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 |
|---|---|---|---|---|---|---|---|
| TM76 | Modified US EPA method 120.1 (1982). Determination of Specific Conductance by Metrohm automated probe analyser. | PM0 | No preparation is required. | Yes | | | |
| TM89 | Modified USEPA method OIA-1667 (1999). Determination of cyanide by Flow Injection Analyser. Where WAD cyanides are required a Ligand displacement step is carried out before analysis. | PM0 | No preparation is required. | Yes | | | |
| TM107 | Determination of Sulphide/Thiocyanate by Skalar Continuous Flow Analyser | PM0 | No preparation is required. | | | | |
| TM170 | Determination of Trace Metals by ICP-MS (Inductively Coupled Plasma – Mass Spectrometry): Modified USEPA Method 200.8, Rev. 5.4, 1994; Modified EPA Method 6020A, Rev.1, Feb 2007; Modified BS EN ISO 17294-2:2016 | 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 | | | |
| NONE | No Method Code | NONE | No Method Code | | | | |
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| | |
|---|---|
| **Attention :** | Thomas Martin |
| **Date :** | 6th July, 2021 |
| **Your reference :** | P2288 |
| **Our reference :** | Test Report 21/9738 Batch 1 |
| **Location :** | Riverine |
| **Date samples received :** | 28th June, 2021 |
| **Status :** | Final report |
| **Issue :** | 1 |

Ten samples were received for analysis on 28th June, 2021 of which ten were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

**Authorised By:**

**Phil Sommerton BSc**
**Senior Project Manager**

Please include all sections of this report if it is reproduced

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin
**EMT Job No:** 21/9738

**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. | 1-8 | 9-16 | 17-23 | 24-31 | 32-39 | 40-47 | 48-55 | 56-63 | 64-71 | 72-79 | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | WSC01 | WSC02 | WSC03 | WSC04 | WSC05 | WSC06 | WSC07 | WSC08 | WSC09 | WSC10 | | | |
| Depth | | | | | | | | | | | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V H HNUF P BOD G | V H HNUF P BOD G | V H HNUF P BOD G | V H HN P BOD G | V H HN P BOD G | V H HNUF P BOD G | V H HN P BOD G | V H HNUF P BOD G | V H HNUF P BOD G | V H HNUF P BOD G | | | |
| Sample Date | 24/06/2021 | 24/06/2021 | 24/06/2021 | 24/06/2021 | 24/06/2021 | 24/06/2021 | 24/06/2021 | 24/06/2021 | 24/06/2021 | 24/06/2021 | | | |
| Sample Type | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | | | |
| Batch Number | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| Date of Receipt | 28/06/2021 | 28/06/2021 | 28/06/2021 | 28/06/2021 | 28/06/2021 | 28/06/2021 | 28/06/2021 | 28/06/2021 | 28/06/2021 | 28/06/2021 | | | |
| Dissolved Arsenic # | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | ug/l | TM30/PM14 |
| Dissolved Barium # | 59 | 46 | 8 | 47 | 44 | 109 | 44 | 37 | 10 | 12 | <3 | ug/l | TM30/PM14 |
| Dissolved Beryllium | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | ug/l | TM30/PM14 |
| Dissolved Boron | 55 | 15 | <12 | <12 | <12 | 22 | <12 | <12 | <12 | <12 | <12 | ug/l | TM30/PM14 |
| Dissolved Cadmium # | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | ug/l | TM30/PM14 |
| Total Dissolved Chromium # | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | ug/l | TM30/PM14 |
| Dissolved Copper # | <7 | <7 | <7 | <7 | <7 | <7 | <7 | <7 | <7 | <7 | <7 | ug/l | TM30/PM14 |
| Dissolved Lead # | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | ug/l | TM30/PM14 |
| Dissolved Mercury # | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | ug/l | TM30/PM14 |
| Dissolved Nickel # | <2 | 4 | <2 | <2 | <2 | <2 | <2 | <2 | <2 | <2 | <2 | ug/l | TM30/PM14 |
| Dissolved Selenium # | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | ug/l | TM30/PM14 |
| Dissolved Vanadium # | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | ug/l | TM30/PM14 |
| Dissolved Zinc # | <3 | <3 | 3 | 69 | 5 | <3 | <3 | 3 | 43 | 38 | <3 | ug/l | TM30/PM14 |
| Total Hardness Dissolved (as CaCO3) | 164 | 170 | 31 | 89 | 93 | 361 | 88 | 95 | 84 | 85 | <1 | mg/l | TM30/PM14 |
| | | | | | | | | | | | | | |
| PAH MS | | | | | | | | | | | | | |
| Naphthalene # | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 0.1 | 0.1 | <0.1 | ug/l | TM4/PM30 |
| Acenaphthylene # | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | ug/l | TM4/PM30 |
| Acenaphthene # | 0.018 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | ug/l | TM4/PM30 |
| Fluorene # | 0.051 | <0.014 | <0.014 | <0.014 | <0.014 | <0.014 | <0.014 | <0.014 | 0.018 | 0.017 | <0.014 | ug/l | TM4/PM30 |
| Phenanthrene # | 0.175 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | 0.018 | 0.016 | <0.011 | ug/l | TM4/PM30 |
| Anthracene # | 0.029 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | ug/l | TM4/PM30 |
| Fluoranthene # | 0.410 | 0.018 | <0.012 | <0.012 | <0.012 | <0.012 | <0.012 | <0.012 | <0.012 | <0.012 | <0.012 | ug/l | TM4/PM30 |
| Pyrene # | 0.649 | 0.018 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | <0.013 | 0.019 | 0.021 | <0.013 | ug/l | TM4/PM30 |
| Benzo(a)anthracene # | 0.115 | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 | ug/l | TM4/PM30 |
| Chrysene # | 0.225 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | ug/l | TM4/PM30 |
| Benzo(bk)fluoranthene # | 0.266 | <0.018 | <0.018 | <0.018 | <0.018 | <0.018 | <0.018 | <0.018 | <0.018 | <0.018 | <0.018 | ug/l | TM4/PM30 |
| Benzo(a)pyrene # | 0.130 | <0.016 | <0.016 | <0.016 | <0.016 | <0.016 | <0.016 | <0.016 | <0.016 | <0.016 | <0.016 | ug/l | TM4/PM30 |
| Indeno(123cd)pyrene # | 0.069 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | ug/l | TM4/PM30 |
| Dibenzo(ah)anthracene # | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | ug/l | TM4/PM30 |
| Benzo(ghi)perylene # | 0.126 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | <0.011 | ug/l | TM4/PM30 |
| PAH 16 Total # | 2.273 | <0.195 | <0.195 | <0.195 | <0.195 | <0.195 | <0.195 | <0.195 | <0.195 | <0.195 | <0.195 | ug/l | TM4/PM30 |
| Benzo(b)fluoranthene | 0.19 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | ug/l | TM4/PM30 |
| Benzo(k)fluoranthene | 0.07 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | ug/l | TM4/PM30 |
| PAH Surrogate % Recovery | 70 | 58 SV | 81 | 86 | 79 | 71 | 76 | 79 | 80 | 79 | <0 | % | TM4/PM30 |
| | | | | | | | | | | | | | |
| EPH (C8-C40) # | 3230 | <10 | 200 AA | <10 | <10 | 110 | <10 | <10 | <10 | <10 | <10 | ug/l | TM5/PM30 |
| | | | | | | | | | | | | | |
| Sulphate as SO4 # | 19.9 | 23.1 | 2.3 | 9.7 | 18.3 | <0.5 | 9.8 | 12.0 | 34.1 | 34.6 | <0.5 | mg/l | TM38/PM0 |
| Chloride # | 38.4 | 23.5 | 20.4 | 15.7 | 23.2 | 10.8 | 16.1 | 17.4 | 195.2 | 194.2 | <0.3 | mg/l | TM38/PM0 |
| Nitrate as NO3 # | <0.2 | 17.3 | <0.2 | 4.2 | 6.3 | <0.2 | 3.9 | 3.3 | <0.2 | <0.2 | <0.2 | mg/l | TM38/PM0 |
| | | | | | | | | | | | | | |
| Free Cyanide # | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | mg/l | TM89/PM0 |
| Total Cyanide # | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.02 | 0.02 | <0.01 | mg/l | TM89/PM0 |

Please see attached notes for all abbreviations and acronyms



Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

## Element Materials Technology

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin
**EMT Job No:** 21/9738

**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. | 1-8 | 9-16 | 17-23 | 24-31 | 32-39 | 40-47 | 48-55 | 56-63 | 64-71 | 72-79 | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | WSC01 | WSC02 | WSC03 | WSC04 | WSC05 | WSC06 | WSC07 | WSC08 | WSC09 | WSC10 | | | |
| Depth | | | | | | | | | | | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V H HNUF P BOD G | V H HNUF P BOD G | V H HNUF P BOD G | V H HN P BOD G | V H HN P BOD G | V H HNUF P BOD G | V H HN P BOD G | V H HNUF P BOD G | V H HNUF P BOD G | V H HNUF P BOD G | | | |
| Sample Date | 24/06/2021 | 24/06/2021 | 24/06/2021 | 24/06/2021 | 24/06/2021 | 24/06/2021 | 24/06/2021 | 24/06/2021 | 24/06/2021 | 24/06/2021 | | | |
| Sample Type | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | Ground Water | | | |
| Batch Number | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| Date of Receipt | 28/06/2021 | 28/06/2021 | 28/06/2021 | 28/06/2021 | 28/06/2021 | 28/06/2021 | 28/06/2021 | 28/06/2021 | 28/06/2021 | 28/06/2021 | | | |
| Ammoniacal Nitrogen as N # | 1.19 | 0.75 | 0.06 | 0.05 | 0.05 | 0.55 | 0.13 | 0.74 | 7.40 | 7.38 | <0.03 | mg/l | TM38/PM0 |
| Hexavalent Chromium | <6 | <6 | <6 | <6 | <6 | <6 | <6 | <6 | <6 | <6 | <6 | ug/l | TM38/PM0 |
| Total Dissolved Chromium III | <6 | <6 | <6 | <6 | <6 | <6 | <6 | <6 | <6 | <6 | <6 | ug/l | TM0/PM0 |
| Thiocyanate | 0.03 | <0.02 | <0.02 | <0.02 | <0.02 | 0.03 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | mg/l | TM107/PM0 |
| Electrical Conductivity @25C # | 455 | 433 | 140 | 235 | 292 | 707 | 230 | 272 | 918 | 914 | <2 | uS/cm | TM76/PM0 |
| pH # | 7.35 | 7.76 | 6.63 | 7.90 | 7.66 | 7.50 | 7.92 | 7.92 | 7.32 | 7.35 | <0.01 | pH units | TM73/PM0 |
| Total Organic Carbon # | 10 | 3 | 16 | 7 | 5 | 32 | 7 | 5 | 14 | 11 | <2 | mg/l | TM60/PM0 |
| Total Suspended Solids # | 588 | 73 | 28 | 11 | 17 | 707 | <10 | 51 | 41 | 77 | <10 | mg/l | TM37/PM0 |
| True Colour | 499 | 34 | 230 | 55 | 72 | 46 | 58 | 51 | 107 | 67 | <15 | mg/l PtCo | TM35/PM0 |

Please see attached notes for all abbreviations and acronyms

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin

| EMT Job No. | Batch | Sample ID | Depth | EMT Sample No. | Analysis | Reason |
|---|---|---|---|---|---|---|
| No deviating sample report results for job 21/9738 | | | | | | |

**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.:*** 21/9738

**SOILS**

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

**WATERS**

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

**DEVIATING SAMPLES**

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

**SURROGATES**

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

**DILUTIONS**

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

**BLANKS**

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

**NOTE**

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

**REPORTS FROM THE SOUTH AFRICA LABORATORY**

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

**Measurement Uncertainty**

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

**ABBREVIATIONS and ACRONYMS USED**

| | |
|---|---|
| # | ISO17025 (UKAS Ref No. 4225) accredited - UK. |
| SA | ISO17025 (SANAS Ref No.T0729) accredited - South Africa |
| B | Indicates analyte found in associated method blank. |
| DR | Dilution required. |
| M | MCERTS accredited. |
| NA | Not applicable |
| NAD | No Asbestos Detected. |
| ND | None Detected (usually refers to VOC and/SVOC TICs). |
| NDP | No Determination Possible |
| SS | Calibrated against a single substance |
| SV | Surrogate recovery outside performance criteria. This may be due to a matrix effect. |
| W | Results expressed on as received basis. |
| + | AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page. |
| >> | Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher, this result is not accredited. |
| * | Analysis subcontracted to an Element Materials Technology approved laboratory. |
| AD | Samples are dried at 35°C ±5°C |
| CO | Suspected carry over |
| LOD/LOR | Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS |
| ME | Matrix Effect |
| NFD | No Fibres Detected |
| BS | AQC Sample |
| LB | Blank Sample |
| N | Client Sample |
| TB | Trip Blank Sample |
| OC | Outside Calibration Range |
| AA | x2 Dilution |

**EMT Job No:** 21/9738

| 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 |
|---|---|---|---|---|---|---|---|
| TM0 | Not available | PM0 | No preparation is required. | | | | |
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM30 | Water samples are extracted with solvent using a magnetic stirrer to create a vortex. | | | | |
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM30 | Water samples are extracted with solvent using a magnetic stirrer to create a vortex. | Yes | | | |
| TM5 | Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present. | PM30 | Water samples are extracted with solvent using a magnetic stirrer to create a vortex. | Yes | | | |
| TM30 | Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 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 | | | | |
| 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 | | | |
| TM35 | True and apparent colour by Hach Lange DR3800 spectrophotometer. Apparent colour includes dissolved and suspended matter. True colour is determinined after filtration of the sample. | PM0 | No preparation is required. | | | | |
| TM37 | Modified methods - TSS: USEPA 160.2 (1985), EN872:2005 and APHA SMEWW 2540D:1999 22nd Edition; VSS: USEPA 1684 (Jan 2001), USEPA 160.4 (1971) and SMEWW 2540E:1999 22nd Edition. Gravimetric determination of Total Suspended Solids (TSS) and Volatile Suspended Solids (VSS). Sample is filtered through a 1.5um pore size glass fibre filter and the resulting residue is dried and weighed at 105°C for TSS and 550°C for VSS. | PM0 | No preparation is required. | 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 | | | |

**EMT Job No:** 21/9738

| 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 |
|---|---|---|---|---|---|---|---|
| TM60 | TC/TOC analysis of Waters by High Temperature Combustion followed by NDIR detection. Based on the following modified standard methods: USEPA 9060A (2002), APHA SMEWW 5310B:1999 22nd Edition, ASTM D 7573, and USEPA 415.1. | PM0 | No preparation is required. | 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 | | | |
| TM76 | Modified US EPA method 120.1 (1982). Determination of Specific Conductance by Metrohm automated probe analyser. | PM0 | No preparation is required. | Yes | | | |
| TM89 | Modified USEPA method OIA-1667 (1999). Determination of cyanide by Flow Injection Analyser. Where WAD cyanides are required a Ligand displacement step is carried out before analysis. | PM0 | No preparation is required. | Yes | | | |
| TM107 | Determination of Sulphide/Thiocyanate by Skalar Continuous Flow Analyser | PM0 | No preparation is required. | | | | |
| | | | | | | | |
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| | | | | | | | |

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Duncrue Street
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BT3 9LA

| | |
|---|---|
| **Attention :** | Thomas Martin |
| **Date :** | 12th August, 2021 |
| **Your reference :** | P2288 |
| **Our reference :** | Test Report 21/11994 Batch 1 |
| **Location :** | Riverine |
| **Date samples received :** | 6th August, 2021 |
| **Status :** | Final Report |
| **Issue :** | 1 |

One sample was received for analysis on 6th August, 2021 and was 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**

Please include all sections of this report if it is reproduced

Element Materials Technology Environmental UK Limited
Registered in England and Wales
Registered Office: 10 Lower Grosvenor Place, London, SW1W 0EN
Company Registration No: 11371415

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin
**EMT Job No:** 21/11994

**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.** | 1-4 | | | | | | | | | | Please see attached notes for all abbreviations and acronyms | | |
| **Sample ID** | CGBH(S) | | | | | | | | | | | | |
| **Depth** | | | | | | | | | | | | | |
| **COC No / misc** | | | | | | | | | | | | | |
| **Containers** | V P G | | | | | | | | | | | | |
| **Sample Date** | 04/08/2021 | | | | | | | | | | | | |
| **Sample Type** | Ground Water | | | | | | | | | | | | |
| **Batch Number** | 1 | | | | | | | | | | LOD/LOR | Units | Method No. |
| **Date of Receipt** | 06/08/2021 | | | | | | | | | | | | |
| Dissolved Arsenic # | <2.5 | | | | | | | | | | <2.5 | ug/l | TM30/PM14 |
| Dissolved Barium # | 128 | | | | | | | | | | <3 | ug/l | TM30/PM14 |
| Dissolved Beryllium | <0.5 | | | | | | | | | | <0.5 | ug/l | TM30/PM14 |
| Dissolved Boron | 46 | | | | | | | | | | <12 | ug/l | TM30/PM14 |
| Dissolved Cadmium # | <0.5 | | | | | | | | | | <0.5 | ug/l | TM30/PM14 |
| Total Dissolved Chromium # | <1.5 | | | | | | | | | | <1.5 | ug/l | TM30/PM14 |
| Dissolved Copper # | <7 | | | | | | | | | | <7 | ug/l | TM30/PM14 |
| Dissolved Lead # | <5 | | | | | | | | | | <5 | ug/l | TM30/PM14 |
| Dissolved Mercury # | <1 | | | | | | | | | | <1 | ug/l | TM30/PM14 |
| Dissolved Nickel # | <2 | | | | | | | | | | <2 | ug/l | TM30/PM14 |
| Dissolved Selenium # | <3 | | | | | | | | | | <3 | ug/l | TM30/PM14 |
| Dissolved Vanadium # | <1.5 | | | | | | | | | | <1.5 | ug/l | TM30/PM14 |
| Dissolved Zinc # | 8 | | | | | | | | | | <3 | ug/l | TM30/PM14 |
| Total Hardness Dissolved (as CaCO3) | 251 | | | | | | | | | | <1 | mg/l | TM30/PM14 |
| | | | | | | | | | | | | | |
| PAH MS | | | | | | | | | | | | | |
| Naphthalene # | <0.1 | | | | | | | | | | <0.1 | ug/l | TM4/PM30 |
| Acenaphthylene # | <0.013 | | | | | | | | | | <0.013 | ug/l | TM4/PM30 |
| Acenaphthene # | <0.013 | | | | | | | | | | <0.013 | ug/l | TM4/PM30 |
| Fluorene # | <0.014 | | | | | | | | | | <0.014 | ug/l | TM4/PM30 |
| Phenanthrene # | <0.011 | | | | | | | | | | <0.011 | ug/l | TM4/PM30 |
| Anthracene # | <0.013 | | | | | | | | | | <0.013 | ug/l | TM4/PM30 |
| Fluoranthene # | <0.012 | | | | | | | | | | <0.012 | ug/l | TM4/PM30 |
| Pyrene # | <0.013 | | | | | | | | | | <0.013 | ug/l | TM4/PM30 |
| Benzo(a)anthracene # | <0.015 | | | | | | | | | | <0.015 | ug/l | TM4/PM30 |
| Chrysene # | <0.011 | | | | | | | | | | <0.011 | ug/l | TM4/PM30 |
| Benzo(bk)fluoranthene # | <0.018 | | | | | | | | | | <0.018 | ug/l | TM4/PM30 |
| Benzo(a)pyrene # | <0.016 | | | | | | | | | | <0.016 | ug/l | TM4/PM30 |
| Indeno(123cd)pyrene # | <0.011 | | | | | | | | | | <0.011 | ug/l | TM4/PM30 |
| Dibenzo(ah)anthracene # | <0.01 | | | | | | | | | | <0.01 | ug/l | TM4/PM30 |
| Benzo(ghi)perylene # | <0.011 | | | | | | | | | | <0.011 | ug/l | TM4/PM30 |
| PAH 16 Total # | <0.195 | | | | | | | | | | <0.195 | ug/l | TM4/PM30 |
| Benzo(b)fluoranthene | <0.01 | | | | | | | | | | <0.01 | ug/l | TM4/PM30 |
| Benzo(k)fluoranthene | <0.01 | | | | | | | | | | <0.01 | ug/l | TM4/PM30 |
| PAH Surrogate % Recovery | 82 | | | | | | | | | | <0 | % | TM4/PM30 |
| | | | | | | | | | | | | | |
| MTBE # | <5 | | | | | | | | | | <5 | ug/l | TM36/PM12 |
| Benzene # | <5 | | | | | | | | | | <5 | ug/l | TM36/PM12 |
| Toluene # | <5 | | | | | | | | | | <5 | ug/l | TM36/PM12 |
| Ethylbenzene # | <5 | | | | | | | | | | <5 | ug/l | TM36/PM12 |
| m/p-Xylene # | <5 | | | | | | | | | | <5 | ug/l | TM36/PM12 |
| o-Xylene # | <5 | | | | | | | | | | <5 | ug/l | TM36/PM12 |

## Element Materials Technology

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin
**EMT Job No:** 21/11994

**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. | 1-4 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | CGBH(S) | | | | | | | | | | | | |
| Depth | | | | | | | | | | | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V P G | | | | | | | | | | | | |
| Sample Date | 04/08/2021 | | | | | | | | | | | | |
| Sample Type | Ground Water | | | | | | | | | | | | |
| Batch Number | 1 | | | | | | | | | | | | |
| Date of Receipt | 06/08/2021 | | | | | | | | | | | | |

Please see attached notes for all abbreviations and acronyms

| | | | | | | | | | | | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TPH CWG | | | | | | | | | | | | | |
| **Aliphatics** | | | | | | | | | | | | | |
| >C5-C6 # | <10 | | | | | | | | | | <10 | ug/l | TM36/PM12 |
| >C6-C8 # | <10 | | | | | | | | | | <10 | ug/l | TM36/PM12 |
| >C8-C10 # | <10 | | | | | | | | | | <10 | ug/l | TM36/PM12 |
| >C10-C12 # | <5 | | | | | | | | | | <5 | ug/l | TM5/PM16/PM30 |
| >C12-C16 # | <10 | | | | | | | | | | <10 | ug/l | TM5/PM16/PM30 |
| >C16-C21 # | <10 | | | | | | | | | | <10 | ug/l | TM5/PM16/PM30 |
| >C21-C35 # | <10 | | | | | | | | | | <10 | ug/l | TM5/PM16/PM30 |
| Total aliphatics C5-35 # | <10 | | | | | | | | | | <10 | ug/l | TM5/TM36/PM12/PM16/PM30 |
| **Aromatics** | | | | | | | | | | | | | |
| >C5-EC7 # | <10 | | | | | | | | | | <10 | ug/l | TM36/PM12 |
| >EC7-EC8 # | <10 | | | | | | | | | | <10 | ug/l | TM36/PM12 |
| >EC8-EC10 # | <10 | | | | | | | | | | <10 | ug/l | TM36/PM12 |
| >EC10-EC12 # | <5 | | | | | | | | | | <5 | ug/l | TM5/PM16/PM30 |
| >EC12-EC16 # | <10 | | | | | | | | | | <10 | ug/l | TM5/PM16/PM30 |
| >EC16-EC21 # | <10 | | | | | | | | | | <10 | ug/l | TM5/PM16/PM30 |
| >EC21-EC35 # | <10 | | | | | | | | | | <10 | ug/l | TM5/PM16/PM30 |
| Total aromatics C5-35 # | <10 | | | | | | | | | | <10 | ug/l | TM5/TM36/PM12/PM16/PM30 |
| Total aliphatics and aromatics(C5-35) # | <10 | | | | | | | | | | <10 | ug/l | TM5/TM36/PM12/PM16/PM30 |
| Sulphate as SO4 # | 57.3 | | | | | | | | | | <0.5 | mg/l | TM38/PM0 |
| Free Cyanide # | <0.01 | | | | | | | | | | <0.01 | mg/l | TM89/PM0 |
| Total Cyanide # | <0.01 | | | | | | | | | | <0.01 | mg/l | TM89/PM0 |
| Hexavalent Chromium | <6 | | | | | | | | | | <6 | ug/l | TM38/PM0 |
| Total Dissolved Chromium III | <6 | | | | | | | | | | <6 | ug/l | TM0/PM0 |
| Thiocyanate | <0.02 | | | | | | | | | | <0.02 | mg/l | TM107/PM0 |
| Electrical Conductivity @25C # | 636 | | | | | | | | | | <2 | uS/cm | TM76/PM0 |
| pH # | 7.49 | | | | | | | | | | <0.01 | pH units | TM73/PM0 |
| Total Suspended Solids # | 1431 | | | | | | | | | | <10 | mg/l | TM37/PM0 |

**Client Name:** MCL Consulting
**Reference:** P2288
**Location:** Riverine
**Contact:** Thomas Martin

| EMT Job No. | Batch | Sample ID | Depth | EMT Sample No. | Analysis | Reason |
|---|---|---|---|---|---|---|
| No deviating sample report results for job 21/11994 | | | | | | |

**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.**


Please include all sections of this report if it is reproduced

# NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

***EMT Job No.:*** 21/11994

**SOILS**

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

**WATERS**

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

**DEVIATING SAMPLES**

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

**SURROGATES**

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

**DILUTIONS**

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

**BLANKS**

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

**NOTE**

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

**REPORTS FROM THE SOUTH AFRICA LABORATORY**

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

**Measurement Uncertainty**

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

**ABBREVIATIONS and ACRONYMS USED**

| | |
|---|---|
| # | ISO17025 (UKAS Ref No. 4225) accredited - UK. |
| SA | ISO17025 (SANAS Ref No.T0729) accredited - South Africa |
| B | Indicates analyte found in associated method blank. |
| DR | Dilution required. |
| M | MCERTS accredited. |
| NA | Not applicable |
| NAD | No Asbestos Detected. |
| ND | None Detected (usually refers to VOC and/SVOC TICs). |
| NDP | No Determination Possible |
| SS | Calibrated against a single substance |
| SV | Surrogate recovery outside performance criteria. This may be due to a matrix effect. |
| W | Results expressed on as received basis. |
| + | AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page. |
| >> | Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher. |
| * | Analysis subcontracted to an Element Materials Technology approved laboratory. |
| AD | Samples are dried at 35°C ±5°C |
| CO | Suspected carry over |
| LOD/LOR | Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS |
| ME | Matrix Effect |
| NFD | No Fibres Detected |
| BS | AQC Sample |
| LB | Blank Sample |
| N | Client Sample |
| TB | Trip Blank Sample |
| OC | Outside Calibration Range |

**EMT Job No:** 21/11994

| 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 |
|---|---|---|---|---|---|---|---|
| TM0 | Not available | PM0 | No preparation is required. | | | | |
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM30 | Water samples are extracted with solvent using a magnetic stirrer to create a vortex. | | | | |
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM30 | Water samples are extracted with solvent using a magnetic stirrer to create a vortex. | Yes | | | |
| TM5 | Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present. | PM16/PM30 | Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE/Water samples are extracted with solvent using a magnetic stirrer to create a vortex. | Yes | | | |
| TM5/TM36 | please refer to TM5 and TM36 for method details | PM12/PM16/PM30 | please refer to PM16/PM30 and PM12 for method details | Yes | | | |
| TM30 | Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 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 | | | | |
| 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 | | | |
| TM36 | Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested. | PM12 | Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis. | Yes | | | |
| TM37 | Modified methods - TSS: USEPA 160.2 (1985), EN872:2005 and APHA SMEWW 2540D:1999 22nd Edition; VSS: USEPA 1684 (Jan 2001), USEPA 160.4 (1971) and SMEWW 2540E:1999 22nd Edition. Gravimetric determination of Total Suspended Solids (TSS) and Volatile Suspended Solids (VSS). Sample is filtered through a 1.5um pore size glass fibre filter and the resulting residue is dried and weighed at 105°C for TSS and 550°C for VSS. | PM0 | No preparation is required. | 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: 2013I | PM0 | No preparation is required. | | | | |

**EMT Job No:** 21/11994

| 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 |
|---|---|---|---|---|---|---|---|
| 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 | | | |
| TM76 | Modified US EPA method 120.1 (1982). Determination of Specific Conductance by Metrohm automated probe analyser. | PM0 | No preparation is required. | Yes | | | |
| TM89 | Modified USEPA method OIA-1667 (1999). Determination of cyanide by Flow Injection Analyser. Where WAD cyanides are required a Ligand displacement step is carried out before analysis. | PM0 | No preparation is required. | Yes | | | |
| TM107 | Determination of Sulphide/Thiocyanate by Skalar Continuous Flow Analyser | PM0 | No preparation is required. | | | | |
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## Appendix G: Ground Gas Summary

| | P2288 Riverine | | Initial FLOW | Steady FLOW | Initial $CH_4$ | Initial Co2 | Steady Co2 | $O_2$ | % LEL | $H_2S$ | CO | AP | Borehole Pressure | DP | Depth to water | Depth to Base |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Date* | *ID* | *l/s* | *l/s* | *%vol* | *%vol* | *%vol* | *%* | *%* | *ppm* | *ppm* | *mb* | *mb* | *mb* | *m* | *m* |
| Strabane | 26/05/2021 | **WS07** | 0.1 | 0 | 0 | 0 | 0 | 20.7 | 0 | 1 | 0 | 1016 | 1016 | 0 | 0.80 | 3.44 |
| | 26/05/2021 | **WS08** | 0.0 | 0 | 0 | 0.3 | 1.5 | 18.3 | 0 | 1 | 0 | 1016 | 1016 | 0 | 2.21 | 3.05 |
| | 26/05/2021 | **WS09** | 0.0 | 0 | 0 | 0.3 | 4.8 | 14.9 | 0 | 1 | 1 | 1016 | 1015 | 0 | 1.22 | 3.03 |
| | 26/05/2021 | **WS10** | 0.0 | 0 | 0.2 | 0.2 | 0 | 21.5 | 4.6 | 1 | 1 | 1016 | 1014 | 0 | 0.96 | 3.88 |
| | 26/05/2021 | **WS11** | 0.0 | 0 | 0 | 0.2 | 1.5 | 19.0 | 0.3 | 1 | 0 | 1016 | 1015 | 0 | 0.77 | 1.30 |
| | 26/05/2021 | **WS12** | 0.0 | 0 | 0 | 0 | 0 | 21.3 | 0 | 2 | 0 | 1016 | 1014 | 0 | 1.30 | 1.87 |
| | 26/05/2021 | **WS13** | 0.0 | 0 | 2.2 | 10.5 | 4.7 | 16.3 | 6.3 | 2 | 1 | 1016 | 1014 | 0 | 1.93 | 3.04 |
| | 26/05/2021 | **WS14** | 0.0 | 0 | 0 | 1.9 | 10.8 | 9.4 | 72.1 | 1 | 1 | 1016 | 1015 | 0 | 1.72 | 2.87 |
| Lifford | 27/05/2021 | **HA01** | 0.0 | 0 | 0.3 | 5.6 | 1.4 | 20.5 | 8.6 | 1 | 1 | 1018 | 1014 | 0 | 0.58 | 0.79 |
| | 27/05/2021 | **HA08** | 0.0 | 0 | 0 | 0.3 | 0.1 | 21.2 | 0 | 0 | 0 | 1018 | 1016 | 0 | 1.29 | 1.48 |
| | 27/05/2021 | **WS01** | -0.2 | 0 | 0 | 1.2 | 2.1 | 18.6 | 0 | 1 | 1 | 1018 | 1017 | 0 | DRY | 2.47 |
| | 27/05/2021 | **WS02** | 0.0 | 0 | 0 | 0.8 | 2.2 | 17.4 | 0 | 1 | 0 | 1018 | 1016 | 0 | 1.53 | 1.87 |
| | 27/05/2021 | **WS03** | 0.0 | 0 | 0.4 | 4.5 | 7.8 | 9.2 | 14.1 | 1 | 1 | 1018 | 1011 | 0 | 2.37 | 2.40 |
| | 27/05/2021 | **WS04** | 0.0 | 0 | 0.3 | 5.6 | 7.3 | 15.0 | 6.8 | 1 | 1 | 1018 | 1012 | 0 | DRY | 2.93 |
| | 27/05/2021 | **WS05** | 0.0 | 0 | 0.5 | 7.4 | 9.1 | 7.3 | 12 | 1 | 0 | 1018 | 1014 | 0 | 1.59 | 1.68 |
| | 27/05/2021 | **WS06** | -1.5 | 0 | 0 | 10.4 | 11.9 | 1.4 | 13 | 1 | 3 | 1018 | 1012 | 0 | 1.13 | 1.83 |

**Weather:** Clear and Dry
**Atmospheric Pressure:** 1016mb and constant

| | P2288 Riverine | | Initial FLOW | Steady FLOW | Initial $CH_4$ | Initial Co2 | Steady Co2 | $O_2$ | % LEL | $H_2S$ | CO | AP | Borehole Pressure | DP | Depth to water | Depth to Base |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Date* | *ID* | *l/s* | *l/s* | *%vol* | *%vol* | *%vol* | *%* | *%* | *ppm* | *ppm* | *mb* | *mb* | *mb* | *m* | *m* |
| Strabane | 04.06.2021 | **HA10** | 0 | 0 | 0 | 0.2 | 0.3 | 20.7 | 0 | 2 | 1 | 1021 | 1010 | 0 | DRY | 1.95 |
| | 04.06.2021 | **HA13** | 0 | 0 | 0 | 5.6 | 0 | 21.2 | 0 | 1 | 1 | 1021 | 1016 | 0 | 1.45 | 1.73 |
| | 04.06.2021 | **WS07** | 0 | 0 | 0 | 1.1 | 0 | 20.9 | 0 | 1 | 0 | 1021 | 1018 | 0 | 0.97 | 3.42 |
| | 04.06.2021 | **WS08** | 0 | 0 | 0 | 1.1 | 5.2 | 12.6 | 0 | 1 | 1 | 1021 | 1016 | 0 | 2.22 | 2.92 |
| | 04.06.2021 | **WS09** | 0 | 0 | 0 | 0.2 | 14 | 8.1 | 0 | 3 | 1 | 1021 | 1010 | 0 | 1.25 | 2.99 |
| | 04.06.2021 | **WS10** | 0 | 0 | 0 | 0.2 | 0 | 21.3 | 0 | 1 | 0 | 1021 | 1016 | 0 | 1.02 | 3.84 |
| | 04.06.2021 | **WS11** | 0 | 0 | 0 | 0.1 | 0.2 | 21.2 | 0 | 1 | 0 | 1021 | 1016 | 0 | 0.80 | 1.17 |
| | 04.06.2021 | **WS12** | 0 | 0 | 0 | 2.3 | 5.5 | 14.8 | 0 | 1 | 0 | 1021 | 1015 | 0 | 1.42 | 1.82 |
| | 04.06.2021 | **WS13** | 0 | 0 | 0 | 0.8 | 4.6 | 16.4 | 0 | 1 | 1 | 1021 | 1016 | 0 | 1.90 | 2.90 |
| | 04.06.2021 | **WS14** | 0 | 0 | 0 | 0.4 | 0.6 | 20.7 | 38.2 | 1 | 0 | 1021 | 1018 | 0 | 1.63 | 2.90 |
| Lifford | 04.06.2021 | **HA08** | 0 | 0 | 0.1 | 1.4 | 0 | 21.3 | 3.1 | 1 | 1 | 1021 | 1016 | 0 | DRY | 1.46 |
| | 04.06.2021 | **HA23** | 0 | 0 | 0 | 1.6 | 2.0 | 19.5 | 0 | 1 | 1 | 1021 | 1015 | 0 | DRY | 0.90 |
| | 04.06.2021 | **WS02** | 0 | 0 | 0 | 0.9 | 6.6 | 7.6 | 0 | 0 | 0 | 1021 | 1015 | 0 | DRY | 1.69 |
| | 04.06.2021 | **WS03** | 0 | 0 | 0.2 | 0.1 | 3.4 | 16.1 | 5.1 | 1 | 3 | 1021 | 1016 | 0 | DRY | 2.19 |
| | 04.06.2021 | **WS04** | 0 | 0 | 0.2 | 0.7 | 3.6 | 17.2 | 5.8 | 1 | 1 | 1021 | 1015 | 0 | DRY | 2.75 |
| | 04.06.2021 | **WS05** | 0 | 0 | 0.1 | 4.9 | 9.6 | 9.7 | 3.5 | 1 | 0 | 1021 | 1016 | 0 | DRY | 1.47 |
| | 04.06.2021 | **WS06** | 0 | 0 | 0 | 1.1 | 0.6 | 20.2 | 1.4 | 2 | 1 | 1021 | 1016 | 0 | 1.32 | 1.80 |

**Weather:** Clear, Dry
**Atmospheric Pressure:** 1021 Constant

| | P2288 Riverine | | Initial FLOW | Steady FLOW | Initial $CH_4$ | Initial Co2 | Steady Co2 | $O_2$ | % LEL | $H_2S$ | CO | AP | Borehole Pressure | DP | Depth to water | Depth to Base |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Date* | *ID* | *l/s* | *l/s* | *%vol* | *%vol* | *%vol* | *%* | *%* | *ppm* | *ppm* | *mb* | *mb* | *mb* | *m* | *m* |
| Strabane | 10.06.2021 | **HA10** | 0 | 0 | 0.4 | 0.3 | 0.9 | 20.6 | 9.5 | 2 | 3 | 1014 | 1005 | 0 | DRY | 1.98 |
| | 10.06.2021 | **HA13** | 0 | 0 | 0.6 | 0.7 | 0 | 21.6 | 15.8 | 1 | 0 | 1014 | 1005 | 0 | 1.53 | 1.83 |
| | 10.06.2021 | **WS07** | 0 | 0 | 0.4 | 3.0 | 0 | 21.4 | 11.3 | 1 | 0 | 1014 | 1005 | 0 | 0.99 | 3.50 |
| | 10.06.2021 | **WS08** | 0 | 0 | 0.5 | 4.9 | 7.1 | 11.6 | 12.8 | 1 | 0 | 1014 | 1005 | 0 | 2.28 | 2.92 |
| | 10.06.2021 | **WS09** | 0 | 0 | 0.4 | 0.5 | 11.8 | 11.3 | 10.5 | 1 | 1 | 1014 | 1006 | 0 | 1.17 | 2.91 |
| | 10.06.2021 | **WS10** | 0 | 0 | 0.6 | 0 | 0 | 21.7 | 15.7 | 1 | 1 | 1014 | 1004 | 0 | 1.08 | 3.88 |
| | 10.06.2021 | **WS11** | 0 | 0 | 0.8 | 0 | 0 | 21.6 | 18.1 | 1 | 1 | 1014 | 1004 | 0 | 0.83 | 1.19 |
| | 10.06.2021 | **WS12** | 0.6 | 0 | 0.7 | 0.3 | 3.7 | 18.4 | 13.7 | 1 | 0 | 1014 | 1005 | 0 | 1.46 | 1.86 |
| | 10.06.2021 | **WS13** | 0 | 0 | 1 | 0.4 | 0.2 | 21.4 | 14.0 | 1 | 0 | 1014 | 1006 | 0 | 1.94 | 2.85 |
| | 10.06.2021 | **WS14** | 0 | 0 | 0.6 | 0.8 | 0.5 | 21.1 | 60.7 | 1 | 0 | 1014 | 1005 | 0 | 1.68 | 2.91 |
| Lifford | 10.06.2021 | **HA08** | 0 | 0 | 0 | 0.5 | 0.1 | 21.2 | 0 | 1 | 0 | 1014 | 1008 | 0 | 0.89 | 1.49 |
| | 10.06.2021 | **HA23** | 0 | 0 | 0.2 | 3.9 | 0.3 | 21.1 | 6.4 | 2 | 0 | 1014 | 1006 | 0 | DRY | 0.90 |
| | 10.06.2021 | **WS02** | 0 | 0 | 0.3 | 6.1 | 6.6 | 9.1 | 4.9 | 2 | 1 | 1014 | 1006 | 0 | 1.47 | 1.73 |
| | 10.06.2021 | **WS03** | 0 | 0 | 0.2 | 4.9 | 5.4 | 13.6 | 3.9 | 1 | 0 | 1014 | 1007 | 0 | DRY | 2.23 |
| | 10.06.2021 | **WS04** | 0 | 0 | 0 | 0.3 | 9.2 | 13.8 | 1.3 | 1 | 1 | 1014 | 1008 | 0 | DRY | 2.77 |
| | 10.06.2021 | **WS05** | 0 | 0 | 0 | 0.2 | 11.4 | 10.5 | 0 | 1 | 0 | 1014 | 1008 | 0 | DRY | 1.51 |
| | 10.06.2021 | **WS06** | 0 | 0 | 0 | 3.4 | 2.2 | 19.7 | 1.0 | 2 | 0 | 1014 | 1007 | 0 | DRY | 1.78 |

| | |
|---|---|
| **Weather** | **Overcast, Dry/Drizzle** |
| **Atmospheric Pressure** | **1014 (Falling)** |

| | P2288 Riverine | | Initial FLOW | Steady FLOW | Initial $CH_4$ | Initial Co2 | Steady Co2 | $O_2$ | % LEL | $H_2S$ | CO | AP | Borehole Pressure | DP | Depth to water | Depth to Base |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Date* | *ID* | *l/s* | *l/s* | *%vol* | *%vol* | *%vol* | *%* | *%* | *ppm* | *ppm* | *mb* | *mb* | *mb* | *m* | *m* |
| *Strabane* | 18.06.2021 | **WS15** | 0.0 | 0 | 0.4 | 0.3 | 10.3 | 0.0 | 8.8 | 0 | 0 | 1021 | 1019 | 0 | 2.22 | 3.89 |
| | 18.06.2021 | **WS16** | 0.0 | 0 | 0 | 1.0 | 2.1 | 19.2 | 52.8 | 1 | 0 | 1021 | 1018 | 0 | 0.69 | 3.14 |
| | 18.06.2021 | **WS17** | 0.0 | 0 | 0 | 0.4 | 12.5 | 19.8 | 0 | 1 | 0 | 1021 | 1018 | 0 | 1.81 | 3.39 |
| | 18.06.2021 | **WS18** | 0.0 | 0 | 0.6 | 0.8 | 3.3 | 16.4 | 13.6 | 1 | 0 | 1021 | 1016 | 0 | DRY | 1.68 |
| | 18.06.2021 | **WS19** | 0.0 | 0 | 0.7 | 0.6 | 4.1 | 18.7 | 71.5 | 3 | 15 | 1021 | 1015 | 0 | 2.01 | 2.90 |
| | 18.06.2021 | **WS20** | 0.0 | 0 | 0 | 0.3 | 4.1 | 14.4 | 0 | 2 | 1 | 1021 | 1019 | 0 | 2.13 | 3.79 |
| | 18.06.2021 | **WS21** | 0.0 | 0 | 0 | 0.1 | 2.0 | 18.7 | 6.8 | 2 | 0 | 1021 | 1019 | 0 | DRY | 1.62 |
| Lifford | 18.06.2021 | **WS22** | 0.0 | 0 | 0.7 | 0.3 | 0.2 | 21.9 | 15.1 | 1 | 0 | 1021 | 1015 | 0 | DRY | 2.90 |

**Weather:** Clear and dry
**Atmospheric Pressure:** 1021mb falling

| | P2288 Riverine | | Initial FLOW | Steady FLOW | Initial $CH_4$ | Initial Co2 | Steady Co2 | $O_2$ | % LEL | $H_2S$ | CO | AP | Borehole Pressure | DP | Depth to water | Depth to Base |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Date* | *ID* | *l/s* | *l/s* | *%vol* | *%vol* | *%vol* | *%* | *%* | *ppm* | *ppm* | *mb* | *mb* | *mb* | *m* | *m* |
| Strabane | 24.06.2021 | **WS15** | 0 | 0 | 0 | 0.3 | 11.1 | 0 | 0 | 1 | 3 | 1021 | 1016 | 0 | 2.27 | 3.85 |
| | 24.06.2021 | **WS16** | 0 | 0 | 1.7 | 2.2 | 2.7 | 17.6 | 91.3 | 2 | 0 | 1021 | 1016 | 0 | 0.78 | 3.05 |
| | 24.06.2021 | **WS17** | 0 | 0 | 0 | 0.3 | 10.4 | 12.9 | 0 | 2 | 0 | 1021 | 1018 | 0 | 1.85 | 3.31 |
| | 24.06.2021 | **WS18** | 0 | 0 | 0 | 1.6 | 2.2 | 17.9 | 0 | 1 | 1 | 1021 | 1016 | 0 | DRY | 1.60 |
| | 24.06.2021 | **WS19** | 0 | 0 | 0 | 2.2 | 3.9 | 18.6 | 6.7 | 1 | 0 | 1021 | 1016 | 0 | 1.23 | 2.90 |
| | 24.06.2021 | **WS20** | 0 | 0 | 0 | 0.3 | 2.0 | 17.7 | 0 | 1 | 0 | 1021 | 1016 | 0 | 2.11 | 3.85 |
| | 24.06.2021 | **WS21** | 0 | 0 | 0 | 0.2 | 0 | 20.7 | 0 | 1 | 1 | 1021 | 1018 | 0 | DRY | 1.65 |
| Lifford | 24.06.2021 | **WS22** | 0 | 0 | 0 | 0.3 | 0.1 | 22.1 | 0 | 1 | 1 | 1021 | 1017 | 0 | DRY | 2.90 |

**Weather: Wet, Raining, Overcast**
**Atmosphe 1023mb Falling**

| | P2288 Riverine | | Initial FLOW | Steady FLOW | Initial $CH_4$ | Initial Co2 | Steady Co2 | $O_2$ | % LEL | $H_2S$ | CO | AP | Borehole Pressure | DP | Depth to water | Depth to Base |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Date* | *ID* | *l/s* | *l/s* | *%vol* | *%vol* | *%vol* | *%* | *%* | *ppm* | *ppm* | *mb* | *mb* | *mb* | *m* | *m* |
| Strabane | 02.07.2021 | **WS15** | 0 | 0 | 0 | 0.4 | 11.5 | 0 | 0 | 1 | 1 | 1018 | 1011 | 0 | 2.28 | - |
| | 02.07.2021 | **WS16** | 0 | 0 | 0 | 3.1 | 3.3 | 16.9 | 71.9 | 1 | 0 | 1018 | 1011 | 0 | 0.73 | - |
| | 02.07.2021 | **WS17** | 0 | 0 | 0 | 0.2 | 6.9 | 15.3 | 0 | 2 | 1 | 1018 | 1011 | 0 | 1.88 | - |
| | 02.07.2021 | **WS18** | 0 | 0 | 0 | 0.4 | 5.9 | 11.9 | 0 | 1 | 1 | 1018 | 1011 | 0 | DRY | 1.51 |
| | 02.07.2021 | **WS19** | 0 | 0 | 0 | 0.5 | 0.1 | 20.9 | 0 | 1 | 0 | 1018 | 1011 | 0 | 0.69 | - |
| | 02.07.2021 | **WS20** | 0 | 0 | 0 | 0.3 | 0.4 | 20.4 | 0 | 1 | 1 | 1018 | 1011 | 0 | 2.12 | - |
| | 02.07.2021 | **WS21** | 0 | 0 | 0 | 0 | 1.2 | 19.8 | 0 | 1 | 0 | 1018 | 1012 | 0 | DRY | 1.61 |
| Lifford | 02.07.2021 | **WS22** | 0 | 0 | 0 | 0.4 | 0.1 | 20.7 | 0 | 0 | 1 | 1018 | 1011 | 0 | DRY | 2.89 |

**Weather:** Overcast, Dry
**Atmospheric Pressure:** 1018 Falling


| | P2288 Riverine | | Initial FLOW | Steady FLOW | Initial $CH_4$ | Initial Co2 | Steady Co2 | $O_2$ | % LEL | $H_2S$ | CO | AP | Borehole Pressure | DP | Depth to water | Depth to Base |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Date* | *ID* | *l/s* | *l/s* | *%vol* | *%vol* | *%vol* | *%* | *%* | *ppm* | *ppm* | *mb* | *mb* | *mb* | *m* | *m* |
| Strabane | 02.07.2021 | **WS15** | 0 | 0 | 0 | 0.4 | 11.5 | 0 | 0 | 1 | 1 | 1018 | 1011 | 0 | 2.28 | - |
| | 02.07.2021 | **WS16** | 0 | 0 | 0 | 3.1 | 3.3 | 16.9 | 71.9 | 1 | 0 | 1018 | 1011 | 0 | 0.73 | - |
| | 02.07.2021 | **WS17** | 0 | 0 | 0 | 0.2 | 6.9 | 15.3 | 0 | 2 | 1 | 1018 | 1011 | 0 | 1.88 | - |
| | 02.07.2021 | **WS18** | 0 | 0 | 0 | 0.4 | 5.9 | 11.9 | 0 | 1 | 1 | 1018 | 1011 | 0 | DRY | 1.51 |
| | 02.07.2021 | **WS19** | 0 | 0 | 0 | 0.5 | 0.1 | 20.9 | 0 | 1 | 0 | 1018 | 1011 | 0 | 0.69 | - |
| | 02.07.2021 | **WS20** | 0 | 0 | 0 | 0.3 | 0.4 | 20.4 | 0 | 1 | 1 | 1018 | 1011 | 0 | 2.12 | - |
| | 02.07.2021 | **WS21** | 0 | 0 | 0 | 0 | 1.2 | 19.8 | 0 | 1 | 0 | 1018 | 1012 | 0 | DRY | 1.61 |
| Lifford | 02.07.2021 | **WS22** | 0 | 0 | 0 | 0.4 | 0.1 | 20.7 | 0 | 0 | 1 | 1018 | 1011 | 0 | DRY | 2.89 |

**Weather:** Overcast, Dry
**Atmospheric Pressure:** 1018 Falling

| | P2288 Riverine | | Initial FLOW | Steady FLOW | Initial $CH_4$ | Initial Co2 | Steady Co2 | $O_2$ | % LEL | $H_2S$ | CO | AP | Borehole Pressure | DP | Depth to water |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Date* | *ID* | *l/s* | *l/s* | *%vol* | *%vol* | *%vol* | *%* | *%* | *ppm* | *ppm* | *mb* | *mb* | *mb* | *m* |
| Strabane | 02.07.2021 | **WS15** | 0 | 0 | 0 | 0.4 | 11.5 | 0 | 0 | 1 | 1 | 1018 | 1011 | 0 | 2.28 |
| | 02.07.2021 | **WS16** | 0 | 0 | 0 | 3.1 | 3.3 | 16.9 | 71.9 | 1 | 0 | 1018 | 1011 | 0 | 0.73 |
| | 02.07.2021 | **WS17** | 0 | 0 | 0 | 0.2 | 6.9 | 15.3 | 0 | 2 | 1 | 1018 | 1011 | 0 | 1.88 |
| | 02.07.2021 | **WS18** | 0 | 0 | 0 | 0.4 | 5.9 | 11.9 | 0 | 1 | 1 | 1018 | 1011 | 0 | DRY |
| | 02.07.2021 | **WS19** | 0 | 0 | 0 | 0.5 | 0.1 | 20.9 | 0 | 1 | 0 | 1018 | 1011 | 0 | 0.69 |
| | 02.07.2021 | **WS20** | 0 | 0 | 0 | 0.3 | 0.4 | 20.4 | 0 | 1 | 1 | 1018 | 1011 | 0 | 2.12 |
| | 02.07.2021 | **WS21** | 0 | 0 | 0 | 0 | 1.2 | 19.8 | 0 | 1 | 0 | 1018 | 1012 | 0 | DRY |
| Lifford | 02.07.2021 | **WS22** | 0 | 0 | 0 | 0.4 | 0.1 | 20.7 | 0 | 0 | 1 | 1018 | 1011 | 0 | DRY |

**Weather:** Overcast, Dry
**Atmospheric Pressure:** 1018 Falling

| | P2288 Riverine | | Initial FLOW | Steady FLOW | Initial $CH_4$ | Initial Co2 | Steady Co2 | $O_2$ | % LEL | $H_2S$ | CO | AP | Borehole Pressure | DP | Depth to water | Depth to Base |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Date* | *ID* | *l/s* | *l/s* | *%vol* | *%vol* | *%vol* | *%* | *%* | *ppm* | *ppm* | *mb* | *mb* | *mb* | *m* | *m* |
| Strabane | 08.07.2021 | **HA10** | 0 | 0 | 0 | 0.7 | 0.6 | 20.8 | 0 | 0 | 1 | 1018 | 1016 | 0 | Dry | 1.98 |
| | 08.07.2021 | **HA13** | 0 | 0 | 0 | 0 | 0 | 20.9 | 0 | 0 | 1 | 1019 | 1014 | 0 | 1.6 | 1.83 |
| | 08.07.2021 | **WS07** | 0 | 0 | 0 | 0.1 | 0 | 20.9 | 0 | 1 | 0 | 1018 | 1015 | 0 | 1.18 | 3.45 |
| | 08.07.2021 | **WS08** | 0 | 0 | 0 | 0 | 4.3 | 16.0 | 0 | 1 | 0 | 1018 | 1015 | 0 | 2.62 | 2.86 |
| | 08.07.2021 | **WS09** | 0 | 0 | 0 | 0.5 | 12.1 | 10.1 | 0 | 0 | 0 | 1018 | 1015 | 0 | 1.39 | 2.91 |
| | 08.07.2021 | **WS10** | 0 | 0 | 0 | 0.1 | 4.7 | 8.2 | >>> | 2 | 2 | 1018 | 1015 | 0 | 0.96 | 3.88 |
| | 08.07.2021 | **WS11** | 0 | 0 | 0.5 | 4.5 | 4.8 | 11.0 | 3.0 | 1 | 1 | 1018 | 1015 | 0 | 0.87 | 1.19 |
| | 08.07.2021 | **WS12** | 0 | 0 | 0 | 0.2 | 0.6 | 20.5 | 0 | 2 | 1 | 1018 | 1015 | 0 | 1.56 | 1.86 |
| | 08.07.2021 | **WS13** | 0 | 0 | 0 | 0.6 | 0.7 | 20.2 | 0 | 1 | 1 | 1018 | 1015 | 0 | 2.12 | 2.95 |
| | 08.07.2021 | **WS14** | 0 | 0 | 0 | 2.3 | 1.3 | 19.7 | 16.6 | 2 | 1 | 1018 | 1015 | 0 | 1.92 | 2.86 |
| | 09.07.2021 | **WS15** | 0 | 0 | 0 | 0.1 | 11.8 | 0 | 1.1 | 2 | 1 | 1019 | 1014 | 0 | 2.37 | 3.78 |
| | 09.07.2021 | **WS16** | 0 | 0 | 0 | 0.4 | 1.1 | 19.7 | 52.3 | 1 | 0 | 1019 | 1014 | 0 | 0.68 | 2.86 |
| | 09.07.2021 | **WS17** | 0 | 0 | 0 | 0.1 | 7.4 | 14.2 | 0 | 2 | 1 | 1019 | 1015 | 0 | 1.90 | 3.22 |
| | 09.07.2021 | **WS18** | 0 | 0 | 0.1 | 0.1 | 6.8 | 11.7 | 2.1 | 2 | 3 | 1019 | 1014 | 0 | DRY | 1.60 |
| | 09.07.2021 | **WS19** | 0 | 0 | 0 | 0.5 | 0 | 21.0 | 1.5 | 2 | 1 | 1019 | 1014 | 0 | 0.72 | 2.89 |
| | 09.07.2021 | **WS20** | 0 | 0 | 0 | 0.1 | 0.4 | 20.5 | 0 | 2 | 1 | 1019 | 1015 | 0 | 2.13 | 3.37 |
| | 09.07.2021 | **WS21** | 0 | 0 | 0 | 0.6 | 0.8 | 20.0 | 0 | 2 | 3 | 1019 | 1015 | 0 | DRY | 1.63 |
| Lifford | 08.07.2021 | **HA08** | 0 | 0 | 0 | 5.1 | 0.1 | 20.9 | 0 | 1 | 0 | 1018 | 1015 | 0 | 0.73 | 1.50 |
| | 08.07.2021 | **HA23** | 0 | 0 | 0.2 | 3.9 | 0.3 | 21.1 | 6.4 | 2 | 0 | 1014 | 1006 | 0 | DRY | 0.90 |
| | 08.07.2021 | **WS02** | 0 | 0 | 0 | 0.6 | 9.1 | 4.8 | 0 | 2 | 1 | 1018 | 1016 | 0 | 1.36 | 1.73 |
| | 08.07.2021 | **WS03** | 0.0 | 0 | 0.3 | 4.5 | 7.8 | 9.2 | 14.1 | 1 | 1 | 1018 | 1011 | 0 | 2.37 | 2.40 |
| | 08.07.2021 | **WS04** | 0.0 | 0 | 0.1 | 5.6 | 7.3 | 15.0 | 6.8 | 1 | 1 | 1018 | 1012 | 0 | DRY | 2.93 |
| | 08.07.2021 | **WS05** | 0 | 0 | 0.6 | 0.9 | 6.2 | 15.9 | 0 | 1 | 0 | 1018 | 1015 | 0 | DRY | 1.53 |
| | 08.07.2021 | **WS06** | 0 | 0 | 0 | 0.2 | 8.9 | 14.8 | 0.5 | 1 | 2 | 1018 | 1015 | 0 | 4.46 | 1.76 |
| | 08.07.2021 | **WS22** | 0 | 0 | 0 | 0.1 | 0.1 | 20.8 | 0 | 1 | 1 | 1018 | 1015 | 0 | 2.80 | 2.91 |

**Weather:** Overcast, Dry/Drizzle

**Atmospheric Pressu** 08.07.2021 = 1018 Constant,
09.07.2021 = 1019 Falling

| P2288 Riverine | Date | ID | Initial FLOW | Steady FLOW | Initial $CH_4$ | Initial Co2 | Steady Co2 | $O_2$ | % LEL | $H_2S$ | CO | AP | Borehole Pressure | DP | Depth to water | Depth to Base |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | *l/s* | *l/s* | *%vol* | *%vol* | *%vol* | *%* | *%* | *ppm* | *ppm* | *mb* | *mb* | *mb* | *m* | *m* |
| Lifford | 15.07.2021 | **WS23** | 0 | 0 | 0 | 1.9 | 2.5 | 20.5 | 0 | 0 | 1 | 1027 | 1008 | 0 | DRY | 2.90 |
| Lifford | 23.07.2021 | **WS23** | 0 | 0 | 0 | 4.0 | 3.7 | 20.6 | 0 | 1 | 1 | 1017 | 1001 | 0 | DRY | 2.90 |
| Lifford | 29.07.2021 | **WS23** | 0 | 0 | 0 | 2.3 | 0.4 | 20.9 | 0 | 0 | 0 | 1005 | 999 | 0 | DRY | 2.90 |
| Lifford | 04.08.2021 | **WS23** | 0 | 0 | 0 | 1.8 | 0.1 | 21.2 | 0 | 0 | 0 | 1011 | 1002 | 0 | DRY | 2.90 |

| P2288 Riverine | | | Initial FLOW | Steady FLOW | Initial $CH_4$ | Initial Co2 | Steady Co2 | $O_2$ | % LEL | $H_2S$ | CO | AP | Borehole Pressure | DP | Depth to water | Depth to Base |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Date* | *ID* | *l/s* | *l/s* | *%vol* | *%vol* | *%vol* | *%* | *%* | *ppm* | *ppm* | *mb* | *mb* | *mb* | *m* | *m* |
| Strabane | 23.07.2021 | HA10 | 0 | 0 | 0 | 0.5 | 0.4 | 20.6 | 0 | 0 | 1 | 1018 | 1002 | 0 | Dry | 1.98 |
| Strabane | 23.07.2021 | HA13 | 0 | 0 | 0 | 0 | 0 | 21.2 | 0 | 1 | 0 | 1018 | 1002 | 0 | 1.54 | 1.84 |
| Lifford | 23.07.2021 | HA23 | 0 | 0 | 0 | 1.2 | 0.6 | 20.1 | 0 | 0 | 1 | 1018 | 1002 | 0 | Dry | 0.90 |
| Lifford | 04.08.2021 | HA23 | 0 | 0 | 0 | 1.4 | 0.9 | 19.8 | 0 | 1 | 1 | 1011 | 1015 | 0 | Dry | 0.90 |

## Appendix 9-7

### Geotechnical Report - Lifford

# Riverine Community Park, Lifford Site – Site Investigation

# INTERPRETATIVE REPORT

| | |
|---|---|
| Client: | Donegal County Council |
| Client's Representative: | McAdams Design Ltd |
| Report No.: | 21-0553A INTERP |
| Date: | 18th August 2021 |

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## CONTENTS

Document Control Sheet

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

1 AUTHORITY ..... 5

2 SCOPE ..... 5

3 DESCRIPTION OF SITE ..... 5

4 SITE OPERATIONS ..... 6
4.1 Summary of site works ..... 6
4.2 Boreholes ..... 6
4.3 Standpipe installations ..... 7
4.4 Slit trenches ..... 7
4.5 Trial Pits ..... 7
4.6 Infiltration tests ..... 7
4.7 Indirect CBR tests (DCP) ..... 8
4.8 Surveying ..... 8
4.9 Groundwater and ground gas monitoring ..... 8

5 LABORATORY WORK ..... 8
5.1 Geotechnical laboratory testing of soils ..... 9

6 GROUND CONDITIONS ..... 9
6.1 General geology of the area ..... 9
6.2 Ground types encountered during investigation of the site ..... 9
6.3 Groundwater ..... 10

7 DISCUSSION ..... 11
7.1 Proposed construction ..... 11
7.2 Recommendations for construction ..... 11
7.2.1 Summary ..... 11
7.2.2 Soil strength parameters ..... 11
7.2.3 Bearing resistance ..... 12
7.2.4 Foundations and ground floor construction ..... 13
7.2.5 Floor slabs ..... 15
7.2.6 Excavations for services ..... 15
7.2.7 Excavations in peat ..... 15
7.2.8 Soil aggressivity ..... 16
7.2.9 Access roads, car parks and hard standing ..... 17
7.3 Infiltration drainage ..... 18

8 REFERENCES ..... 18

## APPENDICES


| | |
|---|---|
| Appendix A | Site and exploratory hole location plans |
| Appendix B | Borehole logs |
| Appendix C | Slit trench logs and drawings |
| Appendix D | Slit trench photographs |
| Appendix E | Soakaway logs and test results |
| Appendix F | Soakaway photographs |
| Appendix G | Indirect in-situ CBR test results |
| Appendix H | Groundwater monitoring records |
| Appendix I | Geotechnical laboratory test results |
| Appendix J | SPT hammer energy measurement reports |

## Document Control Sheet

| | | | | | |
|---|---|---|---|---|---|
| **Report No.:** | | 21-0553A - INTERPRETATION | | | |
| **Project Title:** | | Riverine Community Park, Lifford – Site Investigation | | | |
| **Client:** | | Donegal County Council | | | |
| **Client's Representative:** | | McAdams Design Ltd | | | |
| **Revision:** | A01 | **Status:** | Final for issue | **Issue Date:** | 18th August 2021 |
| **Prepared by:** | | **Reviewed by:** | | **Approved by:** | |
|  Carin Cornwall<br>BSc MSc PhD | |  Neil Haggan<br>BSc (Hons) MSc FGS | |  Darren O'Mahony<br>BSc MSc MIEI EurGeol PGeo | |

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+A1:2020, 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. |
| (Y for Z/ Y for Z) | Incomplete standard penetration test where the full test length was not achieved. The blows 'X' represent the total blows for the given seating or test length 'Z' (mm). |
| N=X | SPT blow count 'N' given by the summation of the blows 'X' required to drive the full test length (300mm). |
| HVP / HVR | In situ hand vane test result (HVP) and vane test residual result (HVR). Results presented in kPa. |
| V<br>VR | Shear vane test (borehole). Shear strength stated in kPa.<br>V: undisturbed vane shear strength VR: remoulded vane shear strength |
| Soil consistency description | In cohesive soils, where samples are disturbed and there are no suitable laboratory tests, N values may be used to indicate consistency on borehole logs – a median relationship of Nx5=Cu is used (as set out in Stroud & Butler 1975). |
| dd-mm-yyyy | Date at the end and start of shifts, shown at the relevant borehole depth. Corresponding casing and water depths shown in the adjacent columns. |
| ▽ | Water strike: initial depth of strike. |
| ▼ | Water strike: depth water rose to. |
| Abbreviations relating to rock core – reference Clause 36.4.4 of BS 5930: 2015 | |
| TCR (%) | Total Core Recovery: Ratio of rock/soil core recovered (both solid and non-intact) to the total length of core run. |
| SCR (%) | Solid Core Recovery: Ratio of solid core to the total length of core run. Solid core has a full diameter, uninterrupted by natural discontinuities, but not necessarily a full circumference and is measured along the core axis between natural fractures. |
| RQD (%) | Rock Quality Designation: Ratio of total length of solid core pieces greater than 100mm to the total length of core run. |
| FI | Fracture Index: Number of natural discontinuities per metre over an indicated length of core of similar intensity of fracturing. |
| NI | Non Intact: Used where the rock material was recovered fragmented, for example as fine to coarse gravel size particles. |
| AZCL | Assessed zone of core loss: The estimated depth range where core was not recovered. |
| DIF | Drilling induced fracture: A fracture of non-geological origin brought about by the rock coring. |
| (xxx/xxx/xxx) | Spacing between discontinuities (minimum/average/maximum) measured in millimetres. |

# Riverine Community Park, Lifford

## 1 AUTHORITY

On the instructions of McAdams Design Ltd, ("the Client's Representative"), acting on the behalf of Donegal County Council ("the Client"), a ground investigation was undertaken at the above location to provide geotechnical information for input to the design and construction of a proposed community park development.

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

All information given in this report is based upon the ground conditions encountered during the 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, slit trenches, soakaway tests, indirect CBR tests, ground water monitoring, soil sampling, in-situ and laboratory testing, and the preparation of a report on the findings including recommendations for construction.

## 3 DESCRIPTION OF SITE

As shown on the site location plans in Appendix A, the works were conducted on both sides of the River Foyle at Lifford and Strabane. The works on the Lifford side were completed on the lands of the local hare coursing club, football club and associated adjacent public lands along the western bank of the river

The site is flat within the areas of the coursing club, playing fields with surrounding areas generally overgrown and sloping downwards towards the riverbank.

# 4 SITE OPERATIONS

## 4.1 Summary of site works

Site operations, which were conducted between 20th May and 2nd July 2021, comprised:

- five light cable percussion boreholes
- rotary percussion follow-on in five boreholes
- a standpipe installation in two boreholes
- two machine dug slit trenches
- four machine dug trial pits
- an infiltration test performed in four trial pits
- indirect CBR tests at thirty-four 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

Five boreholes (BH02, and BH05-BH08) were put down to completion in minimum 200mm diameter using a light cable percussion boring rig and rotary follow-on drilling techniques. Where the cable percussion borehole had not been advanced onto bedrock, rotary percussive methods were employed to advance the borehole to completion depths. Symmetrix cased full-hole drilling was used, with SPTs carried out at standard intervals as required.

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 (UT100) 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+A1:2011 at standard depth intervals using the split spoon sampler ($SPT_{(s)}$) or solid cone attachment ($SPT_{(c)}$). The penetrations are stated for those tests for which the full 150mm seating drive or 300mm test drive was not possible. The N-values provided on the borehole logs are uncorrected and no allowance has been made for energy ratio corrections. The SPT hammer energy measurement report is provided in Appendix J.

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

Where water was added to assist with boring, a note has been added to the log to account for same. Appendix B presents the borehole logs.

## 4.3 Standpipe installations

A groundwater monitoring standpipe was installed in boreholes BH02 and BH05

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

## 4.4 Slit trenches

Two slit trenches (UT 001 and UT 002) were excavated by a combination of hand digging and mechanical excavation using a compact 3t tracked excavator fitted with a 600mm wide toothless bucket, to locate and identify any potential buried services at the site.

Drawing of the trenches and the locations of services encountered during excavation are shown along with the slit trench logs in Appendix C, with photographs presented in Appendix D.

## 4.5 Trial Pits

Four trial pits (INFIL 001 – INFIL 004) were excavated using a 3t tracked excavator fitted with a 600mm wide bucket, to depths of 2.00m. All trial pits were excavated to allow completion of infiltration test.

Disturbed (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 E presents the trial pit logs with photographs of the pits and arising provided in Appendix F.

## 4.6 Infiltration tests

An infiltration/soakaway test was carried out at four locations (INFIL 001 – INFIL 004) in accordance with BRE Digest 365 - Soakaways (BRE, 2016). The tests were conducted in similarly numbered trial pits.

The absence of the outflow from a number of the pits precluded calculation of infiltration coefficients; results were obtained for INFIL 001 location.

Appendix E presents the results and analysis of the infiltration tests with photographs of the trial pits in Appendix F.

## 4.7 Indirect CBR tests (DCP)

An indirect CBR test was conducted at thirty-four locations (CBR01 – CBR29, INFIL 001 - INFIL 004, UT 001 and UT 002) 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 G 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 at depth are a consequence of the coarse-grained content of the penetrated soils and are often not representative of the soil matrix.

## 4.8 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. All elevations given are referenced to existing ground level for all exploratory hole locations.

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.

## 4.9 Groundwater and ground gas monitoring

Following completion of site works, groundwater monitoring was conducted over four rounds. Ground water monitoring was carried out using a water interface probe. A digital datalogger was also installed in borehole BH02 for a period of approximately 1 week; the reported data has been provided separately.

The monitoring records are presented in Appendix H.

# 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.
- **compressibility:** one dimensional consolidation (oedometer)
- **shear strength** (total stress): unconsolidated undrained triaxial tests
- **direct shear:** small shear box tests
- **soil chemistry:** pH and water-soluble sulphate content, BRE Suite A (greenfield – no pyrite), and BRE Suite C (brownfield – no pyrite)

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 I.

## 6 GROUND CONDITIONS

### 6.1 General geology of the area

Published geological mapping indicate the superficial deposits underlying the site comprise tidal flat deposits, peat, and fluvioglacial sands and gravels. These deposits are underlain at depth by quartzites of the Dungiven and Killeter Quartzite Formations.

### 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 100-300mm thickness across the site.
- **Made Ground (granular fill):** reworked gravelly sand with building waster throughout; encountered in UT 002 beneath the topsoil from 0.30-2.30m.
- **Made Ground (cohesive fill):** reworked sandy silt and clay fill encountered at shallow depths in both BH02 (0.00-0.20m) and BH05 (0.20-0.60m).

- **Recent deposits (peat):** no purely peat deposits were encountered, however peaty sands were found in BH02 from 0.60-2.20m), and organic-rich silts and clays were found in BH05 (0.60-2.80m) and BH08 (0.10-1.20m).

- **Tidal flat deposits:** typically, very soft to soft (locally firm to stiff) sometimes organic silts/clays or very loose to loose silty sands found immediately beneath the topsoil across the majority of site areas. Generally, in the order of between 2.00-3.00m deep; the deepest deposits were found to 3.60m at BH05 location.

- **Fluvioglacial deposits:** typically, medium dense to very dense sands and gravels, frequently with cobbles and boulders. Found to persist in BH02, BH06, BH07, BH08 to 20.00m termination depth, and in BH05 to 25.00m termination depth.

## 6.3 Groundwater

Groundwater was encountered during percussion boring through soil as water strikes at between 9.0-19.00m in all boreholes; BH02 struck at 13.00m and rose to 4.00m (20mins), BH05 struck at 19.00m and rose to 3.00m (20mins), BH06 struck at 13.00m and 17.50m and rise to 4.00m and 4.00m respectively (20mins), BH07 struck at 13.00m, 16.00m and 19.00m and rose to 5.00m, 4.00m and 4.50m respectively (20mins), and BH08 struck at 14.50m and rose to 5.00m (20mins). Groundwater was not encountered in any of the trial pits and trenches.

The groundwater at depth beneath the site appears to be under pressure, likely affected by the tidal nature of the River Foyle running adjacent to the site. In a number of holes there are “fines” noted in the granular material immediately above the layer containing the water strikes which would go some way to explaining why we are seeing the large groundwater rises noted on the logs when the rotary rig penetrates the groundwater bearing strata.

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.

Continued monitoring of the installed standpipes will give an indication of the seasonal variation in groundwater level which should be factored into design considerations.

Details of further groundwater monitoring, are presented in Appendix H.

# 7 DISCUSSION

## 7.1 Proposed construction

It is proposed to construct a new community park development on the site with footbridge and associated infrastructure. There will be a number of structures including a pedestrian and cycle bridge between Lifford and Strabane, Riverine Park Building, multi-functional outdoor space and external stage provision, play area, river walk and access, landscaped greenspaces interlaced with a network of pathways and cycleways, wetlands supported by car parking provision.

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

## 7.2 Recommendations for construction

### 7.2.1 Summary

Some parts of the site will allow the implementation of traditional shallow (spread) foundations; strip/pad (BH07) and deep trench fill (BH08) are considered suitable.

In all other site areas (BH02, BH05 and BH06) the ground conditions (highly variable alluvial deposits with fluvioglacial material at depth), coupled with the relatively shallow groundwater table will render the implementation of any shallow (spread) foundations problematic. The variation between fine and coarse grained soils across the footprints of the building units could also lead to the occurrence of differential settlements, which should be avoided. It follows that the most practicable solution for installing safe working foundations in these areas of the site will be by a “deep” foundation method, such as piling to transfer loadings to depth.

### 7.2.2 Soil strength parameters

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

$$C_u = f_1 \times N$$

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

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

### 7.2.3 Bearing resistance

The ultimate bearing resistance for conventional strip or pad foundations can be obtained from Brinch Hansen's general equation:

$$q_n = cN_c s_c d_c l_c b_c + p_o N_q s_q d_q l_q b_q + \frac{1}{2}\gamma B N_\gamma s_\gamma d_\gamma l_\gamma b_\gamma$$

(Equation 1)

where:

$q_n$ = ultimate bearing resistance
c = undrained cohesion of soil
B = foundation width
$p_o$ = effective overburden pressure at foundation level
Nc, Nq, Nγ = bearing capacity factors
$s_c$, $s_q$, $s_\gamma$ = shape factors
$d_c$, $d_q$, $d_\gamma$ = depth factors
$l_c$, $l_q$, $l_\gamma$ = load inclination factors
$b_c$, $b_q$, $b_\gamma$ = base inclination factors

For conventional strip and pad foundations constructed on fine soils, the general equation has been simplified by Terzaghi to:

$$\text{Net ultimate bearing resistance} = cN_c$$

(Equation 2)

where:

c = undrained cohesion
$N_c$ = bearing capacity factor

For cohesionless soils (sand/gravel, c=0), the calculation of ultimate bearing resistance is generally required only for loose sands. This is because coarser gravel soils would not be expected to suffer a bearing capacity failure. However, limits are placed on the allowable bearing resistance in order to control settlement. For shallow conventional pad foundations on granular soils, Terzaghi's simplified equation can be used as follows:

$$q_n = p_o(N_q - 1) + 0.4BN + p$$

(Equation 3)

where:

p = total overburden pressure

It is obvious from the equations 1 to 3 that some knowledge of the foundation width and depth is required before the ultimate bearing resistance can be calculated.

Table 1 provides an indication of minimum founding depth at each borehole location. The table also suggests allowable bearing resistance using Equations 2 and 3 for cohesive and cohesionless soils respectively.

This table does not take into account the variations in soil composition, and the effects of differential movement within a particular structure. Calculation of the design bearing resistance over the entire structure will entail a knowledge of the magnitude and distribution of the structural actions.

### 7.2.4 Foundations and ground floor construction

Foundations should transfer loading to below any Made Ground or subsoil. The recommended foundation construction and allowable bearing pressure (ABP) at the borehole locations are presented in Table 1.

**Table 1: Construction recommendations**

| Borehole | Depth below EGL* to suitable bearing stratum | Estimated ABP (kPa) | Strata description | Foundation type | Ground floor construction | Groundwater (mbgl) |
|---|---|---|---|---|---|---|
| BH02 | 16.00m | >250 | Very dense GRAVEL | Piled | Suspended | Struck 13.00m<br>Install 2.00m |
| BH05 | 9.00m | >250 | Very dense GRAVEL | Piled | Suspended | Struck 19.00m<br>Install 2.50m |
| BH06 | 16.00m | >250 | Very dense GRAVEL | Piled | Suspended | Struck 13.00m and 17.50m |
| BH07 | 1.90m | >200 | Medium dense GRAVEL | Strip & pad | Ground bearing | Struck 13.00m, 16.00m and 19.00m |
| BH08 | 3.00m | >200 | Medium dense GRAVEL | Deep Trench fill (with trench support and possible sump pumping) | Suspended | Struck 14.50m |

*Existing Ground Level

Based on the findings of the site investigation, spread foundations (strip/pad and trench fill) are considered suitable in the areas of BH07 (store) and BH08 (viewing platform) with estimated allowable bearing pressures >200kPa at depths between 1.90m and 4.00m on medium dense granular material.

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

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

In other parts of the site (BH02, BH05, BH06) the thickness of very soft alluvial deposits and very loose fluvioglacial deposits across the footprints of the proposed buildings/construction areas makes the implementation of traditional shallow (spread) foundations unsuitable. Consequently, the most practicable foundation solution will be by a "deep" foundation method, such as piling to transfer loadings to depth.

The practicable alternative foundation solutions are:

1. Piling to transfer loadings to depth:

Piling to transfer loadings to depth is suggested to be the most practicable and applicable option given the variation in depth to a consistent bearing stratum across the site, coupled with the relatively shallow water table which would be problematic for any open trench shallow foundation systems.

Driven piles are the preferred pile type – precast concrete or steel/ductile iron. The piles should be driven to a predetermined set – each pile will, therefore, be effectively proof tested by the installation method.

If the surrounding land use precludes the use of hard drive piles, due to environmental restrictions with respect to noise and vibration, low vibration driven piles, continuous flight auger (CFA) or continuous helical displacement (CHD) piles will be required.

Piles will acquire capacity from shaft friction through the alluvial and glacial deposits, and end bearing within the very dense gravels.

Where site levels are to be raised, piles should be designed to resist additional loading that will arise due to negative skin friction along the pile length passing through Made Ground and soft soils.

The detailed design of piles should be undertaken in conjunction with specialist piling contractors. Their proposals should include the means to verify that the required load capacity has been achieved: for example, dynamic pile tests and/or static load tests.

Where pile foundation solution is adopted, floor slabs should be supported by ground beams spanning between piles caps supported by piles.

### 7.2.5 Floor slabs

Floor slabs should not bear directly onto Made Ground or soft soils. Consequently, the use of ground bearing floor slabs is considered appropriate at BH07 location following the removal of any surface Made Ground and soft silt/clay layers and their replacement using well-graded well-compacted granular fill. However, a suspended floor slab should be adopted where the difference in levels of the proposed floor and the base of Made Ground/soft soils is greater than 900mm.

Given the piled and deep trench solutions in other site areas, a suspended floor slab will be required at BH02, BH05, BH06 and BH08 locations. The use of intermediate lines of support stub walls would reduce the spans required for flooring units.

### 7.2.6 Excavations for services

For the installation of services ducts/trenches, it is suggested that open trenching will be the most practicable construction method. Generally speaking, the ground conditions should render the use of open trenching by backhoe excavator possible, with some trench support required for the uppermost granular stratum.

Where working in open trenches, it is thought that trench support systems, by way of a trench box (or possibly sheet piles), will be required to maintain trench stability and safe working conditions. Groundwater control at these locations should be possible by means of sump pumping.

To preclude the eventuality of differential settlements in pipes, they should be laid on a consistent stratum of appropriate allowable bearing capacity and protected with appropriate fill cover.

Where ducts and chambers must be installed in areas where localised soft spots are encountered, the use of geogrid reinforcement along the base of the excavation on is recommended. This will stiffen the base of the trench and help control longitudinal differential settlement.

Backfilling of trenches may be completed by using compacted Cl 804 granular fill and reinstated as appropriate.

### 7.2.7 Excavations in peat

The site logs show some organic deposits near surface in BH02, BH05 and BH08. Peaty sands found in BH02 from 0.60-2.20m, organic clay found in BH05 from 0.60-2.80m, and organic silt in BH08 from 0.10-1.20m.

Generally speaking, where peaty/organic soils are present in excess of 2.50m thickness, it is known to pose problems in excavations. The thickness of peat present across the site typically falls well below this threshold, and as such the proposed locations should be considered viable, with insignificant risk ratings with regard to peat slide potential.

Given the mean peat thickness across the locations of any proposed pipe/ducts routes, there should be no significant impact on the proposed construction.

#### 7.2.7.1 Mitigation measures

To further reduce the risk for peat slide potential, a number of mitigation measures may be adopted:

- Spoil heaps should not be spread over existing peat layers in thickness >0.50m and should not be placed downslope of adjacent peat. Instead, it should be deposited on the flanks of the excavation and spread out to limit the surcharge pressure on sensitive peat
- Maintain vigilance of open excavations during and after periods of prolonged precipitation, where risk of mobility of peat is greatest
- Trench support systems should be employed – locally trench boxes should suffice, in regions of laterally extensive peat then a more fixed shoring system should be installed.
- The duration that the excavation is open should be limited
- A comprehensive monitoring regime should be set up during construction works such that ground movement and groundwater conditions are being constantly monitored by a qualified, competent and experienced professional.

#### 7.2.7.2 Conclusion

By adhering to best practicable means and adopting the mitigation measures outlined above, coupled with the generally thin peat deposits (<1m thick) and lack of significant shallow groundwater strikes in trial pit excavations, it is thought that there is minimal potential for adverse impact to the stability of the peat land across the site.

### 7.2.8 Soil aggressivity

An assessment of the Aggressive Chemical Environment for Concrete (ACEC) was undertaken through reference to the Building Research Establishment (BRE) Special Digest 1 (2017).

As noted by BRE Special Digest 1, sulphates in the soil and groundwater are the chemical agents most likely to attack concrete. The extent to which sulphates affect concrete is linked to their concentrations, the type of ground, the presence of groundwater, the type of concrete and the form of construction in which concrete is used.

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

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

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

The results of chemical tests (pH and water-soluble sulphate contents) on soil samples indicate Design Sulphate Class DS-2 and ACEC Class AC-1s – reference Table C1 of BRE Special Digest 1 (Building Research Establishment, 2005). The Special Digest does not require any measures to protect underground concrete elements greater that 140mm thick.

### 7.2.9 Access roads, car parks and hard standing

Based on a summary of the CBR tests undertaken at the site, it is envisaged that the upper alluvial layers at the site would be suitable for the placement of road make up layers. Most areas across the site have CBR values in excess of 5% at a depth of 0.5mbgl.

Table 2.1 of volume 7 section2 of the Design Manual for Roads and Bridges (below), gives guidance on the average thickness of the pavement layers in relation to the CBR results. As can be seen, a CBR in excess of 5% requires a 400mm thick capping layer.

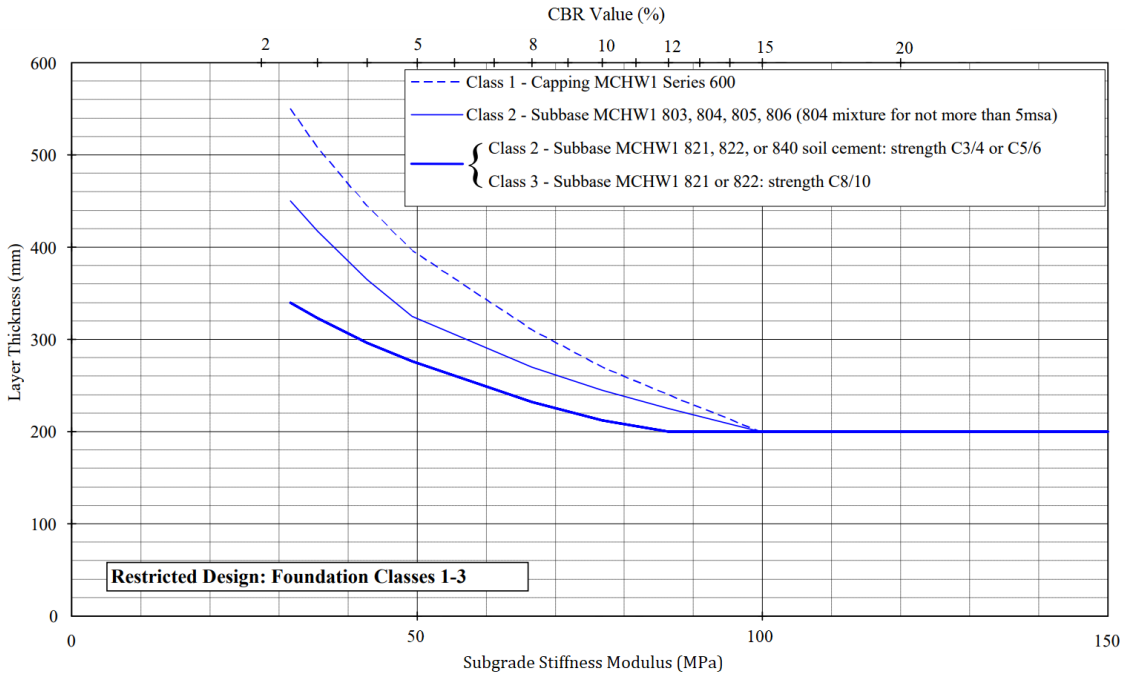



**Table 2.1 (DMRB Vol.7 Sec2) 2009**

Testing indicated potentially lower CBR values in the northern parts of the site (e.g. CBR 017, 018, 020, 021, 023, 025, and 026). The above plot should be used to determine the thicknesses of any capping or sub-base layers that may need to be placed in these areas.

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

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

## 7.3 Infiltration drainage

In infiltration test carried out in trial pit INFIL 001, the rate of infiltration was calculated as 0.555, 0.513, and 0.478m/hr across the three tests. The rates of infiltration coupled with the soil descriptions imply that the subsoil may be considered suitable media for an infiltration drainage system.

Infiltration tests were also carried out in trial pits INFIL 002, INFIL 003 and INFIL 004; the rate of infiltration was too small to determine at both locations. The low-permeability fine-grained soils are therefore considered to be poor infiltration media and would be deemed unsuitable for the implementation of infiltration drainage systems at these locations.

Reference should be made the Sustainable Drainage Systems (SuDS) design guidance, taking into account meteorological conditions and a hydrogeological assessment.

# 8 REFERENCES

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

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

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

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

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

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

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

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

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

CAUSEWAY GEOTECH

# APPENDIX A

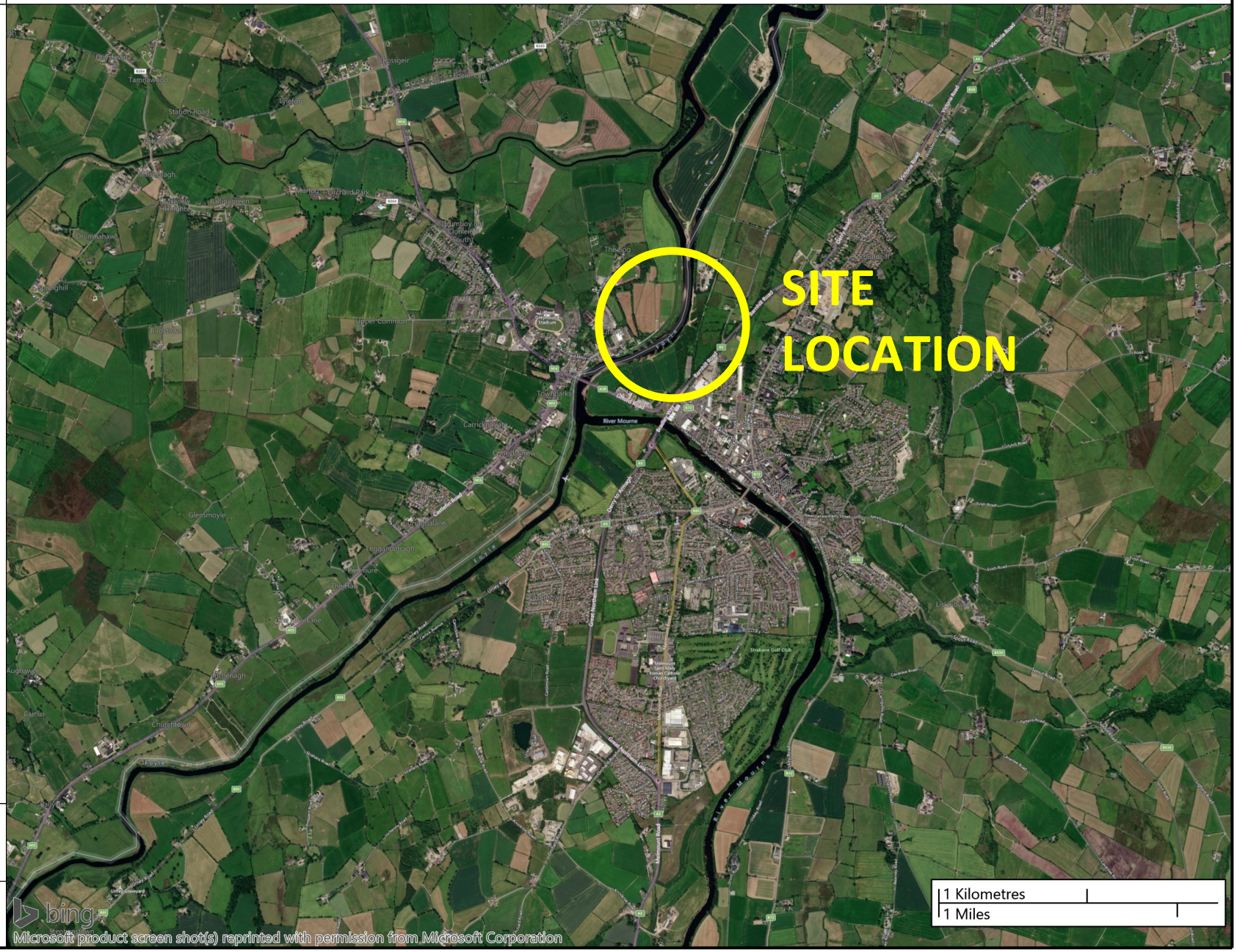
# SITE AND EXPLORATORY HOLE LOCATION PLAN



CAUSEWAY GEOTECH

| | | | |
|---|---|---|---|
| **Project No.:** | 21-0553A | **Client:** | Donegal County Council |
| **Project Name:** | Riverine Community Park, Lifford Site | **Client's Representative:** | McAdam Design Ltd |

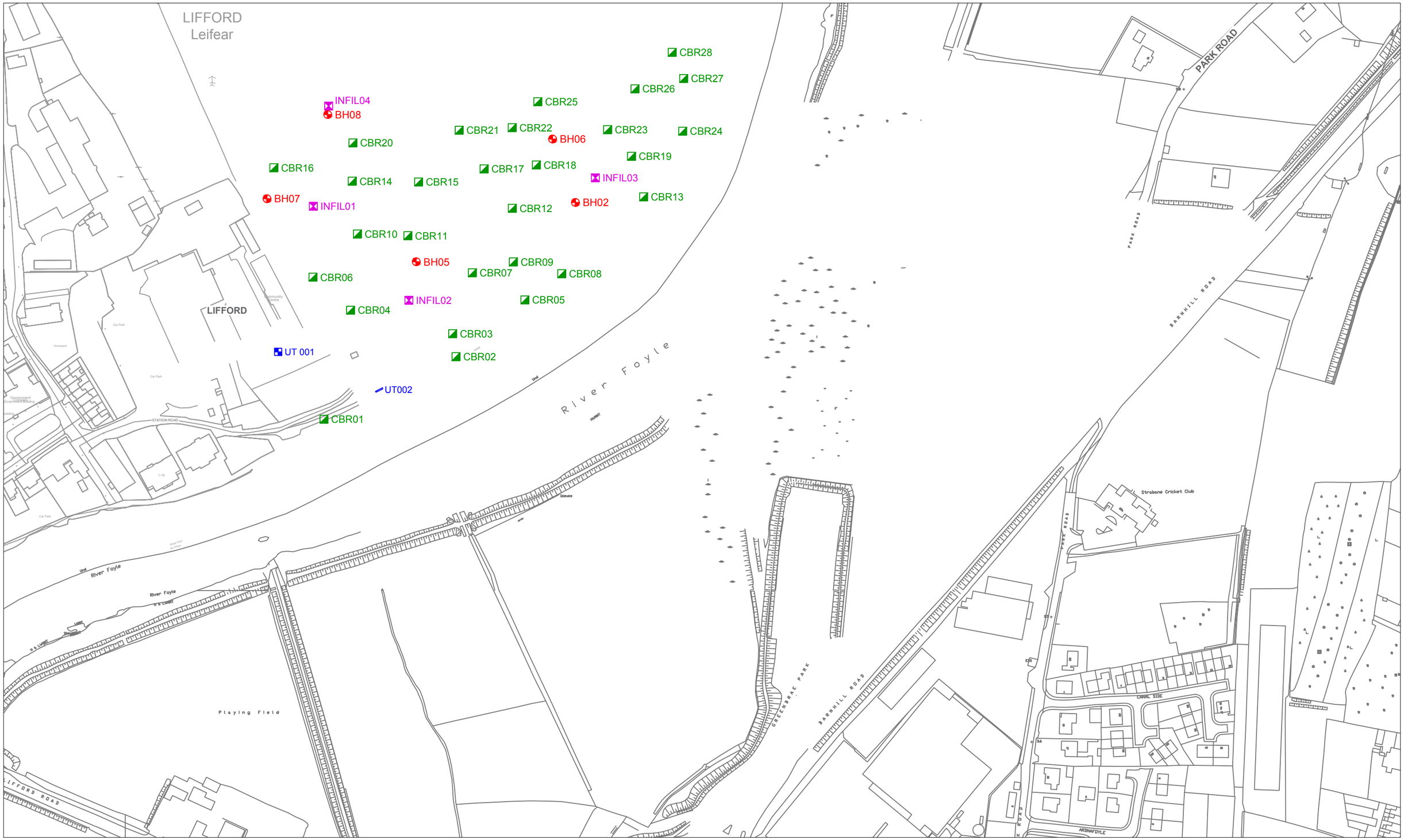
Legend Key




**Title:**

Site Location Plan

| **Last Revised:** | **Scale:** |
|---|---|
| 26/07/2021 | 1:37500 |




| | | | | | |
|---|---|---|---|---|---|
| PROJECT: Riverine Community Park, Lifford | | TITLE: Exploratory hole location plan | | | |
| CLIENT: Donegal County Council | KEY: Borehole; Utilities Trench; California Bearing Ratio; Infiltration Test | CAUSEWAY GEOTECH | SCALE: NTS@A3 | DATE: 26/07/2021 | |
| ENGINEER: McAdam Design Ltd | | | DRWN: BS<br>CHCK: NH | SERIES: 1 of 1 | DWG No: 21-0553A-EHL-001 |

CAUSEWAY GEOTECH

# APPENDIX B

# BOREHOLE LOGS



CAUSEWAY GEOTECH

| Project No. | Project Name: | Borehole ID |
|---|---|---|
| 21-0553 | Riverine Community Park, Lifford Site | BH02 |
| | Client: Donegal County Council | |
| | Client's Rep: McAdam Design Ltd | |

| Method | Plant Used | Top (m) | Base (m) | Coordinates |
|---|---|---|---|---|
| Cable Percussion | Dando 2000 | 0.00 | 11.30 | |
| Rotary Drilling | Comacchio 405 | 11.30 | 20.00 | 233939.82 E |
| | | | | 398692.86 N |

| Final Depth: | 20.00 m | Start Date: | 08/06/2021 | Driller: | MK+KW | Sheet 1 of 3 |
|---|---|---|---|---|---|---|
| Elevation: | 2.64 mOD | End Date: | 02/07/2021 | Logger: | NH | Scale: 1:50 |
| | | | | | | FINAL |

| Depth (m) | Sample / Tests | Field Records | Casing Depth (m) | Water Depth (m) | Level mOD | Depth (m) | Legend | Description | Water | Backfill |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 2.44 | 0.20 | | MADE GROUND: Firm grey SILT. | | |
| | | | | | | | | Very soft brown fine to coarse SAND. | | |
| 0.50 | B1 | | | | | | | | | |
| 0.50 | D9 | | | | 2.04 | 0.60 | | | | |
| | | | | | | | | Very soft brown and black slightly gravelly silty peaty fine to coarse SAND. Gravel is subangular to subrounded fine to medium. | | |
| 1.00 | B2 | | | | | | | | | |
| 1.00 | D10 | | | | | | | | | |
| 1.20 - 1.65 | SPT (C) | N=2 (0,0/1,0,0,1) Hammer SN = 0199 | 1.20 | Dry | | | | | | |
| 2.00 | B3 | | | | | | | | | |
| 2.00 | D11 | | | | 0.44 | 2.20 | | | | |
| 2.00 - 2.45 | SPT (C) | N=3 (1,0/1,0,1,1) Hammer SN = 0199 | 2.00 | Dry | | | | Very loose to loose brown sandy subangular to subrounded fine to coarse GRAVEL. Sand is fine to coarse. | | |
| 3.00 | B4 | | | | | | | | | |
| 3.00 | D12 | | | | | | | | | |
| 3.00 - 3.45 | SPT (C) | N=4 (1,2/2,1,0,1) Hammer SN = 0199 | 3.00 | 2.50 | | | | | | |
| 4.00 | B5 | | | | | | | | | |
| 4.00 | D13 | | | | | | | | | |
| 4.00 - 4.45 | SPT (C) | N=9 (3,1/1,2,2,4) Hammer SN = 0199 | 4.00 | 2.00 | | | | | | |
| | | | | | -1.86 | 4.50 | | Medium dense brown very sandy subangular to subrounded fine to coarse GRAVEL. Sand is fine to coarse. | | |
| 5.00 | B6 | | | | | | | | | |
| 5.00 | D14 | | | | | | | | | |
| 5.00 - 5.45 | SPT (C) | N=11 (2,2/2,3,3,3) Hammer SN = 0199 | 5.00 | 1.90 | | | | | | |
| 6.00 | B7 | | | | | | | | | |
| 6.00 | D15 | | | | | | | | | |
| 6.00 - 6.45 | SPT (C) | N=12 (2,3/3,3,3,3) Hammer SN = 0199 | 6.00 | 2.10 | -3.66 | 6.30 | | Medium dense grey sandy subangular to subrounded fine to coarse GRAVEL. Sand is fine to coarse. | | |
| 7.50 | B8 | | | | | | | | | |
| 7.50 | D16 | | | | | | | | | |
| 7.50 - 7.95 | SPT (C) | N=10 (2,2/3,3,2,2) Hammer SN = 0199 | 7.50 | 2.50 | | | | | | |
| 7.50 | | 08-06-2021 | 7.50 | 2.50 | | | | | | |
| 9.00 | B17 | | | | | | | | | |
| 9.00 | D19 | | | | | | | | | |

**Water Strikes**

| Struck at (m) | Casing to (m) | Time (min) | Rose to (m) |
|---|---|---|---|
| 13.00 | 13.00 | 20 | 4.00 |

**Chiselling Details**

| From (m) | To (m) | Time (hh:mm) |
|---|---|---|
| 11.20 | 11.30 | 01:00 |

**Casing Details**

| To (m) | Diam (mm) |
|---|---|
| 11.30 | 200 |
| 20.00 | 200 |

**Water Added**

| From (m) | To (m) |
|---|---|
| 1.20 | 3.50 |

**Remarks**

Hand dug inspection pit excavated to 1.20m
Standpipe installation
No SPT at 14.00m due to blowing sands

| Core Barrel | Flush Type | Termination Reason | Last Updated |
|---|---|---|---|
| | | Terminated at 20.00m without encountering bedrock | 11/08/2021 |

AGS

CAUSEWAY GEOTECH

| Project No. | Project Name: | Borehole ID |
|---|---|---|
| 21-0553 | Riverine Community Park, Lifford Site | BH02 |
| | Client: Donegal County Council | |
| | Client's Rep: McAdam Design Ltd | |

| Method | Plant Used | Top (m) | Base (m) | Coordinates |
|---|---|---|---|---|
| Cable Percussion | Dando 2000 | 0.00 | 11.30 | |
| Rotary Drilling | Comacchio 405 | 11.30 | 20.00 | 233939.82 E |
| | | | | 398692.86 N |

| Final Depth: | 20.00 m | Start Date: | 08/06/2021 | Driller: | MK+KW | Sheet 2 of 3 |
|---|---|---|---|---|---|---|
| Elevation: | 2.64 mOD | End Date: | 02/07/2021 | Logger: | NH | Scale: 1:50 |
| | | | | | | FINAL |

| Depth (m) | Sample / Tests | Field Records | Casing Depth (m) | Water Depth (m) | Level mOD | Depth (m) | Legend | Description | Water | Backfill |
|---|---|---|---|---|---|---|---|---|---|---|
| 9.00 - 9.45 | SPT (C) | N=16 (5,4/4,3,4,5) Hammer SN = 0199 | 9.00 | 2.70 | | | | Medium dense grey sandy subangular to subrounded fine to coarse GRAVEL. Sand is fine to coarse. | | |
| 10.50 | B18 | | | | | | | | | |
| 10.50 | D20 | | | | | | | | | |
| 11.00 - 11.45 | SPT (C) | N=18 (4,4/4,5,5,4) Hammer SN = 0199 | 10.5 | 3.00 | | | | | | |
| 11.30 - 11.34 | SPT (C) | N=50 (25 for 40mm/50 for 5mm) Hammer SN = 0199 | 11.3 | 3.00 | | | | | | |
| 11.30 | | 11-06-2021 | 11.3 | 3.00 | | | | | | |
| 13.00 - 13.45 | SPT (C) | N=35 (6,10/8,8,9,10) Hammer SN = 0210<br>Strong inflow at 13.00m | 13.0 | 4.00 | -10.36 | 13.00 | | Dense greyish brown gravelly silty fine to coarse SAND. Gravel is subangular to subrounded fine to coarse. (Blowing) | | |
| 16.00 - 16.25 | SPT (C) | N=50 (25 for 105mm/50 for 145mm) Hammer SN = 0210 | 16.0 | 4.00 | -13.36 | 16.00 | | Very dense greyish brown sandy subangular to subrounded fine to coarse GRAVEL with high cobble content. Sand is fine to coarse. Cobbles are subangular to subrounded. | | |
| 17.50 - 17.79 | SPT (C) | N=50 (25 for 145mm/50 for 145mm) Hammer SN = 0210 | 17.5 | 4.00 | | | | | | |

9.5 10.0 10.5 11.0 11.5 12.0 12.5 13.0 13.5 14.0 14.5 15.0 15.5 16.0 16.5 17.0 17.5 18.0 18.5

**Water Strikes**

| Struck at (m) | Casing to (m) | Time (min) | Rose to (m) |
|---|---|---|---|
| 13.00 | 13.00 | 20 | 4.00 |

**Chiselling Details**

| From (m) | To (m) | Time (hh:mm) |
|---|---|---|
| 11.20 | 11.30 | 01:00 |

**Casing Details**

| To (m) | Diam (mm) |
|---|---|
| 11.30 | 200 |
| 20.00 | 200 |

**Water Added**

| From (m) | To (m) |
|---|---|
| 1.20 | 3.50 |

**Remarks**

Hand dug inspection pit excavated to 1.20m
Standpipe installation
No SPT at 14.00m due to blowing sands

| Core Barrel | Flush Type | Termination Reason | Last Updated |
|---|---|---|---|
| | | Terminated at 20.00m without encountering bedrock | 11/08/2021 |

AGS

CAUSEWAY GEOTECH

| Project No. | Project Name: | Borehole ID |
|---|---|---|
| 21-0553 | Riverine Community Park, Lifford Site | BH02 |
| | Client: Donegal County Council | |
| | Client's Rep: McAdam Design Ltd | |

| Method | Plant Used | Top (m) | Base (m) | Coordinates | Final Depth: | Start Date: | Driller: | Sheet 3 of 3 |
|---|---|---|---|---|---|---|---|---|
| Cable Percussion | Dando 2000 | 0.00 | 11.30 | 233939.82 E | 20.00 m | 08/06/2021 | MK+KW | Scale: 1:50 |
| Rotary Drilling | Comacchio 405 | 11.30 | 20.00 | 398692.86 N | Elevation: 2.64 mOD | End Date: 02/07/2021 | Logger: NH | FINAL |

| Depth (m) | Sample / Tests | Field Records | Casing Depth (m) | Water Depth (m) | Level mOD | Depth (m) | Legend | Description | Water | Backfill |
|---|---|---|---|---|---|---|---|---|---|---|
| 19.00 - 19.30 | SPT (C) | N=50 (25 for 140mm/50 for 165mm) Hammer SN = 0210 | 19.0 | 4.00 | | | | Very dense greyish brown sandy subangular to subrounded fine to coarse GRAVEL with high cobble content. Sand is fine to coarse. Cobbles are subangular to subrounded. | | |
| 20.00 - 20.34 | SPT (C) | N=50 (25 for 130mm/50 for 215mm) Hammer SN = 0210 | 20.0 | 4.00 | -17.36 | 20.00 | | End of Borehole at 20.00m | | |

| Water Strikes | | | |
|---|---|---|---|
| Struck at (m) | Casing to (m) | Time (min) | Rose to (m) |
| 13.00 | 13.00 | 20 | 4.00 |

| Casing Details | | Water Added | |
|---|---|---|---|
| To (m) | Diam (mm) | From (m) | To (m) |
| 11.30 | 200 | 1.20 | 3.50 |
| 20.00 | 200 | | |

**Remarks**

Hand dug inspection pit excavated to 1.20m
Standpipe installation
No SPT at 14.00m due to blowing sands

| Core Barrel | Flush Type | Termination Reason | Last Updated |
|---|---|---|---|
| | | Terminated at 20.00m without encountering bedrock | 11/08/2021 |

AGS

CAUSEWAY GEOTECH

| Project No. | Project Name: | Borehole ID |
|---|---|---|
| 21-0553 | Riverine Community Park, Lifford Site | BH05 |
| | Client: Donegal County Council | |
| | Client's Rep: McAdam Design Ltd | |

| Method | Plant Used | Top (m) | Base (m) | Coordinates |
|---|---|---|---|---|
| Cable Percussion | Dando 2000 | 0.00 | 14.50 | |
| Rotary Drilling | Comacchio 405 | 14.50 | 25.00 | 233819.66 E |
| | | | | 398648.12 N |

| Final Depth: | 25.00 m | Start Date: | 03/06/2021 | Driller: | MK+KW | Sheet 1 of 3 |
|---|---|---|---|---|---|---|
| Elevation: | 4.45 mOD | End Date: | 24/06/2021 | Logger: | NH | Scale: 1:50 |
| | | | | | | FINAL |

| Depth (m) | Sample / Tests | Field Records | Casing Depth (m) | Water Depth (m) | Level mOD | Depth (m) | Legend | Description | Water | Backfill |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 4.25 | 0.20 | | Grass and TOPSOIL | | |
| 0.50 | B1 | | | | | | | MADE GROUND: Firm grey sandy gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. | | |
| 0.50 | D9 | | | | 3.85 | 0.60 | | | | |
| 1.00 | B2 | | | | | | | Firm grey slightly gravelly sandy silty organic CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium. | | |
| 1.00 | D10 | | | | | | | | | |
| 1.20 - 1.65 | SPT (C) | N=13 (2,2/3,3,3,4) Hammer SN = 0199 | 1.20 | Dry | | | | | | |
| 2.00 | B3 | | | | | | | | | |
| 2.00 | D11 | | | | | | | | | |
| 2.00 - 2.45 | UT17 | Ublow=15 100% | 2.00 | Dry | | | | | | |
| | | | | | 1.65 | 2.80 | | | | |
| 3.00 | B4 | | | | | | | Firm brown slightly sandy slightly gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subrounded. | | |
| 3.00 | D12 | | | | | | | | | |
| 3.00 - 3.45 | SPT (C) | N=12 (1,0/2,3,3,4) Hammer SN = 0199 | 3.00 | Dry | 1.15 | 3.30 | | Soft brown gravelly silty fine to coarse SAND. Gravel is subangular to subrounded fine to coarse. | | |
| | | | | | 0.85 | 3.60 | | Medium dense brown slightly silty very sandy subangular to subrounded fine to coarse GRAVEL with low cobble and boulder content. Sand is fine to coarse. Cobbles and boulders are subangular to subrounded. | | |
| 4.00 | B5 | | | | | | | | | |
| 4.00 | D13 | | | | | | | | | |
| 4.00 - 4.45 | SPT (C) | N=20 (3,4/5,5,5,5) Hammer SN = 0199 | 4.00 | 1.00 | | | | | | |
| 5.00 | B6 | | | | | | | | | |
| 5.00 | D14 | | | | | | | | | |
| 5.00 - 5.45 | SPT (C) | N=19 (4,5/6,5,4,4) Hammer SN = 0199 | 5.00 | 2.00 | | | | | | |
| 6.00 | B7 | | | | | | | | | |
| 6.00 | D15 | | | | | | | | | |
| 6.00 - 6.45 | SPT (C) | N=21 (3,5/4,6,6,5) Hammer SN = 0199 | 6.00 | 3.40 | | | | | | |
| 7.10 | | 04-06-2021 | 7.50 | 4.00 | | | | | | |
| 7.50 | B8 | | | | | | | | | |
| 7.50 | D16 | | | | | | | | | |
| 7.50 - 7.95 | SPT (C) | N=18 (5,6/4,4,4,6) Hammer SN = 0199 | 7.50 | 3.40 | | | | | | |
| 8.00 | | 03-06-2021 | 7.50 | 3.40 | | | | | | |
| 9.00 | B18 | | | | -4.55 | 9.00 | | Dense greyish brown sandy silty subangular to subrounded fine to | | |
| 9.00 | D22 | | | | | | | | | |

**Water Strikes**

| Struck at (m) | Casing to (m) | Time (min) | Rose to (m) |
|---|---|---|---|
| 19.00 | 19.00 | 20 | 3.00 |

**Chiselling Details**

| From (m) | To (m) | Time (hh:mm) |
|---|---|---|
| 14.40 | 14.50 | 01:00 |

**Casing Details**

| To (m) | Diam (mm) |
|---|---|
| 14.50 | 200 |
| 25.00 | 200 |

**Water Added**

| From (m) | To (m) |
|---|---|
| 1.20 | 5.00 |

**Remarks**

Hand dug inspection pit excavated to 1.20m
Standpipe installation

| Core Barrel | Flush Type | Termination Reason | Last Updated |
|---|---|---|---|
| | | Terminated at 25.00m without encountering bedrock | 11/08/2021 |

AGS

CAUSEWAY GEOTECH

| Project No. | Project Name: | Borehole ID |
|---|---|---|
| 21-0553 | Riverine Community Park, Lifford Site | BH05 |
| | Client: Donegal County Council | |
| | Client's Rep: McAdam Design Ltd | |

| Method | Plant Used | Top (m) | Base (m) | Coordinates |
|---|---|---|---|---|
| Cable Percussion | Dando 2000 | 0.00 | 14.50 | |
| Rotary Drilling | Comacchio 405 | 14.50 | 25.00 | 233819.66 E |
| | | | | 398648.12 N |

| Final Depth: | 25.00 m | Start Date: | 03/06/2021 | Driller: | MK+KW | Sheet 2 of 3 |
|---|---|---|---|---|---|---|
| Elevation: | 4.45 mOD | End Date: | 24/06/2021 | Logger: | NH | Scale: 1:50 |
| | | | | | | FINAL |

| Depth (m) | Sample / Tests | Field Records | Casing Depth (m) | Water Depth (m) | Level mOD | Depth (m) | Legend | Description | Water | Backfill |
|---|---|---|---|---|---|---|---|---|---|---|
| 9.00 - 9.45 | SPT (C) | N=42 (4,5/5,10,13,14) Hammer SN = 0199 | 9.00 | 5.50 | | | | Dense greyish brown sandy silty subangular to subrounded fine to coarse GRAVEL with low cobble and boulder content. Sand is fine to coarse. Cobbles and boulders are subangular to subrounded. | | |
| 10.50 | B19 | | | | -5.95 | 10.40 | | Very stiff grey slightly gravelly sandy clayey SILT with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium. Cobbles are subrounded. | | |
| 10.50 | D23 | | | | | | | | | |
| 10.50 - 10.95 | SPT (C) | N=49 (6,9/10,11,12,16) Hammer SN = 0199 | 10.5 | 6.50 | | | | | | |
| 12.00 | B20 | | | | | | | | | |
| 12.00 | D24 | | | | -7.75 | 12.20 | | Dense to very dense grey very sandy silty subangular to subrounded fine to coarse GRAVEL with low cobble and boulder content. Sand is fine to coarse. Cobbles and boulders are subangular to subrounded. | | |
| 12.00 - 12.45 | SPT (C) | N=43 (7,10/9,10,11,13) Hammer SN = 0199 | 12.0 | 7.80 | | | | | | |
| 13.50 | B21 | | | | | | | | | |
| 13.50 | D25 | | | | | | | | | |
| 13.50 - 13.95 | SPT (C) | N=42 (9,12/11,9,8,14) Hammer SN = 0199 | 13.5 | 8.20 | | | | | | |
| 14.50 - 14.82 | SPT (C) | N=50 (10,10/50 for 175mm) Hammer SN = 0199 | 14.5 | 8.80 | -10.05 | 14.50 | | Very dense greyish brown very sandy silty angular to subrounded fine to coarse GRAVEL with low cobble and boulder content. Sand is fine to coarse. Cobbles and boulders are subangular to subrounded. | | |
| 14.50 | | 04-06-2021 | 14.5 | 9.00 | | | | | | |
| 16.00 - 16.23 | SPT (C) | N=50 (25 for 70mm/50 for 160mm) Hammer SN = 0210 | 16.0 | 5.00 | | | | | | |
| 17.50 - 17.71 | SPT (C) | N=50 (25 for 105mm/50 for 105mm) Hammer SN = 0210 | 17.5 | 5.00 | | | | | | |

**Water Strikes**

| Struck at (m) | Casing to (m) | Time (min) | Rose to (m) |
|---|---|---|---|
| 19.00 | 19.00 | 20 | 3.00 |

**Chiselling Details**

| From (m) | To (m) | Time (hh:mm) |
|---|---|---|
| 14.40 | 14.50 | 01:00 |

**Casing Details**

| To (m) | Diam (mm) |
|---|---|
| 14.50 | 200 |
| 25.00 | 200 |

**Water Added**

| From (m) | To (m) |
|---|---|
| 1.20 | 5.00 |

**Remarks**

Hand dug inspection pit excavated to 1.20m
Standpipe installation

| Core Barrel | Flush Type | Termination Reason | Last Updated |
|---|---|---|---|
| | | Terminated at 25.00m without encountering bedrock | 11/08/2021 |

AGS

CAUSEWAY GEOTECH

| Project No. | Project Name: | Borehole ID |
|---|---|---|
| 21-0553 | Riverine Community Park, Lifford Site | BH05 |
| | Client: Donegal County Council | |
| | Client's Rep: McAdam Design Ltd | |

| Method | Plant Used | Top (m) | Base (m) | Coordinates |
|---|---|---|---|---|
| Cable Percussion | Dando 2000 | 0.00 | 14.50 | |
| Rotary Drilling | Comacchio 405 | 14.50 | 25.00 | 233819.66 E |
| | | | | 398648.12 N |

| Final Depth: | 25.00 m | Start Date: | 03/06/2021 | Driller: | MK+KW | Sheet 3 of 3 |
|---|---|---|---|---|---|---|
| Elevation: | 4.45 mOD | End Date: | 24/06/2021 | Logger: | NH | Scale: 1:50 |
| | | | | | | FINAL |

| Depth (m) | Sample / Tests | Field Records | Casing Depth (m) | Water Depth (m) | Level mOD | Depth (m) | Legend | Description | Water | Backfill |
|---|---|---|---|---|---|---|---|---|---|---|
| 19.00 - 19.24 | SPT (C) | N=50 (25 for 100mm/50 for 140mm) Hammer SN = 0210 Strong influx @ 19.00m | 19.0 | 3.00 | | | | Very dense greyish brown very sandy silty angular to subrounded fine to coarse GRAVEL with low cobble and boulder content. Sand is fine to coarse. Cobbles and boulders are subangular to subrounded. | | |
| 21.00 - 21.22 | SPT (C) | N=50 (25 for 90mm/50 for 125mm) Hammer SN = 0210 | 21.0 | 3.00 | | | | | | |
| 23.50 - 23.70 | SPT (C) | N=50 (25 for 80mm/50 for 120mm) Hammer SN = 0210 | 23.5 | 3.00 | | | | | | |
| 25.00 - 25.17 | SPT (C) | N=50 (25 for 70mm/50 for 100mm) Hammer SN = 0210 | 25.0 | 3.00 | -20.55 | 25.00 | | End of Borehole at 25.00m | | |

19.0 19.5 20.0 20.5 21.0 21.5 22.0 22.5 23.0 23.5 24.0 24.5 25.0 25.5 26.0 26.5 27.0 27.5

**Water Strikes**

| Struck at (m) | Casing to (m) | Time (min) | Rose to (m) |
|---|---|---|---|
| 19.00 | 19.00 | 20 | 3.00 |

**Casing Details**

| To (m) | Diam (mm) |
|---|---|
| 14.50 | 200 |
| 25.00 | 200 |

**Water Added**

| From (m) | To (m) |
|---|---|
| 1.20 | 5.00 |

**Remarks**

Hand dug inspection pit excavated to 1.20m
Standpipe installation

| Core Barrel | Flush Type | Termination Reason | Last Updated |
|---|---|---|---|
| | | Terminated at 25.00m without encountering bedrock | 11/08/2021 |

AGS

CAUSEWAY GEOTECH

| Project No. | Project Name: | Borehole ID |
|---|---|---|
| 21-0553 | Riverine Community Park, Lifford Site | BH06 |
| | Client: Donegal County Council | |
| | Client's Rep: McAdam Design Ltd | |

| Method | Plant Used | Top (m) | Base (m) | Coordinates |
|---|---|---|---|---|
| Cable Percussion | Dando 2000 | 0.00 | 12.50 | |
| Rotary Drilling | Comacchio 405 | 12.50 | 20.00 | 233922.55 E |
| | | | | 398740.75 N |

| Final Depth: | 20.00 m | Start Date: | 14/06/2021 | Driller: | MK+KW | Sheet 1 of 3 |
|---|---|---|---|---|---|---|
| Elevation: | 3.21 mOD | End Date: | 11/07/2021 | Logger: | NH | Scale: 1:50 |
| | | | | | | FINAL |

| Depth (m) | Sample / Tests | Field Records | Casing Depth (m) | Water Depth (m) | Level mOD | Depth (m) | Legend | Description | Water | Backfill |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 2.90 | 0.30 | | TOPSOIL with grass | | |
| 0.50 | B1 | | | | | | | Brown very silty fine to coarse SAND. | | |
| 0.50 | D10 | | | | | | | | | |
| 1.00 | B2 | | | | | | | | | |
| 1.00 | D11 | | | | 2.10 | 1.10 | | | | |
| 1.20 - 1.65 | SPT (C) | N=3 (2,2/1,0,1,1) Hammer SN = 0199 | 1.20 | Dry | | | | Very loose brown gravelly fine to coarse SAND. Gravel is subangular to subrounded fine to medium. | | |
| | | | | | 1.40 | 1.80 | | | | |
| 2.00 | B3 | | | | | | | Very soft to soft brownish grey very sandy silty CLAY. Sand is fine to medium. | | |
| 2.00 | D12 | | | | | | | | | |
| 2.00 - 2.45 | UT19 | Ublow=5 80% | 2.00 | Dry | | | | | | |
| 3.00 | B4 | | | | | | | | | |
| 3.00 | D13 | | | | 0.00 | 3.20 | | | | |
| 3.00 - 3.45 | SPT (C) | N=18 (0,1/4,5,5,4) Hammer SN = 0199 | 3.00 | Dry | | | | Medium dense brown slightly silty sandy subangular to subrounded fine to coarse GRAVEL with low cobble and boulder content. Sand is fine to coarse. Cobbles and boulders are subangular to subrounded. | | |
| 4.00 | B5 | | | | | | | | | |
| 4.00 | D14 | | | | | | | | | |
| 4.00 - 4.45 | SPT (C) | N=22 (3,4/4,5,6,7) Hammer SN = 0199 | 4.00 | 2.50 | | | | | | |
| 5.00 | B6 | | | | | | | | | |
| 5.00 | D15 | | | | | | | | | |
| 5.00 - 5.45 | SPT (C) | N=23 (4,4/5,5,6,7) Hammer SN = 0199 | 5.00 | 2.00 | | | | | | |
| 6.00 | B7 | | | | | | | | | |
| 6.00 | D16 | | | | | | | | | |
| 6.00 - 6.45 | SPT (C) | N=19 (5,10/4,4,5,6) Hammer SN = 0199 | 6.00 | 3.00 | -3.10 | 6.30 | | Soft to firm grey clayey SILT. | | |
| 7.50 | B8 | | | | -4.30 | 7.50 | | Medium dense grey slightly sandy subangular to subrounded fine GRAVEL. Sand is fine to coarse. | | |
| 7.50 | D17 | | | | | | | | | |
| 7.50 - 7.95 | SPT (C) | N=21 (4,5/5,6,4,6) Hammer SN = 0199 | 7.50 | 2.50 | | | | | | |
| 9.00 | B9 | | | | | | | | | |
| 9.00 | D18 | | | | | | | | | |

**Water Strikes**

| Struck at (m) | Casing to (m) | Time (min) | Rose to (m) |
|---|---|---|---|
| 13.00 | 13.00 | 20 | 4.00 |
| 17.50 | 17.50 | 20 | 4.00 |

**Casing Details**

| To (m) | Diam (mm) |
|---|---|
| 12.50 | 200 |
| 20.00 | 200 |

**Water Added**

| From (m) | To (m) |
|---|---|
| 1.20 | 3.50 |

**Chiselling Details**

| From (m) | To (m) | Time (hh:mm) |
|---|---|---|
| 12.20 | 12.50 | 01:30 |

**Remarks**

Hand dug inspection pit excavated to 1.20m

**Core Barrel**

**Flush Type**

**Termination Reason**

Terminated at 20.00m without encountering bedrock

**Last Updated**

11/08/2021

AGS

CAUSEWAY GEOTECH

| Project No. | Project Name: | Borehole ID |
|---|---|---|
| 21-0553 | Riverine Community Park, Lifford Site | BH06 |
| | Client: Donegal County Council | |
| | Client's Rep: McAdam Design Ltd | |

| Method | Plant Used | Top (m) | Base (m) | Coordinates |
|---|---|---|---|---|
| Cable Percussion | Dando 2000 | 0.00 | 12.50 | |
| Rotary Drilling | Comacchio 405 | 12.50 | 20.00 | 233922.55 E |
| | | | | 398740.75 N |

| Final Depth: | 20.00 m | Start Date: | 14/06/2021 | Driller: | MK+KW | Sheet 2 of 3 |
|---|---|---|---|---|---|---|
| Elevation: | 3.21 mOD | End Date: | 11/07/2021 | Logger: | NH | Scale: 1:50 |
| | | | | | | FINAL |

| Depth (m) | Sample / Tests | Field Records | Casing Depth (m) | Water Depth (m) | Level mOD | Depth (m) | Legend | Description |
|---|---|---|---|---|---|---|---|---|
| 9.00 - 9.45 | SPT (C) | N=16 (4,4/4,4,4,4) Hammer SN = 0199 | 9.00 | 3.50 | | | | Medium dense grey slightly sandy subangular to subrounded fine GRAVEL. Sand is fine to coarse. |
| 9.50 | | 14-06-2021 | 9.00 | 3.50 | | | | |
| 10.50 | B20 | | | | | | | |
| 10.50 | D22 | | | | | | | |
| 10.50 - 10.95 | SPT (C) | N=18 (3,4/4,5,4,5) Hammer SN = 0199 | 10.5 | 3.30 | | | | |
| 12.00 | B21 | | | | -8.80 | 12.00 | | |
| 12.00 | D23 | | | | | | | Medium dense light brown slightly silty gravelly fine to coarse SAND. Gravel is subangular to subrounded fine to medium. (Blowing) |
| 12.00 - 12.45 | SPT (C) | N=16 (3,3/4,4,4,4) Hammer SN = 0199 | 12.0 | 3.50 | | | | |
| 12.50 - 12.52 | SPT (C) | N=50 (25 for 10mm/50 for 10mm) Hammer SN = 0199 | 12.5 | 3.10 | | | | |
| 12.50 | | 15-06-2021 | 12.5 | 3.00 | | | | |
| 13.00 - 13.45 | SPT (C) | N=29 (5,4/6,6,7,10) Hammer SN = 0210<br>Strong inflow at 13.00m | 13.0 | 4.00 | | | | |
| 14.50 - 14.95 | SPT (C) | N=22 (6,6/5,4,5,8) Hammer SN = 0210 | 14.5 | 4.00 | | | | |
| 16.00 - 16.45 | SPT (C) | N=40 (6,7/7,9,10,14) Hammer SN = 0210 | 16.0 | 4.00 | -12.80 | 16.00 | | Dense to very dense greyish brown very sandy silty subangular to subrounded fine to coarse GRAVEL with high cobble and low boulder content. Sand is fine to coarse. Cobbles and boulders are subangular to subrounded. |
| 17.50 - 17.77 | SPT (C) | N=50 (25 for 125mm/50 for 145mm) Hammer SN = 0210<br>Strong inflow at 17.50m | 17.5 | 4.00 | | | | |

Water

Backfill

9.5 10.0 10.5 11.0 11.5 12.0 12.5 13.0 13.5 14.0 14.5 15.0 15.5 16.0 16.5 17.0 17.5 18.0 18.5

**Water Strikes**

| Struck at (m) | Casing to (m) | Time (min) | Rose to (m) |
|---|---|---|---|
| 13.00 | 13.00 | 20 | 4.00 |
| 17.50 | 17.50 | 20 | 4.00 |

**Casing Details**

| To (m) | Diam (mm) |
|---|---|
| 12.50 | 200 |
| 20.00 | 200 |

**Water Added**

| From (m) | To (m) |
|---|---|
| 1.20 | 3.50 |

**Chiselling Details**

| From (m) | To (m) | Time (hh:mm) |
|---|---|---|
| 12.20 | 12.50 | 01:30 |

**Remarks**

Hand dug inspection pit excavated to 1.20m

**Core Barrel**

**Flush Type**

**Termination Reason**

Terminated at 20.00m without encountering bedrock

**Last Updated**

11/08/2021

AGS

CAUSEWAY GEOTECH

| Project No. | Project Name: | Borehole ID |
|---|---|---|
| 21-0553 | Riverine Community Park, Lifford Site | BH06 |
| | Client: Donegal County Council | |
| | Client's Rep: McAdam Design Ltd | |

| Method | Plant Used | Top (m) | Base (m) | Coordinates |
|---|---|---|---|---|
| Cable Percussion | Dando 2000 | 0.00 | 12.50 | |
| Rotary Drilling | Comacchio 405 | 12.50 | 20.00 | 233922.55 E |
| | | | | 398740.75 N |

| Final Depth: | 20.00 m | Start Date: | 14/06/2021 | Driller: | MK+KW | Sheet 3 of 3 |
|---|---|---|---|---|---|---|
| Elevation: | 3.21 mOD | End Date: | 11/07/2021 | Logger: | NH | Scale: 1:50 |
| | | | | | | FINAL |

| Depth (m) | Sample / Tests | Field Records | Casing Depth (m) | Water Depth (m) | Level mOD | Depth (m) | Legend | Description | Water | Backfill |
|---|---|---|---|---|---|---|---|---|---|---|
| 19.00 - 19.27 | SPT (C) | N=50 (25 for 120mm/50 for 155mm) Hammer SN = 0210 | 19.0 | 4.00 | | | | Dense to very dense greyish brown very sandy silty subangular to subrounded fine to coarse GRAVEL with high cobble and low boulder content. Sand is fine to coarse. Cobbles and boulders are subangular to subrounded. | | |
| 20.00 - 20.30 | SPT (C) | N=50 (25 for 115mm/50 for 185mm) Hammer SN = 0210 | 20.0 | 4.00 | -16.80 | 20.00 | | End of Borehole at 20.00m | | |

**Water Strikes**

| Struck at (m) | Casing to (m) | Time (min) | Rose to (m) |
|---|---|---|---|
| 13.00 | 13.00 | 20 | 4.00 |
| 17.50 | 17.50 | 20 | 4.00 |

**Casing Details**

| To (m) | Diam (mm) |
|---|---|
| 12.50 | 200 |
| 20.00 | 200 |

**Water Added**

| From (m) | To (m) |
|---|---|
| 1.20 | 3.50 |

**Remarks**

Hand dug inspection pit excavated to 1.20m

| Core Barrel | Flush Type | Termination Reason | Last Updated |
|---|---|---|---|
| | | Terminated at 20.00m without encountering bedrock | 11/08/2021 |

AGS

CAUSEWAY GEOTECH

| Project No. | Project Name: | Borehole ID |
|---|---|---|
| 21-0553 | Riverine Community Park, Lifford Site | BH07 |
| | Client: Donegal County Council | |
| | Client's Rep: McAdam Design Ltd | |

| Method | Plant Used | Top (m) | Base (m) | Coordinates |
|---|---|---|---|---|
| Cable Percussion | Dando 2000 | 0.00 | 11.80 | |
| Rotary Drilling | Comacchio 405 | 11.80 | 20.00 | 233706.97 E |
| | | | | 398695.69 N |

| Final Depth: | 20.00 m | Start Date: | 28/05/2021 | Driller: | MK+KW | Sheet 1 of 3 |
|---|---|---|---|---|---|---|
| Elevation: | 2.94 mOD | End Date: | 28/06/2021 | Logger: | NH | Scale: 1:50 |
| | | | | | | FINAL |

| Depth (m) | Sample / Tests | Field Records | Casing Depth (m) | Water Depth (m) | Level mOD | Depth (m) | Legend | Description | Water | Backfill |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Firm brown slightly sandy slightly gravelly clayey SILT. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium. | | |
| 0.50 | B1 | | | | | | | | | |
| 0.50 | D5 | | | | | | | | | |
| 1.00 | B2 | | | | | | | | | |
| 1.00 | D6 | | | | 1.74 | 1.20 | | | | |
| 1.20 - 1.65 | SPT (S) | N=18 (2,3/3,4,4,7) Hammer SN = 0199 | 1.20 | Dry | | | | Firm to stiff brownish grey sandy gravelly clayey SILT. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. | | |
| | | | | | 1.24 | 1.70 | | Brownish grey silty fine to coarse SAND. | | |
| | | | | | 1.04 | 1.90 | | | | |
| 2.00 | B3 | | | | | | | Medium dense to dense brown slightly silty very sandy subangular to rounded fine to coarse GRAVEL with low cobble and boulder content. Sand is fine to coarse. Cobbles and boulders are subrounded to rounded. | | |
| 2.00 | D7 | | | | | | | | | |
| 2.00 - 2.45 | SPT (S) | N=29 (7,4/5,7,8,9) Hammer SN = 0199 | 2.00 | Dry | | | | | | |
| 2.50 | | 02-06-2021 | 3.00 | 1.50 | | | | | | |
| 3.00 | B4 | | | | | | | | | |
| 3.00 | D8 | | | | | | | | | |
| 3.00 - 3.45 | SPT (C) | N=28 (3,5/6,6,8,8) Hammer SN = 0199 | 3.00 | 2.50 | | | | | | |
| 3.50 | | 28-05-2021 | 3.00 | 2.00 | | | | | | |
| 4.00 | B9 | | | | -1.06 | 4.00 | | Very dense greyish brown sandy subangular to rounded fine to coarse GRAVEL with high cobble and boulder content. Sand is fine to coarse. Cobbles and boulders are subrounded to rounded. | | |
| 4.00 | D15 | | | | | | | | | |
| 4.00 - 4.44 | SPT (C) | N=50 (9,14/50 for 290mm) Hammer SN = 0199 | 4.00 | 2.30 | | | | | | |
| 5.00 | B10 | | | | | | | | | |
| 5.00 | D16 | | | | | | | | | |
| 5.00 - 5.38 | SPT (C) | N=50 (8,10/50 for 235mm) Hammer SN = 0199 | 5.00 | 2.50 | | | | | | |
| 6.00 | B11 | | | | | | | | | |
| 6.00 | D17 | | | | | | | | | |
| 6.00 - 6.40 | SPT (C) | N=50 (9,10/50 for 255mm) Hammer SN = 0199 | 6.00 | 2.50 | | | | | | |
| 7.50 | B12 | | | | -4.56 | 7.50 | | Medium dense to dense grey slightly sandy subangular to subrounded fine to coarse GRAVEL with low cobble and boulder content. Sand is fine to coarse. Cobbles and boulders are subrounded to rounded. | | |
| 7.50 | D18 | | | | | | | | | |
| 7.50 - 7.95 | SPT (C) | N=16 (3,4/4,4,4,4) Hammer SN = 0199 | 7.50 | 2.60 | | | | | | |
| 9.00 | B13 | | | | | | | | | |
| 9.00 | D19 | | | | | | | | | |

**Water Strikes**

| Struck at (m) | Casing to (m) | Time (min) | Rose to (m) |
|---|---|---|---|
| 13.00 | 13.00 | 20 | 5.00 |
| 16.00 | 16.00 | 20 | 4.00 |
| 19.00 | 19.00 | 20 | 4.50 |

**Casing Details**

| To (m) | Diam (mm) |
|---|---|
| 11.80 | 200 |
| 20.00 | 200 |

**Water Added**

| From (m) | To (m) |
|---|---|
| 1.20 | 3.00 |

**Chiselling Details**

| From (m) | To (m) | Time (hh:mm) |
|---|---|---|
| 2.60 | 2.90 | 01:00 |

**Remarks**

Hand dug inspection pit excavated to 1.20m

**Core Barrel**

**Flush Type**

**Termination Reason**

Terminated at 20.00m without encountering bedrock

**Last Updated**

11/08/2021

AGS

CAUSEWAY GEOTECH

| Project No. | Project Name: | Borehole ID |
|---|---|---|
| 21-0553 | Riverine Community Park, Lifford Site | BH07 |
| | Client: Donegal County Council | |
| | Client's Rep: McAdam Design Ltd | |

| Method | Plant Used | Top (m) | Base (m) | Coordinates |
|---|---|---|---|---|
| Cable Percussion | Dando 2000 | 0.00 | 11.80 | |
| Rotary Drilling | Comacchio 405 | 11.80 | 20.00 | 233706.97 E |
| | | | | 398695.69 N |

| Final Depth: | 20.00 m | Start Date: | 28/05/2021 | Driller: | MK+KW | Sheet 2 of 3 |
|---|---|---|---|---|---|---|
| Elevation: | 2.94 mOD | End Date: | 28/06/2021 | Logger: | NH | Scale: 1:50 |
| | | | | | | FINAL |

| Depth (m) | Sample / Tests | Field Records | Casing Depth (m) | Water Depth (m) | Level mOD | Depth (m) | Legend | Description | Water | Backfill |
|---|---|---|---|---|---|---|---|---|---|---|
| 9.00 - 9.45 | SPT (C) | N=40 (7,7/10,10,9,11) Hammer SN = 0199 | 9.00 | 2.60 | | | | Medium dense to dense grey slightly sandy subangular to subrounded fine to coarse GRAVEL with low cobble and boulder content. Sand is fine to coarse. Cobbles and boulders are subrounded to rounded. | | |
| 10.50 | B14 | | | | -7.56 | 10.50 | | | | |
| 10.50 | D20 | | | | | | | Dense grey slightly silty sandy subangular to subrounded fine to coarse GRAVEL with low cobble and boulder content. Sand is fine to coarse. Cobbles and boulders are subangular to subrounded. | | |
| 10.50 - 10.95 | SPT (C) | N=43 (7,8/10,10,11,12) Hammer SN = 0199 | 10.5 | 2.50 | | | | | | |
| 10.50 | | 03-06-2021 | 11.5 | 4.20 | | | | | | |
| 11.50 | | 02-06-2021 | 11.5 | 2.30 | | | | | | |
| 11.70 | B21 | | | | | | | | | |
| 11.70 | D22 | | | | -8.86 | 11.80 | | Very dense grey slightly silty sandy angular to subrounded fine to coarse GRAVEL with low cobble and boulder content. Sand is fine to coarse. Cobbles and boulders are subangular to subrounded. | | |
| 11.70 - 11.72 | SPT (C) | N=50 (25 for 10mm/50 for 10mm) Hammer SN = 0199 | 11.7 | 5.80 | | | | | | |
| 11.70 | | 03-06-2021 | 11.7 | 6.00 | | | | | | |
| 13.00 - 13.41 | SPT (C) | N=50 (22 for 115mm/50 for 295mm) Hammer SN = 0210 Strong influx @ 13.00m | 13.0 | 5.00 | | | | | | |
| 16.00 - 16.19 | SPT (C) | N=50 (25 for 95mm/50 for 95mm) Hammer SN = 0210 Strong influx @ 1.00m | 16.0 | 5.00 | | | | | | |
| 17.50 - 17.70 | SPT (C) | N=50 (25 for 105mm/50 for 90mm) Hammer SN = 0210 | 17.5 | 5.00 | | | | | | |

9.5 10.0 10.5 11.0 11.5 12.0 12.5 13.0 13.5 14.0 14.5 15.0 15.5 16.0 16.5 17.0 17.5 18.0 18.5

**Water Strikes**

| Struck at (m) | Casing to (m) | Time (min) | Rose to (m) |
|---|---|---|---|
| 13.00 | 13.00 | 20 | 5.00 |
| 16.00 | 16.00 | 20 | 4.00 |
| 19.00 | 19.00 | 20 | 4.50 |

**Casing Details**

| To (m) | Diam (mm) |
|---|---|
| 11.80 | 200 |
| 20.00 | 200 |

**Water Added**

| From (m) | To (m) |
|---|---|
| 1.20 | 3.00 |

**Chiselling Details**

| From (m) | To (m) | Time (hh:mm) |
|---|---|---|
| 2.60 | 2.90 | 01:00 |

**Remarks**

Hand dug inspection pit excavated to 1.20m

| Core Barrel | Flush Type | Termination Reason | Last Updated |
|---|---|---|---|
| | | Terminated at 20.00m without encountering bedrock | 11/08/2021 |

AGS

CAUSEWAY GEOTECH

| Project No. | Project Name: | Borehole ID |
|---|---|---|
| 21-0553 | Riverine Community Park, Lifford Site | BH07 |
| | Client: Donegal County Council | |
| | Client's Rep: McAdam Design Ltd | |

| Method | Plant Used | Top (m) | Base (m) | Coordinates | Final Depth: | Start Date: | Driller: | Sheet 3 of 3 |
|---|---|---|---|---|---|---|---|---|
| Cable Percussion<br>Rotary Drilling | Dando 2000<br>Comacchio 405 | 0.00<br>11.80 | 11.80<br>20.00 | 233706.97 E<br>398695.69 N | 20.00 m | 28/05/2021 | MK+KW | Scale: 1:50 |
| | | | | | Elevation: 2.94 mOD | End Date: 28/06/2021 | Logger: NH | FINAL |

| Depth (m) | Sample / Tests | Field Records | Casing Depth (m) | Water Depth (m) | Level mOD | Depth (m) | Legend | Description | Water | Backfill |
|---|---|---|---|---|---|---|---|---|---|---|
| 19.00 - 19.20 | SPT (C) | N=50 (25 for 90mm/50 for 110mm) Hammer SN = 0210<br>Strong influx @ 19.00m | 19.0 | 5.00 | | | | Very dense grey slightly silty sandy angular to subrounded fine to coarse GRAVEL with low cobble and boulder content. Sand is fine to coarse. Cobbles and boulders are subangular to subrounded. | | |
| 20.00 - 20.20 | SPT (C) | N=50 (25 for 80mm/50 for 115mm) Hammer SN = 0210 | 20.0 | 5.00 | -17.06 | 20.00 | | End of Borehole at 20.00m | | |

19.0 19.5 20.0 20.5 21.0 21.5 22.0 22.5 23.0 23.5 24.0 24.5 25.0 25.5 26.0 26.5 27.0 27.5

**Water Strikes**

| Struck at (m) | Casing to (m) | Time (min) | Rose to (m) |
|---|---|---|---|
| 13.00 | 13.00 | 20 | 5.00 |
| 16.00 | 16.00 | 20 | 4.00 |
| 19.00 | 19.00 | 20 | 4.50 |

**Casing Details**

| To (m) | Diam (mm) |
|---|---|
| 11.80 | 200 |
| 20.00 | 200 |

**Water Added**

| From (m) | To (m) |
|---|---|
| 1.20 | 3.00 |

**Remarks**

Hand dug inspection pit excavated to 1.20m

| Core Barrel | Flush Type | Termination Reason | Last Updated |
|---|---|---|---|
| | | Terminated at 20.00m without encountering bedrock | 11/08/2021 |

AGS

CAUSEWAY GEOTECH

| Project No. | Project Name: | Borehole ID |
|---|---|---|
| 21-0553 | Riverine Community Park, Lifford Site | BH08 |
| | Client: Donegal County Council | |
| | Client's Rep: McAdam Design Ltd | |

| Method | Plant Used | Top (m) | Base (m) | Coordinates |
|---|---|---|---|---|
| Cable Percussion<br>Rotary Drilling | Dando 2000<br>Comacchio 405 | 0.00<br>13.00 | 13.00<br>20.00 | 233752.84 E<br>398759.25 N |

| Final Depth: | 20.00 m | Start Date: | 05/06/2021 | Driller: | MK+KW | Sheet 1 of 3<br>Scale: 1:50 |
|---|---|---|---|---|---|---|
| Elevation: | 2.62 mOD | End Date: | 30/06/2021 | Logger: | NH | FINAL |

| Depth (m) | Sample / Tests | Field Records | Casing Depth (m) | Water Depth (m) | Level mOD | Depth (m) | Legend | Description | Water | Backfill |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 2.52 | 0.10 | | Grass and TOPSOIL | | |
| | | | | | | | | Firm brown slightly sandy organic clayey SILT. Sand is fine to coarse. | | |
| 0.50 | B1 | | | | | | | | | |
| 0.50 | D5 | | | | | | | | | |
| 1.00 | B2 | | | | | | | | | |
| 1.00 | D6 | | | | 1.42 | 1.20 | | | | |
| 1.20 | UT9 | Ublow=10 100% | 1.20 | Dry | | | | Very soft brownish grey silty fine to coarse SAND | | |
| 2.00 | B3 | | | | | | | | | |
| 2.00 | D7 | | | | | | | | | |
| 2.00 - 2.45 | SPT (S) | N=6 (1,1/1,2,1,2) Hammer SN = 0199 | 2.00 | Dry | | | | | | |
| | | | | | 0.17 | 2.45 | | Medium dense to dense brown slightly silty sandy subangular to subrounded fine to coarse GRAVEL with low cobble and boulder content. Sand is fine to coarse. Cobbles and boulders are subrounded to rounded. | | |
| 3.00 | B4 | | | | | | | | | |
| 3.00 | D8 | | | | | | | | | |
| 3.00 - 3.45 | SPT (C) | N=24 (5,4/4,6,8,6) Hammer SN = 0199 | 3.00 | 1.50 | | | | | | |
| 3.10 | | 07-06-2021 | 3.50 | 2.00 | | | | | | |
| 3.50 | | 05-06-2021 | 3.50 | 1.50 | | | | | | |
| 4.00 | B10 | | | | | | | | | |
| 4.00 | D18 | | | | | | | | | |
| 4.00 - 4.45 | SPT (C) | N=41 (5,5/8,10,13,10) Hammer SN = 0199 | 4.00 | 3.50 | | | | | | |
| 5.00 | B11 | | | | | | | | | |
| 5.00 | D19 | | | | | | | | | |
| 5.00 - 5.45 | SPT (C) | N=18 (3,3/4,4,5,5) Hammer SN = 0199 | 5.00 | 4.20 | -2.68 | 5.30 | | Medium dense brown slightly silty very gravelly fine to coarse SAND. Gravel is subangular to subrounded fine to medium. | | |
| 6.00 | B12 | | | | | | | | | |
| 6.00 | D20 | | | | | | | | | |
| 6.00 - 6.45 | SPT (C) | N=15 (3,4/3,3,5,4) Hammer SN = 0199 | 6.00 | 5.70 | | | | | | |
| | | | | | -4.58 | 7.20 | | Medium dense to dense brownish grey slightly silty sandy subangular to subrounded fine to coarse GRAVEL with low cobble and boulder content. Sand is fine to coarse. Cobbles and boulders are subrounded to rounded. | | |
| 7.50 | B13 | | | | | | | | | |
| 7.50 | D21 | | | | | | | | | |
| 7.50 - 7.95 | SPT (C) | N=47 (5,8/11,13,15,8) Hammer SN = 0199 | 7.50 | 6.80 | | | | | | |
| 9.00 | B14 | | | | | | | | | |
| 9.00 | D22 | | | | | | | | | |

**Water Strikes**

| Struck at (m) | Casing to (m) | Time (min) | Rose to (m) |
|---|---|---|---|
| 14.50 | 14.50 | 20 | 5.00 |

**Casing Details**

| To (m) | Diam (mm) |
|---|---|
| 13.00 | 200 |
| 20.00 | 200 |

**Water Added**

| From (m) | To (m) |
|---|---|
| 1.20 | 3.50 |

**Chiselling Details**

| From (m) | To (m) | Time (hh:mm) |
|---|---|---|
| 3.50 | 4.00 | 01:00 |
| 7.20 | 8.50 | 01:00 |

**Remarks**

Hand dug inspection pit excavated to 1.20m

| Core Barrel | Flush Type | Termination Reason | Last Updated |
|---|---|---|---|
| | | Terminated at 20.00m without encountering bedrock | 11/08/2021 |

AGS

CAUSEWAY GEOTECH

| Project No. | Project Name: | Borehole ID |
|---|---|---|
| 21-0553 | Riverine Community Park, Lifford Site | BH08 |
| | Client: Donegal County Council | |
| | Client's Rep: McAdam Design Ltd | |

| Method | Plant Used | Top (m) | Base (m) | Coordinates |
|---|---|---|---|---|
| Cable Percussion | Dando 2000 | 0.00 | 13.00 | |
| Rotary Drilling | Comacchio 405 | 13.00 | 20.00 | 233752.84 E |
| | | | | 398759.25 N |

| Final Depth: | 20.00 m | Start Date: | 05/06/2021 | Driller: | MK+KW | Sheet 2 of 3 |
|---|---|---|---|---|---|---|
| Elevation: | 2.62 mOD | End Date: | 30/06/2021 | Logger: | NH | Scale: 1:50 |
| | | | | | | FINAL |

| Depth (m) | Sample / Tests | Field Records | Casing Depth (m) | Water Depth (m) | Level mOD | Depth (m) | Legend | Description | Water | Backfill |
|---|---|---|---|---|---|---|---|---|---|---|
| 9.00 - 9.45 | SPT (C) | N=15 (3,4/4,4,4,3) Hammer SN = 0199 | 9.00 | 7.20 | | | | Medium dense to dense brownish grey slightly silty sandy subangular to subrounded fine to coarse GRAVEL with low cobble and boulder content. Sand is fine to coarse. Cobbles and boulders are subrounded to rounded. | | |
| 10.50 | B15 | | | | | | | | | |
| 10.50 | D23 | | | | | | | | | |
| 10.50 - 10.95 | SPT (C) | N=13 (3,4/3,3,3,4) Hammer SN = 0199 | 10.5 | 7.30 | | | | | | |
| 12.00 | B16 | | | | | | | | | |
| 12.00 | D24 | | | | | | | | | |
| 12.00 - 12.45 | SPT (C) | N=24 (4,4/5,6,7,6) Hammer SN = 0199 | 12.0 | 7.80 | | | | | | |
| 13.00 | B17 | | | | | | | | | |
| 13.00 | D25 | | | | | | | | | |
| 13.00 - 13.45 | SPT (C) | N=18 (3,5/5,4,4,5) Hammer SN = 0199 | 13.0 | 8.40 | | | | | | |
| 13.00 | | 07-06-2021 | 13.0 | 8.50 | | | | | | |
| | | | | | -11.38 | 14.00 | | Very dense greyish brown slightly silty sandy subangular to subrounded fine to coarse GRAVEL with medium cobble and boulder content. Sand is fine to coarse. Cobbles and boulders are subrounded to rounded. | | |
| 14.50 - 14.77 | SPT () | N=50 (25 for 140mm/50 for 130mm) Hammer SN = 0210 Strong flow @ 14.50m | 14.5 | 5.00 | | | | | | |
| 16.00 - 16.18 | SPT () | N=50 (25 for 70mm/50 for 110mm) Hammer SN = 0210 | 16.0 | 5.00 | | | | | | |
| 17.50 - 17.74 | SPT () | N=50 (25 for 90mm/50 for 155mm) Hammer SN = 0210 | 17.5 | 5.00 | | | | | | |

**Water Strikes**

| Struck at (m) | Casing to (m) | Time (min) | Rose to (m) |
|---|---|---|---|
| 14.50 | 14.50 | 20 | 5.00 |

**Chiselling Details**

| From (m) | To (m) | Time (hh:mm) |
|---|---|---|
| 3.50 | 4.00 | 01:00 |
| 7.20 | 8.50 | 01:00 |

**Casing Details**

| To (m) | Diam (mm) |
|---|---|
| 13.00 | 200 |
| 20.00 | 200 |

**Water Added**

| From (m) | To (m) |
|---|---|
| 1.20 | 3.50 |

**Remarks**

Hand dug inspection pit excavated to 1.20m

| Core Barrel | Flush Type | Termination Reason | Last Updated |
|---|---|---|---|
| | | Terminated at 20.00m without encountering bedrock | 11/08/2021 |

AGS

CAUSEWAY GEOTECH

| Project No. | Project Name: | Borehole ID |
|---|---|---|
| 21-0553 | Riverine Community Park, Lifford Site | BH08 |
| | Client: Donegal County Council | |
| | Client's Rep: McAdam Design Ltd | |

| Method | Plant Used | Top (m) | Base (m) | Coordinates | Final Depth: | Start Date: | Driller: | Sheet 3 of 3 |
|---|---|---|---|---|---|---|---|---|
| Cable Percussion<br>Rotary Drilling | Dando 2000<br>Comacchio 405 | 0.00<br>13.00 | 13.00<br>20.00 | 233752.84 E<br>398759.25 N | 20.00 m | 05/06/2021 | MK+KW | Scale: 1:50 |
| | | | | | Elevation: 2.62 mOD | End Date: 30/06/2021 | Logger: NH | FINAL |

| Depth (m) | Sample / Tests | Field Records | Casing Depth (m) | Water Depth (m) | Level mOD | Depth (m) | Legend | Description | Water | Backfill |
|---|---|---|---|---|---|---|---|---|---|---|
| 19.00 - 19.18 | SPT () | N=50 (25 for 70mm/50 for 115mm) Hammer SN = 0210 | 19.0 | 5.00 | | | | Very dense greyish brown slightly silty sandy subangular to subrounded fine to coarse GRAVEL with medium cobble and boulder content. Sand is fine to coarse. Cobbles and boulders are subrounded to rounded. | | |
| 20.00 - 20.16 | SPT () | N=50 (25 for 60mm/50 for 95mm) Hammer SN = 0210 | 20.0 | 5.00 | -17.38 | 20.00 | | End of Borehole at 20.00m | | |

19.0 19.5 20.0 20.5 21.0 21.5 22.0 22.5 23.0 23.5 24.0 24.5 25.0 25.5 26.0 26.5 27.0 27.5

**Water Strikes**

| Struck at (m) | Casing to (m) | Time (min) | Rose to (m) |
|---|---|---|---|
| 14.50 | 14.50 | 20 | 5.00 |

**Casing Details**

| To (m) | Diam (mm) |
|---|---|
| 13.00 | 200 |
| 20.00 | 200 |

**Water Added**

| From (m) | To (m) |
|---|---|
| 1.20 | 3.50 |

**Remarks**

Hand dug inspection pit excavated to 1.20m

| Core Barrel | Flush Type | Termination Reason | Last Updated |
|---|---|---|---|
| | | Terminated at 20.00m without encountering bedrock | 11/08/2021 |

AGS

CAUSEWAY GEOTECH

# APPENDIX C

# SLIT TRENCH LOGS AND DRAWINGS



CAUSEWAY GEOTECH

| | | | |
|---|---|---|---|
| **Project No.** 21-0553 | **Project Name:** Riverine Community Park, Lifford Site | | **Trial Pit ID** UT 001 |
| **Coordinates** 233715.42 E 398580.13 N | **Client:** Donegal County Council | | |
| **Method:** Slit Trenching | **Client's Representative:** McAdam Design Ltd | | Sheet 1 of 1 Scale: 1:25 |
| **Plant:** 3T Tracked Excavator | **Elevation** 3.37 mOD | **Date:** 21/05/2021 | **Logger:** JAC | FINAL |

| Depth (m) | Sample / Tests | Field Records | Level (mOD) | Depth (m) | Legend | Description | Water |
|---|---|---|---|---|---|---|---|
| | | | 3.17 | 0.20 | | TOPSOIL | |
| | | | | | | Firm brown sightly sandy SILT. Sand is fine. | |
| | | | 1.97 | 1.40 | | Firm to stiff dark brown SILT/CLAY. | |
| | | | 1.77 | 1.60 | | End of trial pit at 1.60m | |

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5

| Water Strikes | |
|---|---|
| Struck at (m) | Remarks |

**Depth:** 1.60
**Width:** 0.50
**Length:** 5.50

**Remarks:**
Pit completed for Utilities Trench location
No groundwater encountered

**Stability:** Stable

**Termination Reason:**

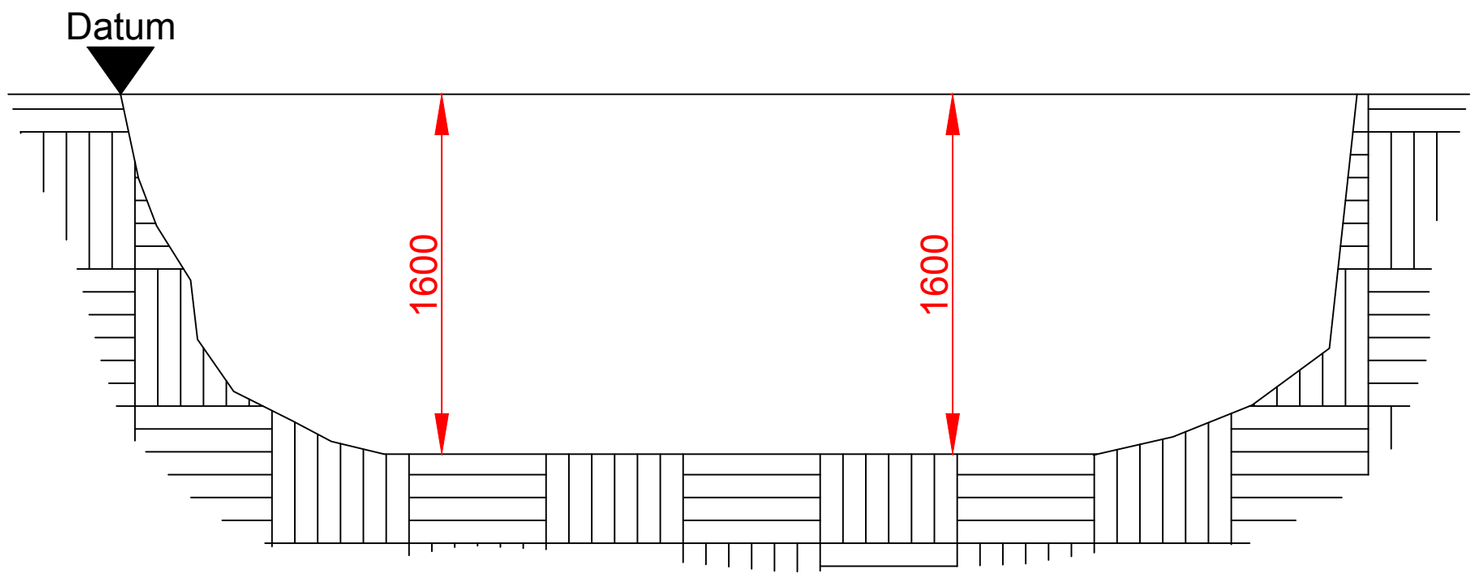
**Last Updated** 11/08/2021

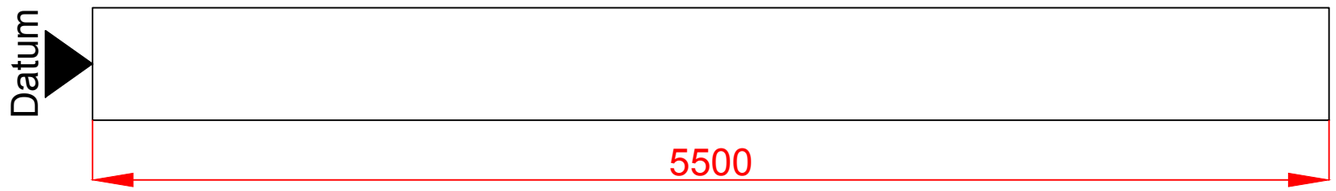
AGS

| JOB NUMBER: 21-0533A | JOB NAME: Riverine Community Park, Lifford Site | LOCATION: UT 001 |
|---|---|---|

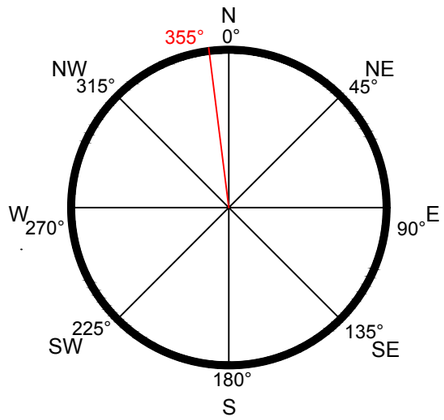
| CLIENT: | CLIENTS REPRESENTATIVE: | CREW: | PLANT & EQUIPMENT |
|---|---|---|---|
| Donegal County Council | McAdam Design Ltd | JC | 8 Tonne Excavator & Hand Tools |

TRENCH: (SECTION & PLAN)




TRENCH - ORIENTATION




TRENCH ORIENTATED : 355° FROM NORTH

COORDINATES: DATUM

EASTING: 233715.42

NORTHING: 398580.13

ELEVATION: 3.369

| No: | Type of Service: | Diameter (in mm) | Depth to Top of Service (m) | Distance to Centre of Service (m) | Details/Comments |
|---|---|---|---|---|---|
| 01 | | | | | No services found |
| 02 | | | | | |
| 03 | | | | | |
| 04 | | | | | |
| 05 | | | | | |
| 06 | | | | | |
| 07 | | | | | |
| 08 | | | | | |
| 09 | | | | | |
| 10 | | | | | |
| 11 | | | | | |
| 12 | | | | | |
| 13 | | | | | |
| 14 | | | | | |
| 15 | | | | | |

TRENCH LENGTH (m) : 5.50

TRENCH DEPTH (m) : 1.60

TRENCH WIDTH (m) : 0.70

STABILITY: Good

GROUNDWATER: None

SCALE: NTS@A3

DRAWN: BS

CHECKED: NH

DATE EXCAVATED: 21/05/2021

CAUSEWAY GEOTECH

CAUSEWAY GEOTECH

| | | | |
|---|---|---|---|
| **Project No.** 21-0553 | **Project Name:** Riverine Community Park, Lifford Site | | **Trial Pit ID** UT 002 |
| **Coordinates** 233788.90 E 398550.35 N | **Client:** Donegal County Council | | |
| **Method:** Slit Trenching | **Client's Representative:** McAdam Design Ltd | | Sheet 1 of 1 Scale: 1:25 |
| **Plant:** 3T Tracked Excavator | **Elevation** 3.48 mOD | **Date:** 20/05/2021 | **Logger:** JAC | FINAL |

| Depth (m) | Sample / Tests | Field Records | Level (mOD) | Depth (m) | Legend | Description | Water |
|---|---|---|---|---|---|---|---|
| | | | | | | TOPSOIL | |
| | | | 3.18 | 0.30 | | MADE GROUND: Dark brown silty very gravelly fine to coarse SAND with medium cobble content, fragments of brick, ceramic, glass, metal bar and timber. Gravel is subangular to subrounded fine to coarse. Cobbles are subangular to subrounded. | |
| | | | 1.18 | 2.30 | | End of trial pit at 2.30m | |

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5

| Water Strikes | |
|---|---|
| Struck at (m) | Remarks |
| | |

**Depth:** 2.30
**Width:** 0.50
**Length:** 6.10

**Remarks:**
Pit completed for Utilities Trench location
No groundwater encountered

**Stability:** Stable

**Termination Reason:**

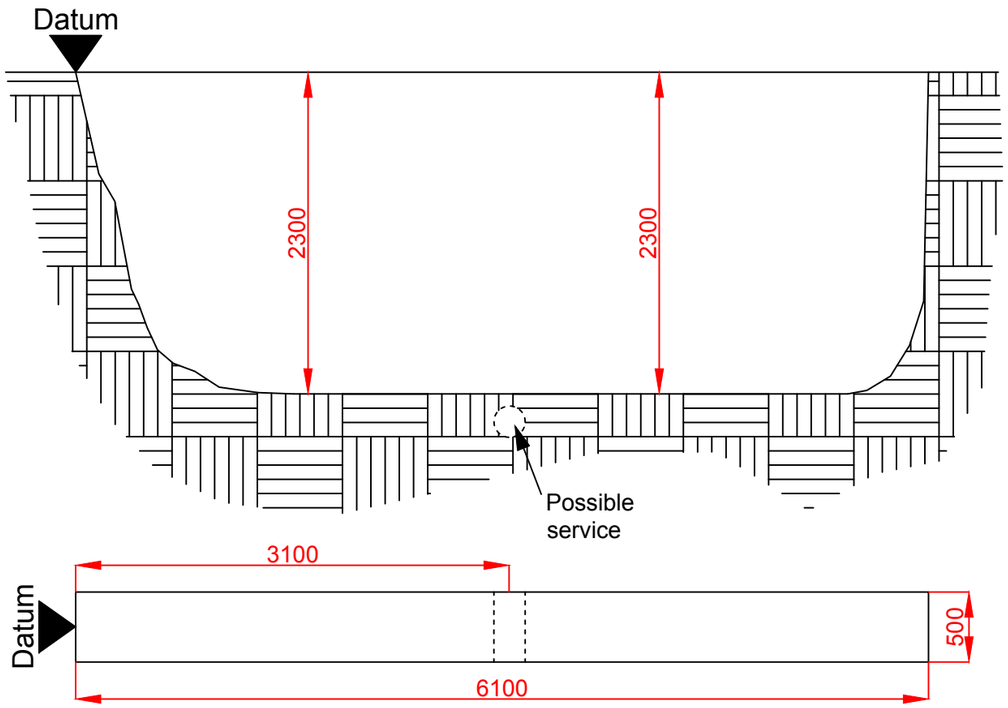
**Last Updated** 11/08/2021

AGS

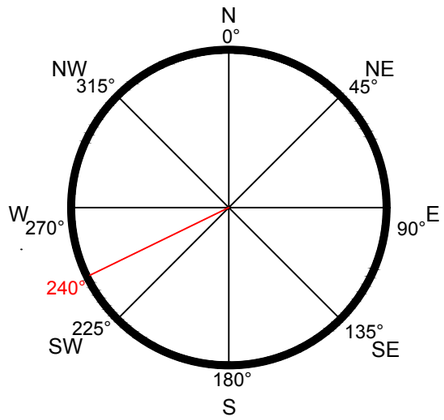
| JOB NUMBER: 21-0533A | JOB NAME: Riverine Community Park, Lifford Site | LOCATION: UT 002 |
|---|---|---|

| CLIENT: Donegal County Council | CLIENTS REPRESENTATIVE: McAdam Design Ltd | CREW: JC | PLANT & EQUIPMENT: 8 Tonne Excavator & Hand Tools |
|---|---|---|---|

TRENCH: (SECTION & PLAN)




TRENCH - ORIENTATION




TRENCH ORIENTATED : 240° FROM NORTH

COORDINATES: DATUM

EASTING: 233794.41

NORTHING: 398552.14

ELEVATION: 3.54

| No: | Type of Service: | Diameter (in mm) | Depth to Top of Service (m) | Distance to Centre of Service (m) | Details/Comments |
|---|---|---|---|---|---|
| 01 | | | | | Possible drainage pipe in stone |
| 02 | | | | | |
| 03 | | | | | |
| 04 | | | | | |
| 05 | | | | | |
| 06 | | | | | |
| 07 | | | | | |
| 08 | | | | | |
| 09 | | | | | |
| 10 | | | | | |
| 11 | | | | | |
| 12 | | | | | |
| 13 | | | | | |
| 14 | | | | | |
| 15 | | | | | |

TRENCH LENGTH (m) : 6.10

TRENCH DEPTH (m) : 2.30

TRENCH WIDTH (m) : 0.50

STABILITY: Good

GROUNDWATER: None

SCALE: NTS@A3

DRAWN: BS

CHECKED: NH

DATE EXCAVATED: 20/05/2021

CAUSEWAY GEOTECH

CAUSEWAY GEOTECH

# APPENDIX D

# SLIT TRENCH PHOTOGRAPHS






**Utilities Trench: UT 001**



**Utilities Trench: UT 001**



**Utilities Trench: UT 001**




**Utilities Trench: UT 001**



**Utilities Trench: UT 002**



**Utilities Trench: UT 002**



**Utilities Trench: UT 002**



**Utilities Trench: UT 002**

CAUSEWAY GEOTECH

# APPENDIX E

# SOAKAWAY LOGS AND TEST RESULTS



CAUSEWAY GEOTECH

| | | | |
|---|---|---|---|
| **Project No.** 21-0553 | **Project Name:** Riverine Community Park, Lifford Site | | **Trial Pit ID** INFIL 001 |
| **Coordinates** 233742.01 E 398690.00 N | **Client:** Donegal County Council | | |
| **Method:** Trial Pitting | **Client's Representative:** McAdam Design Ltd | | Sheet 1 of 1 Scale: 1:25 |
| **Plant:** 3T Tracked Excavator | **Elevation** 3.74 mOD | **Date:** 21/05/2021 | **Logger:** JAC | FINAL |

| Depth (m) | Sample / Tests | Field Records | Level (mOD) | Depth (m) | Legend | Description | Water |
|---|---|---|---|---|---|---|---|
| | | | 3.48 | 0.25 | | TOPSOIL roots and rootlets | |
| 0.50 | B1 | | | | | Brown silty very sandy subangular to rounded fine to coarse GRAVEL with medium cobble content. Sand is fine to coarse. Cobbles are subrounded to rounded. | |
| | | | 2.54 | 1.20 | | Light brown slightly silty gravelly fine to coarse SAND. Gravel is subrounded to rounded fine to coarse. | |
| 1.50 | B2 | | | | | | |
| | | | 1.74 | 2.00 | | End of trial pit at 2.00m | |

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5

| Water Strikes | |
|---|---|
| Struck at (m) | Remarks |
| | |

**Depth:** 2.00
**Width:** 0.80
**Length:** 1.60

**Remarks:**
Pit completed for Soakaway test location
No groundwater encountered

| Stability: | Termination Reason: | Last Updated |
|---|---|---|
| Unstable | Terminated at scheduled depth | 11/08/2021 |

AGS

# Soakaway Infiltration Test

**Project No.:** 21-0553A
**Site:** Riverine Community Park, Lifford
**Test Location:** INFIL 001 (test 1)
**Test Date:** 21 May 2021

| | width (m) | length (m) |
|---|---|---|
| test pit top dimensions | 0.80 | 1.60 |
| test pit base dimensions | 0.35 | 1.20 |

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

test pit depth (m) 2.00

depth to groundwater before adding water (m) = Dry

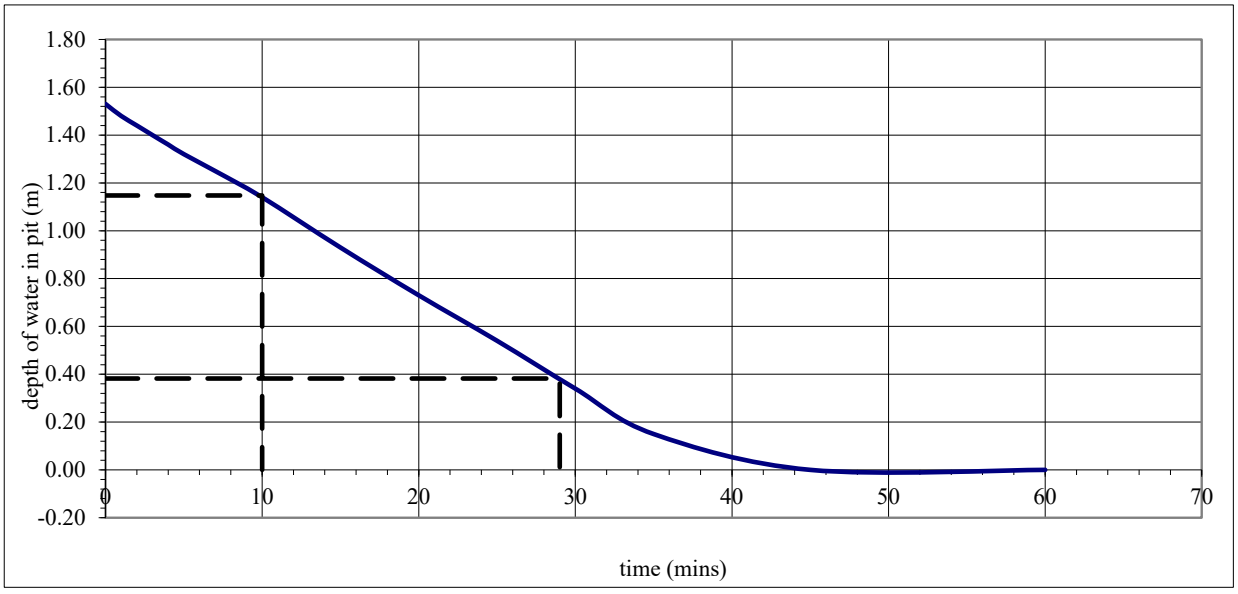
| time (mins) | depth to water surface (m) | depth of water in pit (m) |
|---|---|---|
| 0 | 0.47 | 1.53 |
| 1 | 0.52 | 1.48 |
| 2 | 0.56 | 1.44 |
| 3 | 0.60 | 1.40 |
| 4 | 0.64 | 1.36 |
| 5 | 0.68 | 1.32 |
| 7 | 0.75 | 1.25 |
| 10 | 0.86 | 1.14 |
| 15 | 1.07 | 0.93 |
| 20 | 1.27 | 0.73 |
| 25 | 1.46 | 0.54 |
| 30 | 1.66 | 0.34 |
| 35 | 1.85 | 0.15 |
| 45 | 2.00 | 0.00 |
| 60 | 2.00 | 0.00 |
| | | |
| | | |
| | | |
| | | |

From graph below:
test start - 75% depth at
1.1475 m water depth
time is 10.0 minutes

test end - 25% depth at
0.3825 m water depth
time is 29.0 minutes

**test infiltration rate (q) = 0.555 m/h**

| 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) |
|---|---|---|---|---|---|---|---|
| 10 | 0.85 | 1.1475 | 19 | 0.55 | 3.10 | 9.3E-03 | 0.555 |
| 29 | 1.62 | 0.3825 | | | | | |



# Soakaway Infiltration Test

**Project No.:** 21-0553A
**Site:** Riverine Community Park, Lifford
**Test Location:** INFIL 001 (test 2)
**Test Date:** 21 May 2021

*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 | 1.60 |
| test pit base dimensions | 0.35 | 1.20 |

test pit depth (m) 2.00

depth to groundwater before adding water (m) = Dry

| time (mins) | depth to water surface (m) | depth of water in pit (m) |
|---|---|---|
| 0 | 0.63 | 1.37 |
| 1 | 0.68 | 1.32 |
| 2 | 0.73 | 1.27 |
| 3 | 0.77 | 1.23 |
| 4 | 0.81 | 1.19 |
| 5 | 0.85 | 1.15 |
| 7 | 0.92 | 1.08 |
| 10 | 1.03 | 0.97 |
| 15 | 1.14 | 0.86 |
| 20 | 1.33 | 0.67 |
| 25 | 1.53 | 0.47 |
| 30 | 1.73 | 0.27 |
| 35 | 1.92 | 0.08 |
| 45 | 2.00 | 0.00 |
| 60 | 2.00 | 0.00 |
| | | |
| | | |
| | | |
| | | |

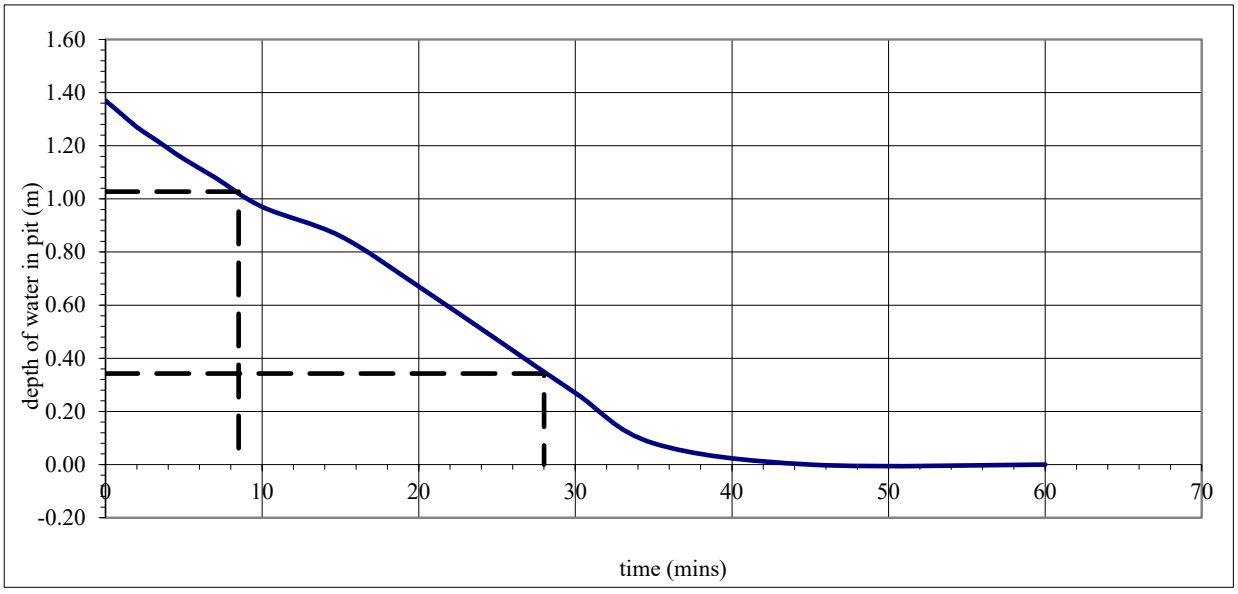
From graph below:

test start - 75% depth at
1.0275 m water depth
time is 8.5 minutes

test end - 25% depth at
0.3425 m water depth
time is 28.0 minutes

**test infiltration rate (q) = 0.513 m/h**

| 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) |
|---|---|---|---|---|---|---|---|
| 8.5 | 0.97 | 1.0275 | 19.5 | 0.47 | 2.79 | 8.5E-03 | 0.513 |
| 28 | 1.66 | 0.3425 | | | | | |



# Soakaway Infiltration Test

**Project No.:** 21-0553A
**Site:** Riverine Community Park, Lifford
**Test Location:** INFIL 001 (test 3)
**Test Date:** 21 May 2021

*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 | 1.60 |
| test pit base dimensions | 0.35 | 1.20 |

test pit depth (m) 2.00

depth to groundwater before adding water (m) = Dry

| time (mins) | depth to water surface (m) | depth of water in pit (m) |
|---|---|---|
| 0 | 0.55 | 1.45 |
| 1 | 0.60 | 1.40 |
| 2 | 0.65 | 1.35 |
| 3 | 0.70 | 1.30 |
| 4 | 0.75 | 1.25 |
| 5 | 0.79 | 1.21 |
| 7 | 0.87 | 1.13 |
| 10 | 0.99 | 1.01 |
| 15 | 1.11 | 0.89 |
| 20 | 1.30 | 0.70 |
| 25 | 1.48 | 0.52 |
| 30 | 1.66 | 0.34 |
| 35 | 1.84 | 0.16 |
| 45 | 2.00 | 0.00 |
| 60 | 2.00 | 0.00 |
| | | |
| | | |
| | | |
| | | |

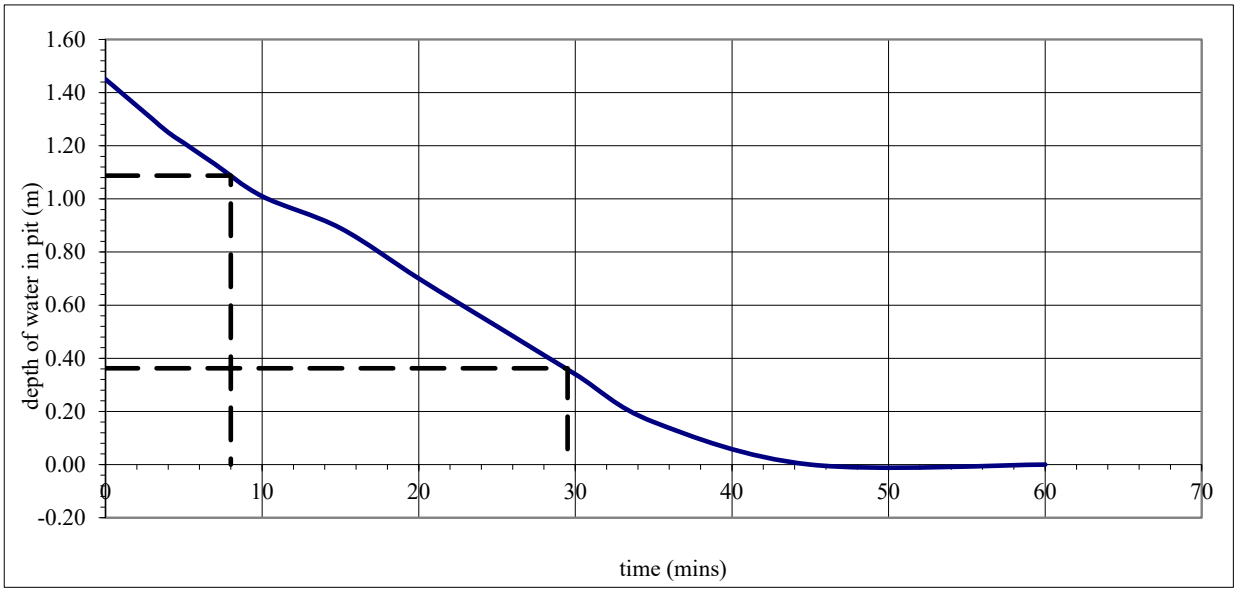
From graph below:

test start - 75% depth at
1.0875 m water depth
time is 8.0 minutes

test end - 25% depth at
0.3625 m water depth
time is 29.5 minutes

**test infiltration rate (q) = 0.478 m/h**

| 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) |
|---|---|---|---|---|---|---|---|
| 8 | 0.91 | 1.0875 | 21.5 | 0.50 | 2.95 | 8.0E-03 | 0.478 |
| 29.5 | 1.64 | 0.3625 | | | | | |



CAUSEWAY GEOTECH

| | | | |
|---|---|---|---|
| **Project No.** 21-0553 | **Project Name:** Riverine Community Park, Lifford Site | | **Trial Pit ID** INFIL 002 |
| **Coordinates** 233814.12 E 398619.08 N | **Client:** Donegal County Council | | |
| **Method:** Trial Pitting | **Client's Representative:** McAdam Design Ltd | | Sheet 1 of 1 Scale: 1:25 |
| **Plant:** 3T Tracked Excavator | **Elevation** 5.01 mOD | **Date:** 21/05/2021 | **Logger:** JAC | FINAL |

| Depth (m) | Sample / Tests | Field Records | Level (mOD) | Depth (m) | Legend | Description | Water |
|---|---|---|---|---|---|---|---|
| | | | 4.81 | 0.20 | | TOPSOIL | |
| 0.50 | B1 | | | | | Firm to stiff brown slightly gravelly sandy SILT. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium. | |
| | | | 3.71 | 1.30 | | | |
| 1.50 | B2 | | | | | Firm to stiff brownish grey sandy gravelly SILT with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subangular to subrounded. | |
| | | | 3.01 | 2.00 | | End of trial pit at 2.00m | |

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5

| Water Strikes | |
|---|---|
| Struck at (m) | Remarks |
| | |

**Depth:** 2.00
**Width:** 0.50
**Length:** 1.70

**Remarks:**
Pit completed for Soakaway test location
No groundwater encountered

| Stability: | Termination Reason: | Last Updated |
|---|---|---|
| Stable | Terminated at scheduled depth | 11/08/2021 |

AGS

# Soakaway Infiltration Test

**Project No.:** 21-0553A
**Site:** Riverine Community Park, Lifford
**Test Location:** INFIL 002
**Test Date:** 21 May 2021

| | width (m) | length (m) |
|---|---|---|
| test pit top dimensions | 0.50 | 1.70 |
| test pit base dimensions | 0.50 | 1.20 |

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

test pit depth (m) 2.00

depth to groundwater before adding water (m) = Dry

| time (mins) | depth to water surface (m) | depth of water in pit (m) |
|---|---|---|
| 0 | 0.36 | 1.64 |
| 1 | 0.36 | 1.64 |
| 2 | 0.36 | 1.64 |
| 3 | 0.36 | 1.64 |
| 4 | 0.36 | 1.64 |
| 5 | 0.36 | 1.64 |
| 7 | 0.36 | 1.64 |
| 10 | 0.36 | 1.64 |
| 15 | 0.37 | 1.63 |
| 20 | 0.37 | 1.63 |
| 25 | 0.37 | 1.63 |
| 30 | 0.37 | 1.63 |
| 35 | 0.37 | 1.63 |
| 45 | 0.37 | 1.63 |
| 60 | 0.37 | 1.63 |
| | | |
| | | |
| | | |
| | | |

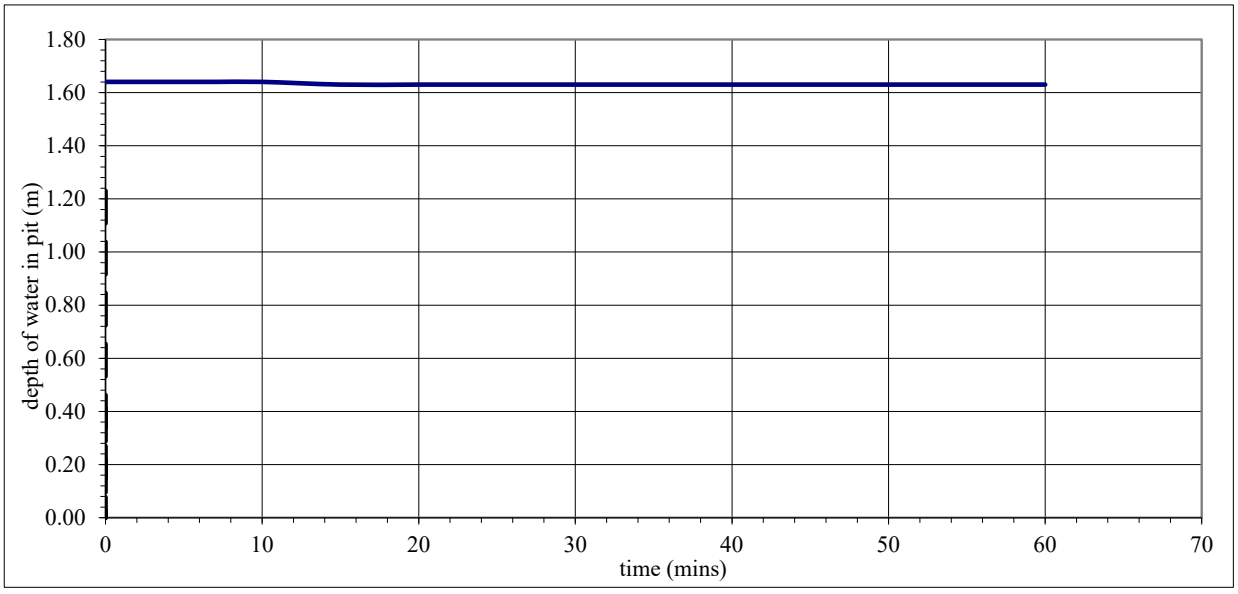
From graph below:

test start - 75% depth at
1.23 m water depth
time is not determined

test end - 25% depth at
0.41 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) |
|---|---|---|---|---|---|---|---|
| | 0.77 | 1.23 | | 0.58 | 3.60 | | |
| | 1.59 | 0.41 | | | | | |



CAUSEWAY GEOTECH

| | | | |
|---|---|---|---|
| **Project No.** 21-0553 | **Project Name:** Riverine Community Park, Lifford Site | | **Trial Pit ID** INFIL 003 |
| **Coordinates** 233954.93 E 398711.45 N | **Client:** Donegal County Council | | |
| **Method:** Trial Pitting | **Client's Representative:** McAdam Design Ltd | | Sheet 1 of 1 Scale: 1:25 |
| **Plant:** 3T Tracked Excavator | **Elevation** 2.78 mOD | **Date:** 21/05/2021 | **Logger:** JAC | FINAL |

| Depth (m) | Sample / Tests | Field Records | Level (mOD) | Depth (m) | Legend | Description | Water |
|---|---|---|---|---|---|---|---|
| | | | 2.58 | 0.20 | | TOPSOIL | |
| 0.50 | B1 | | | | | Firm to stiff brown very sandy clayey SILT. Sand is fine to coarse. | |
| | | | 1.38 | 1.40 | | Firm to stiff orangish brown sandy SILT with thin beds of silty fine to medium sand. | |
| 1.60 | B2 | | | | | | |
| | | | 0.78 | 2.00 | | End of trial pit at 2.00m | |

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5

| Water Strikes | |
|---|---|
| Struck at (m) | Remarks |
| | |

**Depth:** 2.00
**Width:** 0.50
**Length:** 1.60

**Remarks:**
Pit completed for Soakaway test location
No groundwater encountered

| Stability: | Termination Reason: | Last Updated |
|---|---|---|
| Stable | Terminated at scheduled depth | 11/08/2021 |

AGS

# Soakaway Infiltration Test

**Project No.:** 21-0553A
**Site:** Riverine Community Park, Lifford
**Test Location:** INFIL 003
**Test Date:** 21 May 2021

| | width (m) | length (m) |
|---|---|---|
| test pit top dimensions | 0.50 | 1.50 |
| test pit base dimensions | 0.50 | 1.20 |

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

test pit depth (m) 2.00

depth to groundwater before adding water (m) = Dry

| time (mins) | depth to water surface (m) | depth of water in pit (m) |
|---|---|---|
| 0 | 0.51 | 1.49 |
| 1 | 0.52 | 1.48 |
| 2 | 0.53 | 1.47 |
| 3 | 0.53 | 1.47 |
| 4 | 0.54 | 1.46 |
| 5 | 0.55 | 1.45 |
| 7 | 0.57 | 1.43 |
| 10 | 0.59 | 1.41 |
| 15 | 0.64 | 1.36 |
| 20 | 0.68 | 1.32 |
| 25 | 0.72 | 1.28 |
| 30 | 0.75 | 1.25 |
| 35 | 0.78 | 1.22 |
| 45 | 0.85 | 1.15 |
| 60 | 0.95 | 1.05 |
| | | |
| | | |
| | | |
| | | |

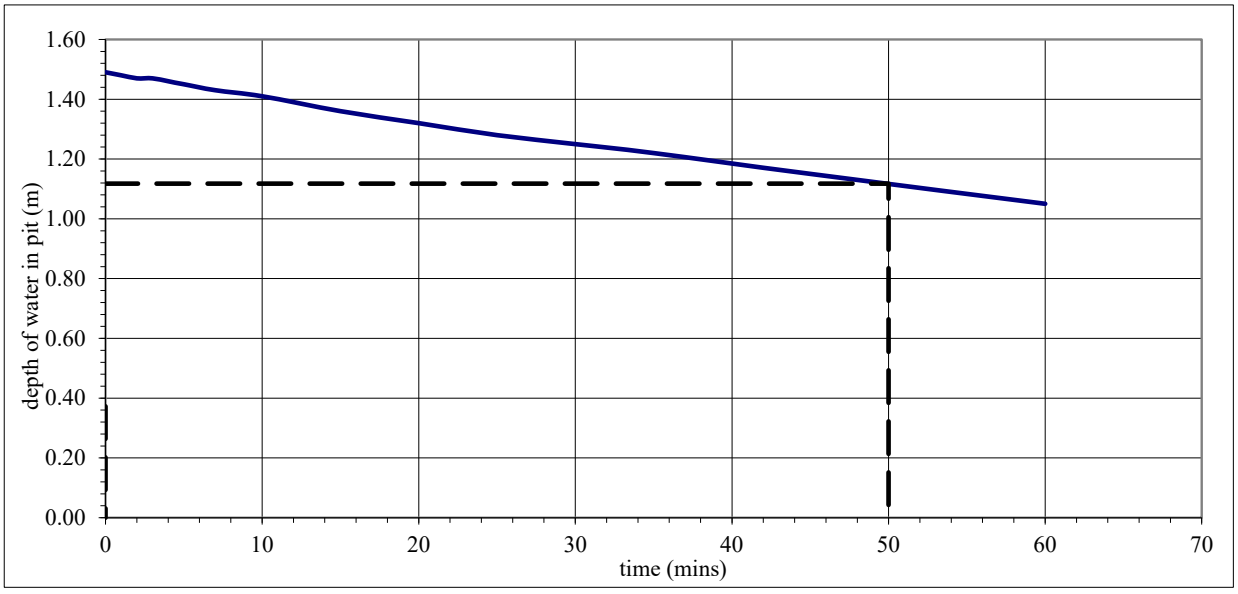
From graph below:

test start - 75% depth at
1.1175 m water depth
time is 50.0 minutes

test end - 25% depth at
0.3725 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) |
|---|---|---|---|---|---|---|---|
| 50 | 0.88 | 1.1175 | | 0.49 | 3.24 | | |
| | 1.63 | 0.3725 | | | | | |



CAUSEWAY GEOTECH

| | | | |
|---|---|---|---|
| **Project No.** 21-0553 | **Project Name:** Riverine Community Park, Lifford Site | | **Trial Pit ID** INFIL 004 |
| **Coordinates** 233753.54 E 398765.66 N | **Client:** Donegal County Council | | |
| **Method:** Trial Pitting | **Client's Representative:** McAdam Design Ltd | | Sheet 1 of 1 Scale: 1:25 |
| **Plant:** 3T Tracked Excavator | **Elevation** 2.46 mOD | **Date:** 21/05/2021 | **Logger:** JAC | FINAL |

| Depth (m) | Sample / Tests | Field Records | Level (mOD) | Depth (m) | Legend | Description | Water |
|---|---|---|---|---|---|---|---|
| | | | 2.26 | 0.20 | | TOPSOIL | |
| 0.50 | B1 | | | | | Firm brown very sandy SILT. Sand is fine to coarse. | |
| | | | 1.56 | 0.90 | | Firm to stiff light greyish brown silty CLAY. | |
| 1.50 | B2 | | | | | | |
| | | | 0.46 | 2.00 | | End of trial pit at 2.00m | |

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5

| Water Strikes | |
|---|---|
| Struck at (m) | Remarks |
| | |

**Depth:** 2.00
**Width:** 0.50
**Length:** 2.00

**Remarks:**
Pit completed for Soakaway test location
No groundwater encountered

| Stability: | Termination Reason: | Last Updated |
|---|---|---|
| Stable | Terminated at scheduled depth | 11/08/2021 |

AGS

# Soakaway Infiltration Test

**Project No.:** 21-0553A
**Site:** Riverine Community Park, Lifford
**Test Location:** INFIL 004
**Test Date:** 21 May 2021

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

| | width (m) | length (m) |
|---|---|---|
| test pit top dimensions | 0.50 | 2.00 |
| test pit base dimensions | 0.50 | 1.10 |

test pit depth (m) 2.00

depth to groundwater before adding water (m) = Dry

| time (mins) | depth to water surface (m) | depth of water in pit (m) |
|---|---|---|
| 0 | 0.64 | 1.36 |
| 1 | 0.64 | 1.36 |
| 2 | 0.64 | 1.36 |
| 3 | 0.64 | 1.36 |
| 4 | 0.64 | 1.36 |
| 5 | 0.64 | 1.36 |
| 7 | 0.64 | 1.36 |
| 10 | 0.64 | 1.36 |
| 15 | 0.64 | 1.36 |
| 20 | 0.64 | 1.36 |
| 25 | 0.64 | 1.36 |
| 30 | 0.64 | 1.36 |
| 35 | 0.64 | 1.36 |
| 45 | 0.65 | 1.35 |
| 60 | 0.65 | 1.35 |
| | | |
| | | |
| | | |
| | | |

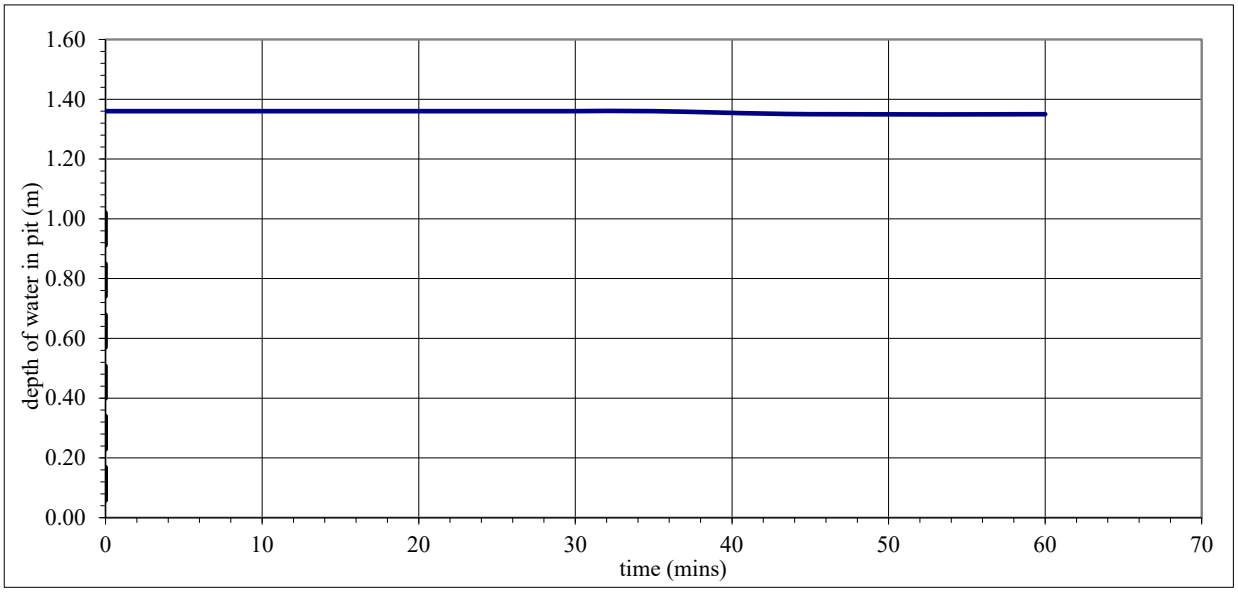
From graph below:

test start - 75% depth at
1.02 m water depth
time is not determined

test end - 25% depth at
0.34 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) |
|---|---|---|---|---|---|---|---|
| | 0.98 | 1.02 | | 0.48 | 2.99 | | |
| | 1.66 | 0.34 | | | | | |



CAUSEWAY GEOTECH

# APPENDIX F

# SOAKAWAY PIT PHOTOGRAPHS






**Soakaway Pit: INFIL 001**



CAUSEWAY GEOTECH



**Soakaway Pit: INFIL 001**



**Soakaway Pit: INFIL 001**




**Soakaway Pit: INFIL 001**




**Soakaway Pit: INFIL 002**



**Soakaway Pit: INFIL 002**



**Soakaway Pit: INFIL 002**




**Soakaway Pit: INFIL 002**




**Soakaway Pit: INFIL 003**



**Soakaway Pit: INFIL 003**




**Soakaway Pit: INFIL 003**




**Soakaway Pit: INFIL 004**



**Soakaway Pit: INFIL 004**



**Soakaway Pit: INFIL 004**




## Soakaway Pit: INFIL 004

CAUSEWAY GEOTECH

# APPENDIX G

# INDIRECT IN-SITU CBR TEST RESULTS



# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

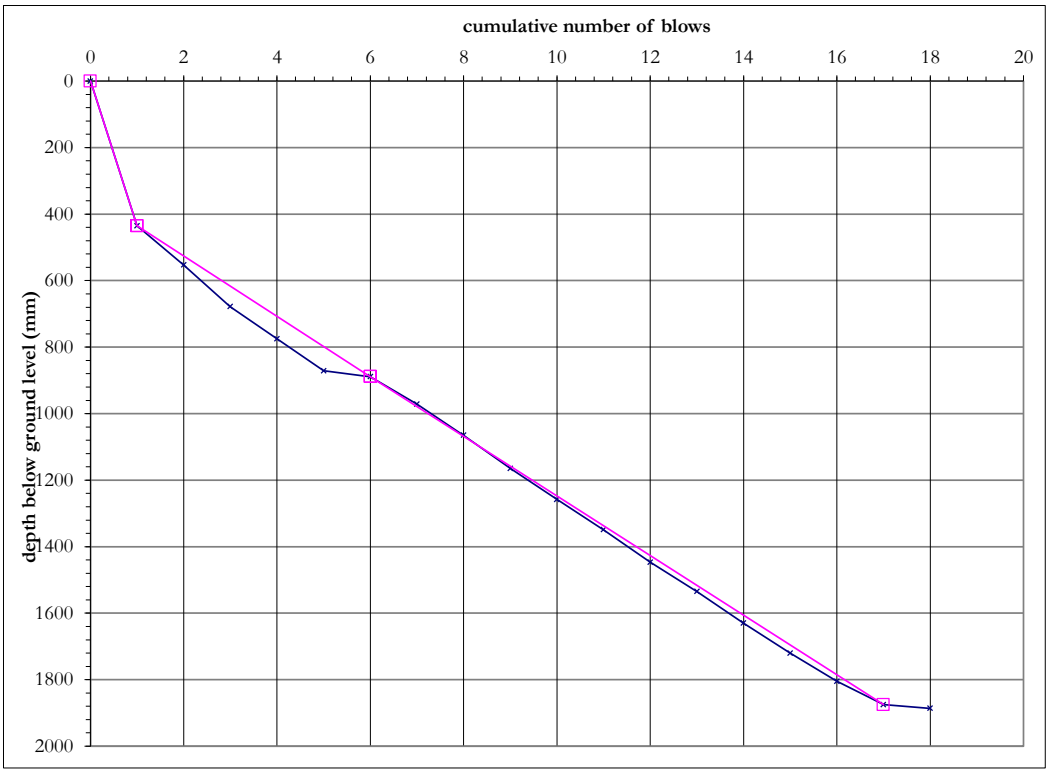
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Lifford |

| | |
|---|---|
| **Test Number** | CBR 001 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 25/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 435 | 0.5 |
| 435 | | |
| | | |
| 435 | 91 | 2.6 |
| 889 | | |
| | | |
| 889 | 90 | 2.6 |
| 1875 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 0.5<br>Max: 2.6 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

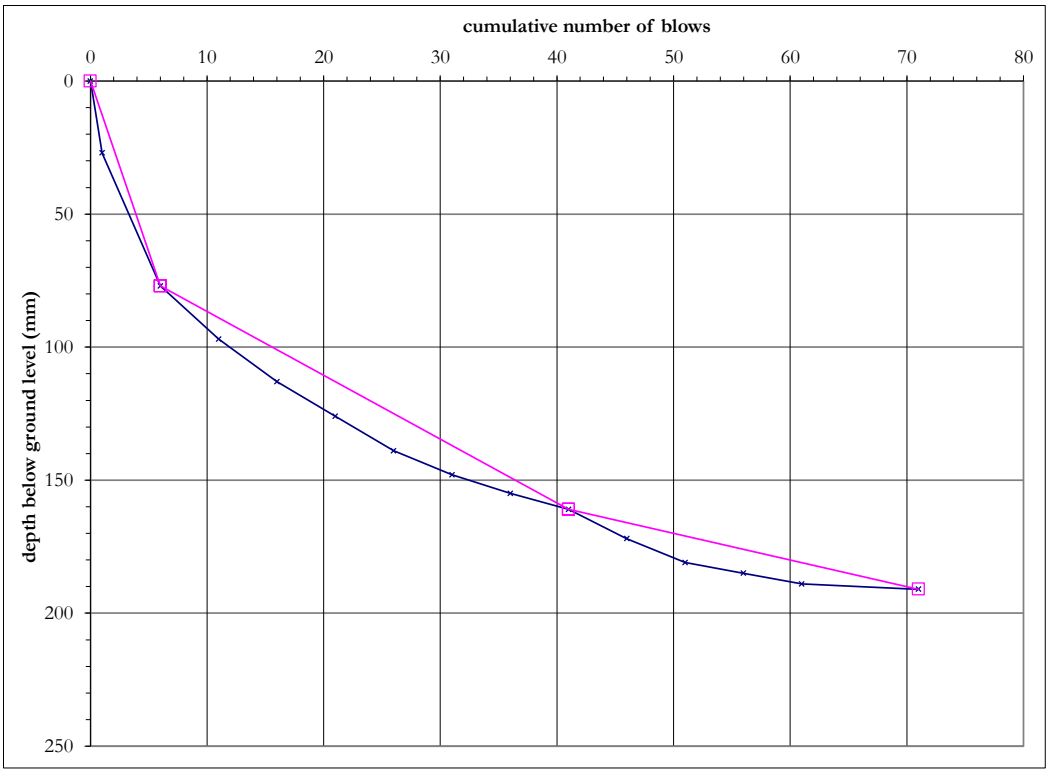
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Lifford |

| | |
|---|---|
| **Test Number** | CBR 002 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 24/05/2021 |
| **Weather** | Cloudy |

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

| Surface preparation | Description of surface material at test depth |
|---|---|
| N/A | Grass & stone |




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 13 | 20 |
| 77 | | |
| | | |
| 77 | 2.4 | >100 |
| 161 | | |
| | | |
| 161 | 1 | >100 |
| 191 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 20<br>Max: >100 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

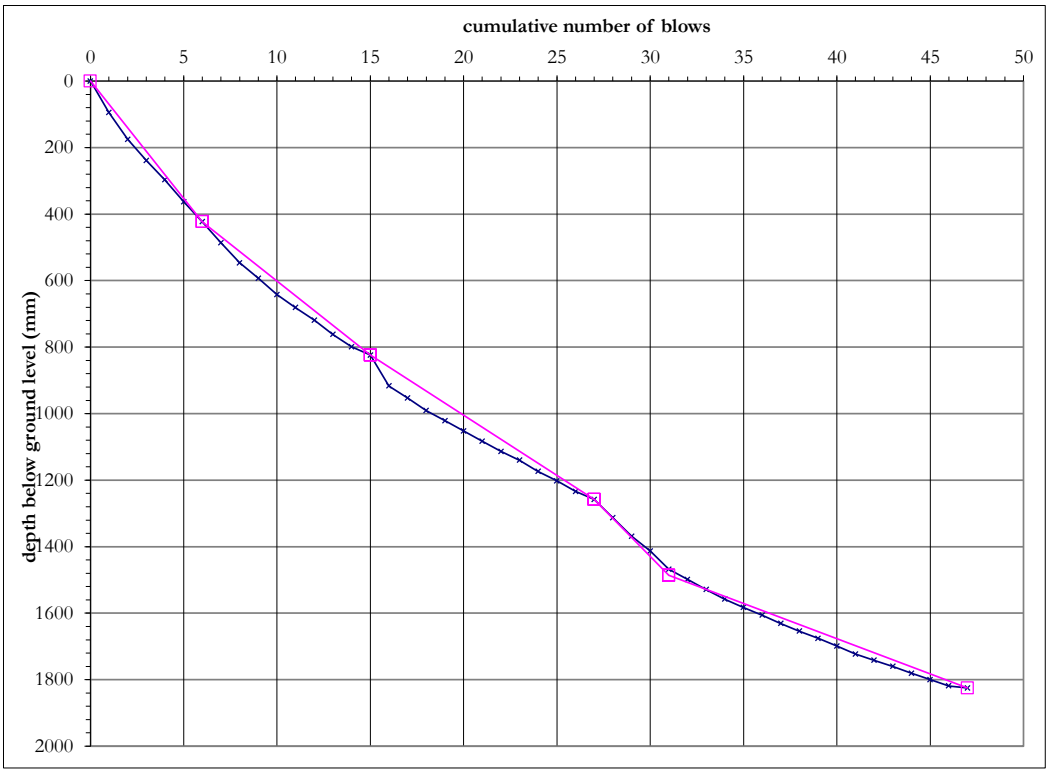
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Lifford |

| | |
|---|---|
| **Test Number** | CBR 003 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 25/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 71 | 3.4 |
| 423 | | |
| 423 | 45 | 5.5 |
| 824 | | |
| 824 | 36 | 6.8 |
| 1258 | | |
| 1258 | 57 | 4.2 |
| 1486 | | |
| 1486 | 21 | 12 |
| 1825 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 3.4<br>Max: 12 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

UKAS TESTING 10122

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

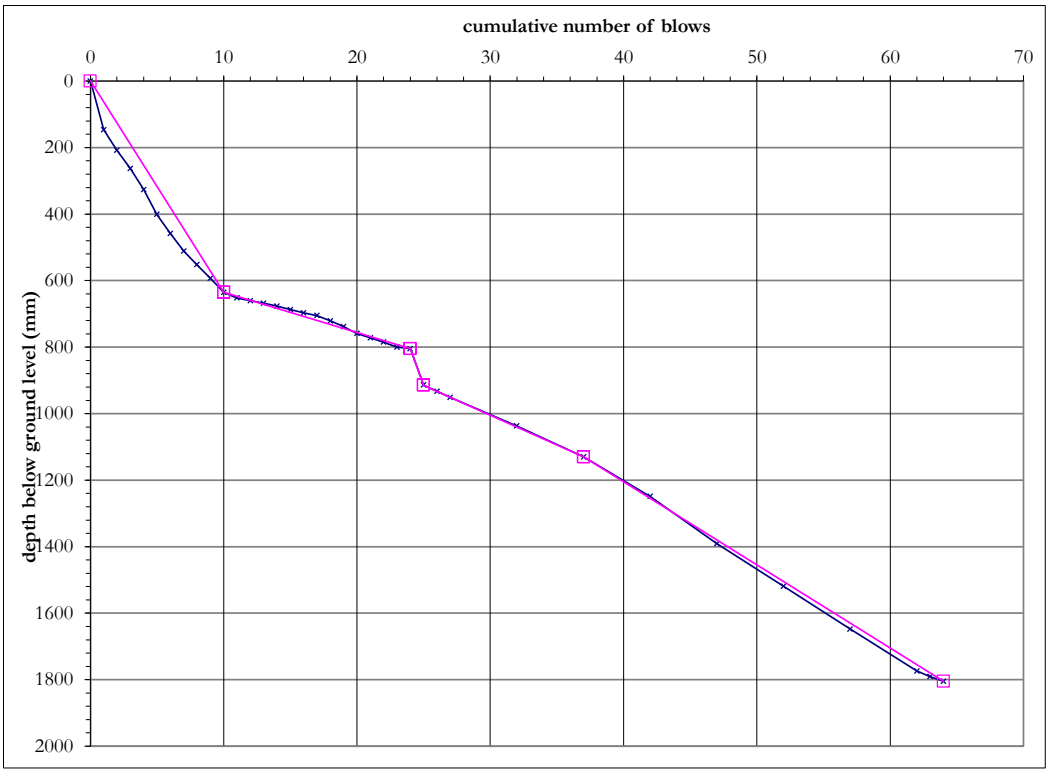
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Lifford |

| | |
|---|---|
| **Test Number** | CBR 004 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 25/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 64 | 3.8 |
| 635 | | |
| 635 | 12 | 22 |
| 805 | | |
| 805 | 109 | 2.1 |
| 914 | | |
| 915 | 18 | 14 |
| 1130 | | |
| 1130 | 25 | 10 |
| 1805 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 2.1<br>Max: 22 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

UKAS TESTING 10122

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

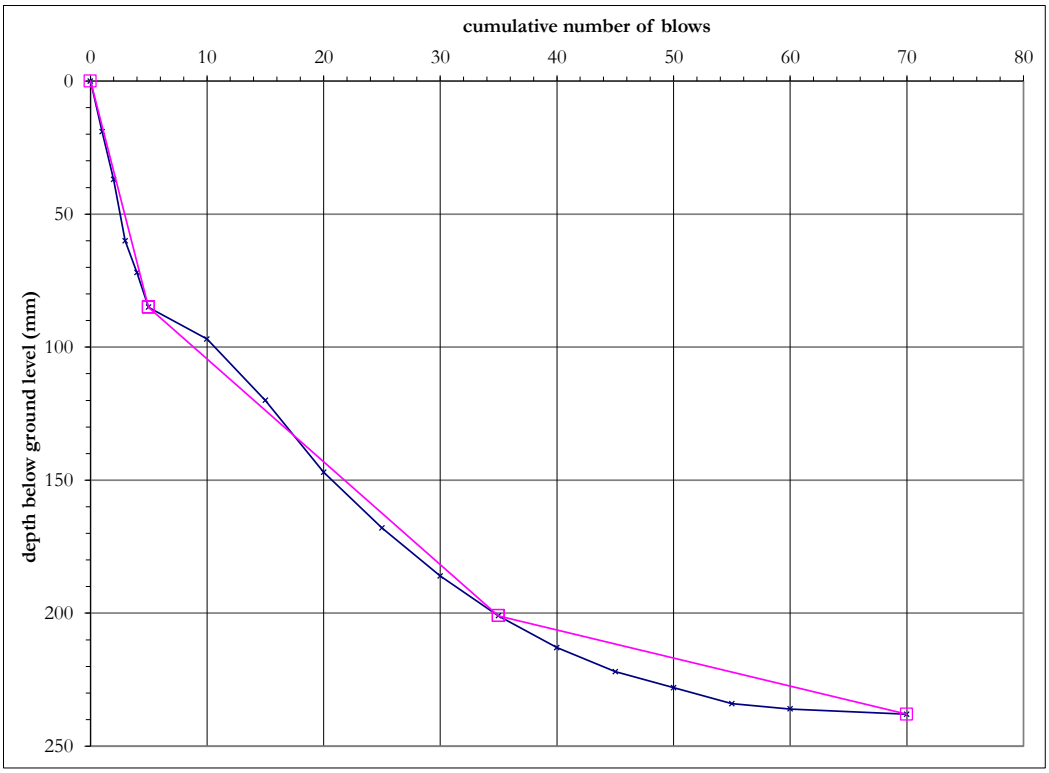
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Lifford |

| | |
|---|---|
| **Test Number** | CBR 005 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 24/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 17 | 15 |
| 85 | | |
| | | |
| 85 | 3.9 | 72 |
| 201 | | |
| | | |
| 201 | 1.1 | >100 |
| 238 | | |
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|---|---|---|
| **CBR Range** | Min: 15<br>Max: >100 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

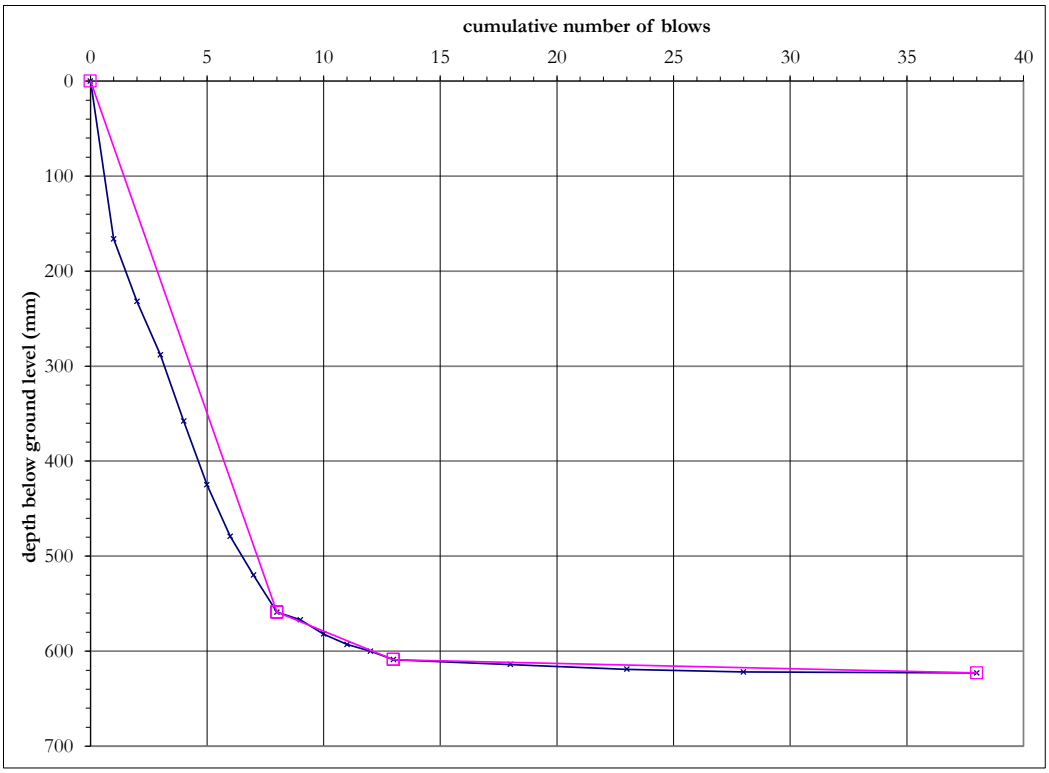
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Lifford |

| | |
|---|---|
| **Test Number** | CBR 006 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 25/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 70 | 3.4 |
| 559 | | |
| | | |
| 559 | 10 | 26 |
| 609 | | |
| | | |
| 609 | 0.6 | >100 |
| 623 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 3.4<br>Max: >100 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

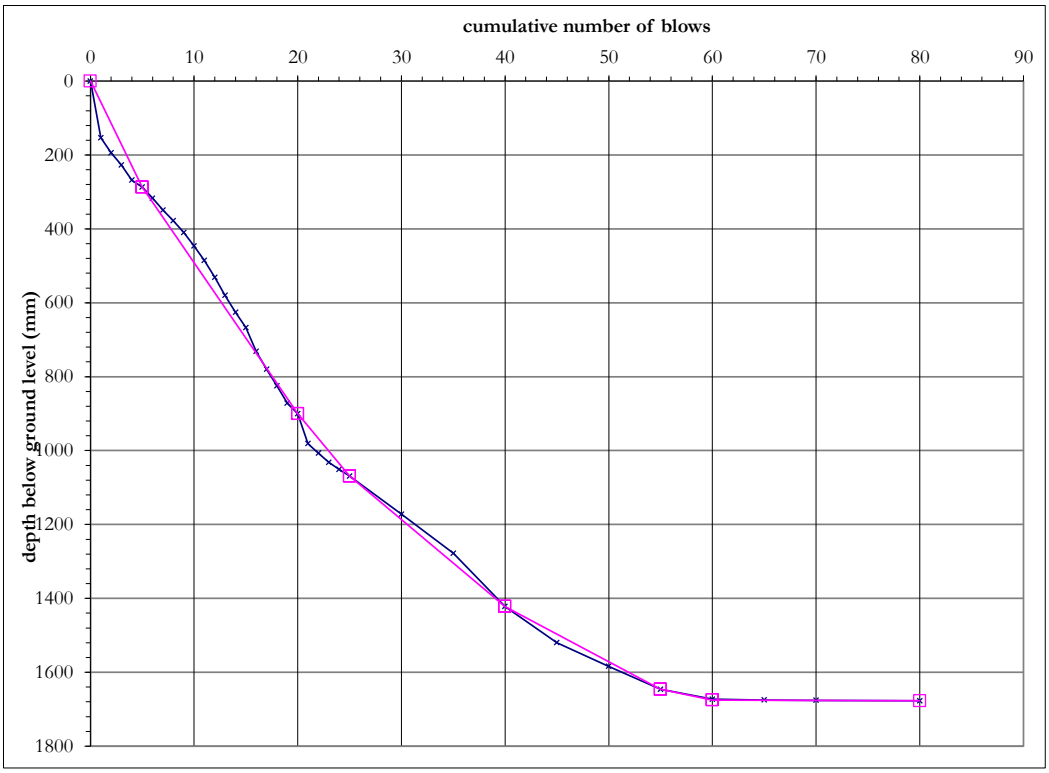
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Lifford |

| | |
|---|---|
| **Test Number** | CBR 007 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 25/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 57 | 4.2 |
| 287 | | |
| 287 | 41 | 6 |
| 900 | | |
| 900 | 34 | 7.3 |
| 1069 | | |
| 1069 | 24 | 11 |
| 1422 | | |
| 1422 | 15 | 17 |
| 1646 | | |
| 1646 | 5.8 | 47 |
| 1675 | | |
| 1675 | 0.1 | >100 |
| 1677 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 4.2<br>Max: >100 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

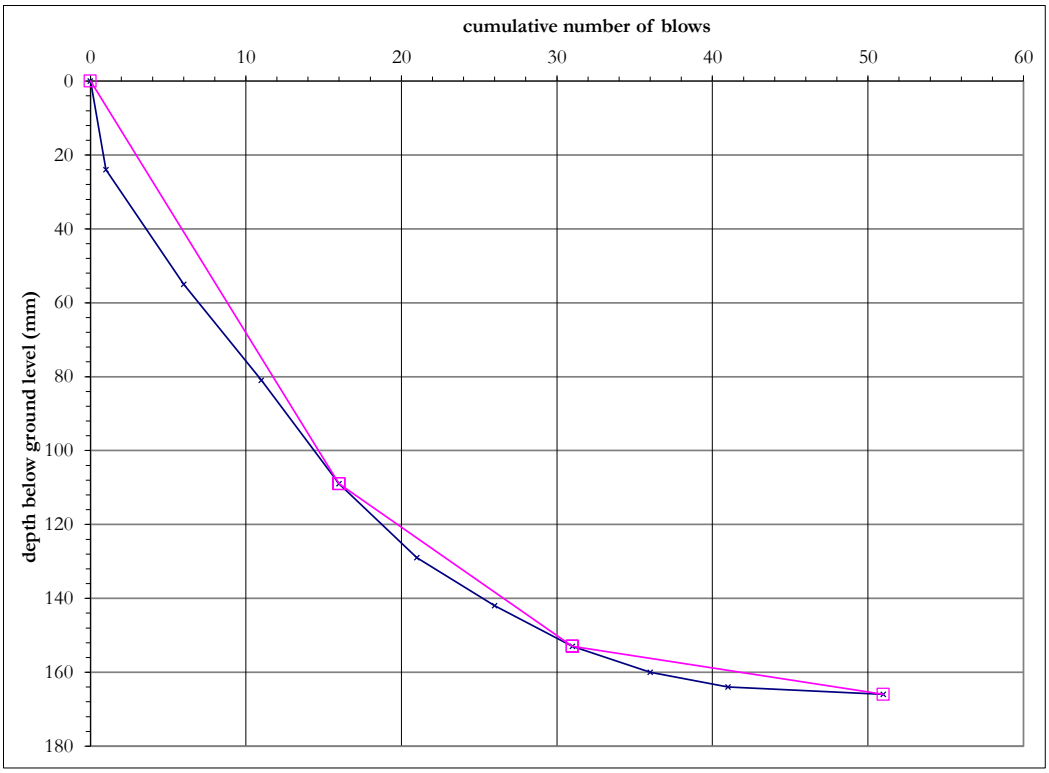
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Lifford |

| | |
|---|---|
| **Test Number** | CBR 008 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 24/05/2021 |
| **Weather** | Cloudy |

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

| Surface preparation | Description of surface material at test depth |
|---|---|
| N/A | Hardcore fill |




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 6.8 | 40 |
| 109 | | |
| | | |
| 109 | 2.9 | 97 |
| 153 | | |
| | | |
| 153 | 0.7 | >100 |
| 166 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 40<br>Max: >100 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

UKAS TESTING 10122

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

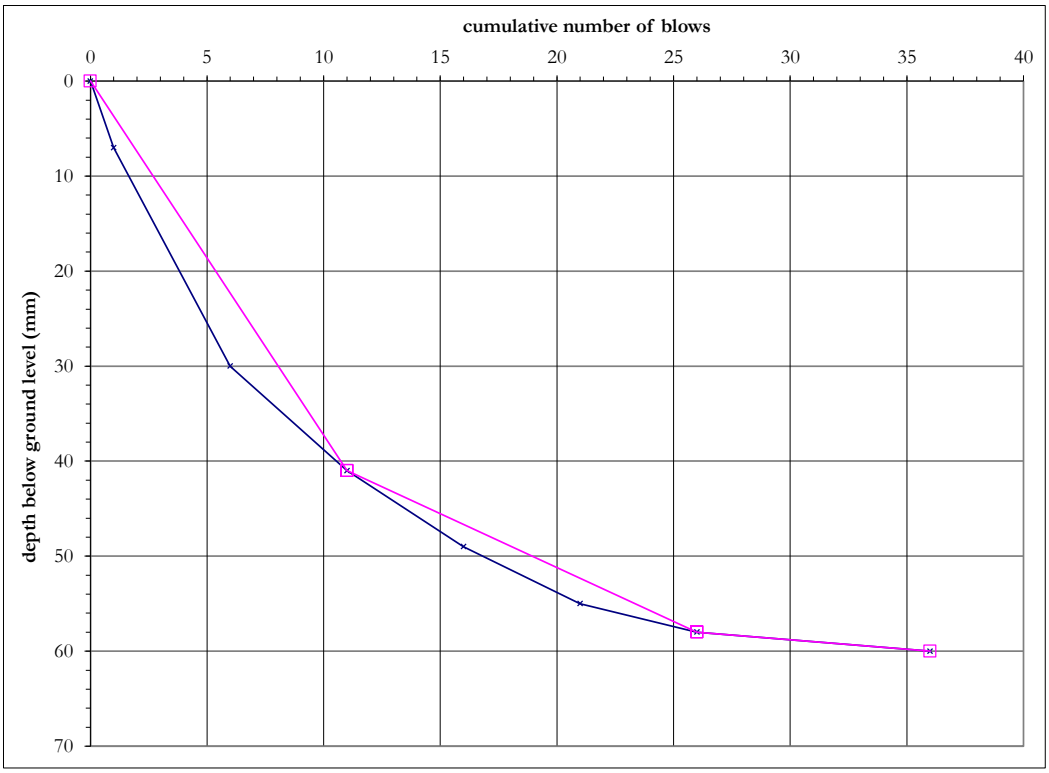
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Lifford |

| | |
|---|---|
| **Test Number** | CBR 009 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 24/05/2021 |
| **Weather** | Cloudy |

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

| Surface preparation | Description of surface material at test depth |
|---|---|
| N/A | Stone/Hardcore |




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 3.7 | 75 |
| 41 | | |
| | | |
| 41 | 1.1 | >100 |
| 58 | | |
| | | |
| 58 | 0.2 | >100 |
| 60 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 75<br>Max: >100 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Lifford |

| | |
|---|---|
| **Test Number** | CBR 010 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 25/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 51 | 4.7 |
| 461 | | |
| 461 | 29 | 8.6 |
| 809 | | |
| 809 | 93 | 2.5 |
| 902 | | |
| 902 | 26 | 9.6 |
| 1294 | | |
| 1294 | 127 | 1.8 |
| 1421 | | |
| 1421 | 24 | 10 |
| 1805 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 1.8<br>Max: 10 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

UKAS TESTING 10122

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

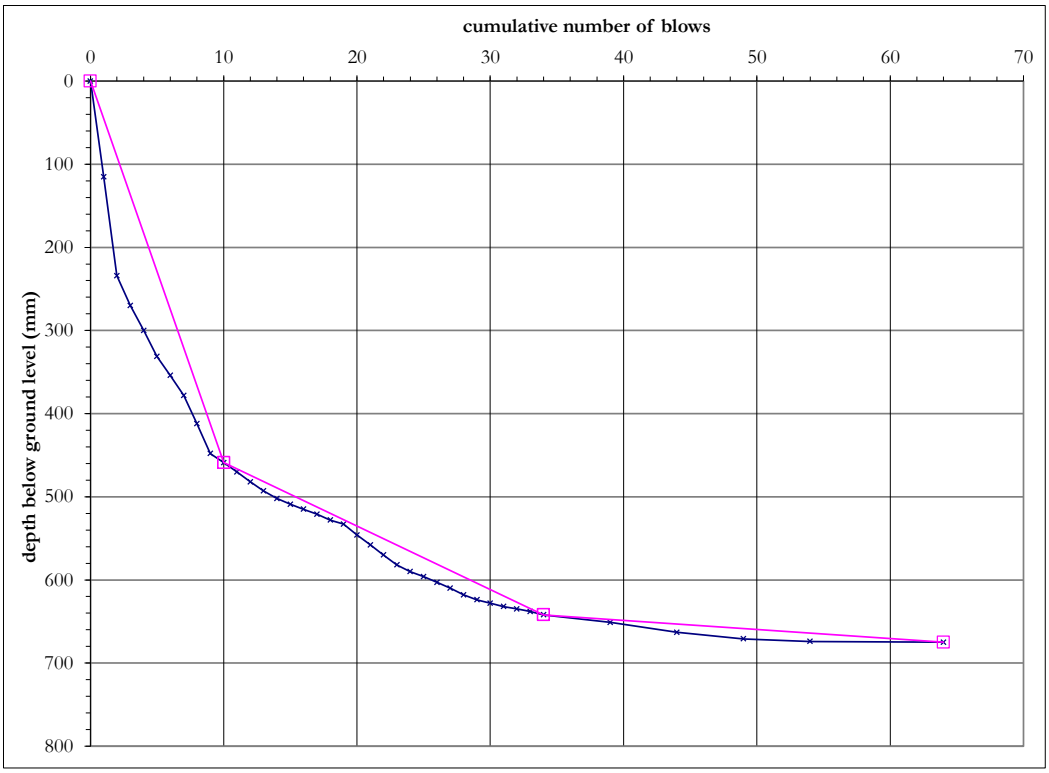
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Lifford |

| | |
|---|---|
| **Test Number** | CBR 011 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 25/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 46 | 5.3 |
| 459 | | |
| | | |
| 459 | 7.6 | 35 |
| 642 | | |
| | | |
| 642 | 1.1 | >100 |
| 675 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 5.3<br>Max: >100 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

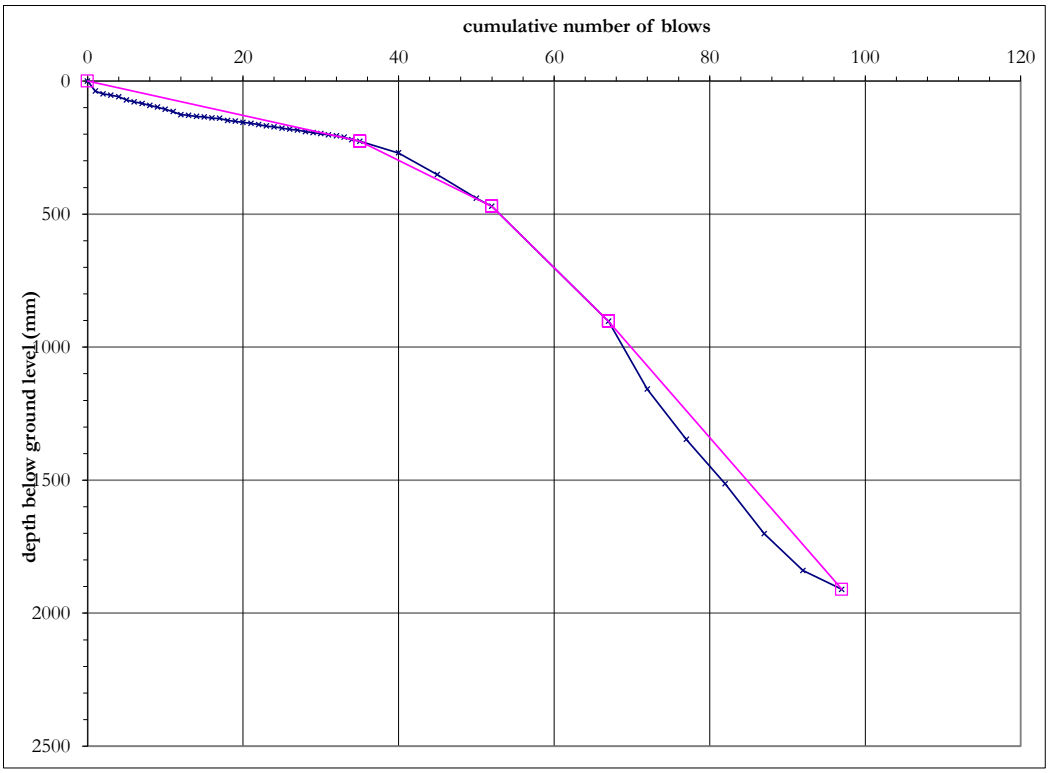
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Lifford |

| | |
|---|---|
| **Test Number** | CBR 012 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 25/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 6.5 | 42 |
| 226 | | |
| 226 | 14 | 18 |
| 471 | | |
| 471 | 29 | 8.7 |
| 903 | | |
| 903 | 34 | 7.4 |
| 1911 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 7.4<br>Max: 42 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

UKAS TESTING 10122

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

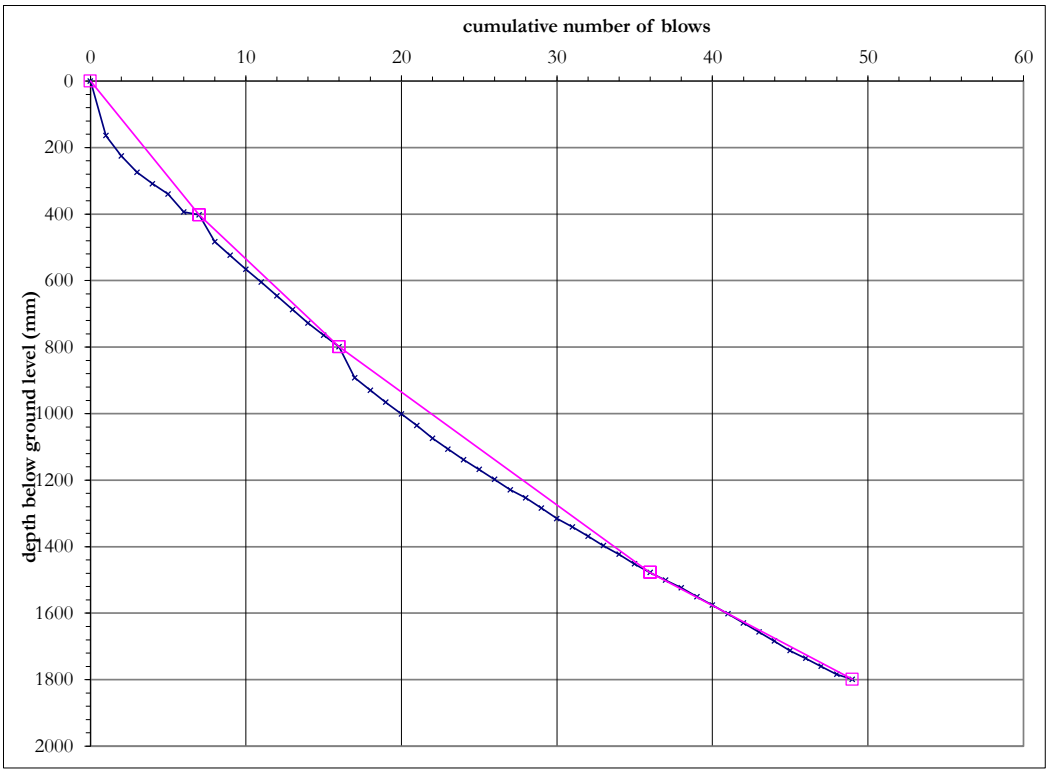
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Lifford |

| | |
|---|---|
| **Test Number** | CBR 013 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 24/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 57 | 4.2 |
| 402 | | |
| 402 | 44 | 5.5 |
| 799 | | |
| 799 | 34 | 7.3 |
| 1478 | | |
| 1478 | 25 | 10 |
| 1799 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 4.2<br>Max: 10 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

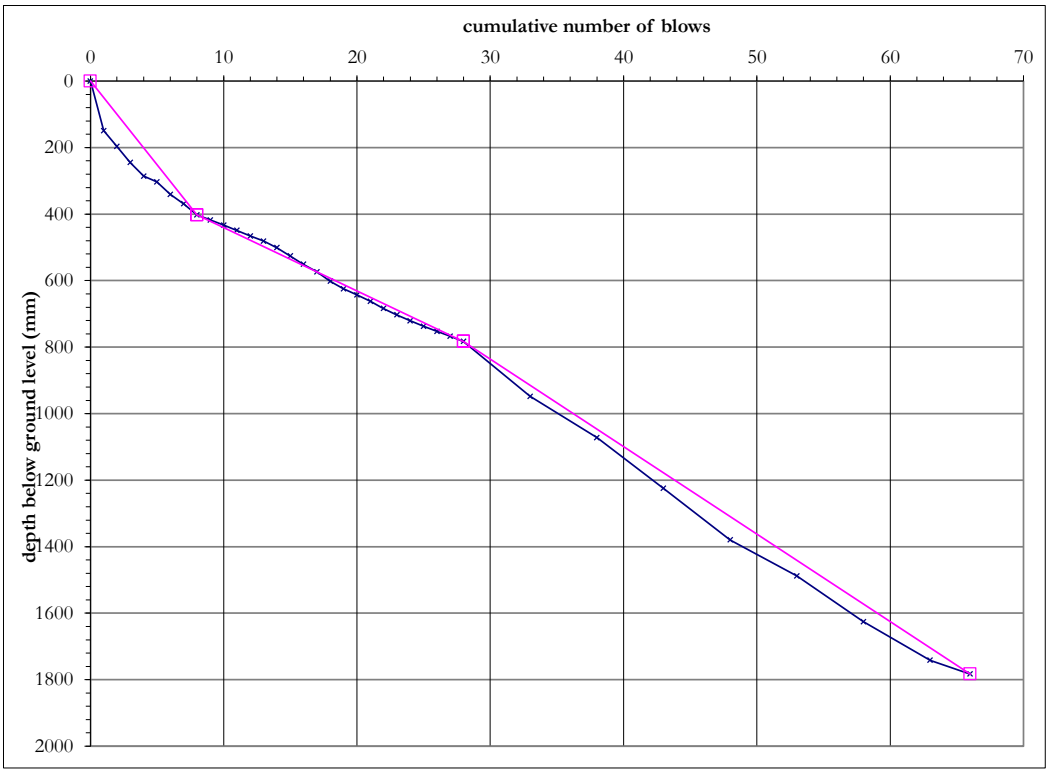
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Lifford |

| | |
|---|---|
| **Test Number** | CBR 014 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 25/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 50 | 4.8 |
| 402 | | |
| | | |
| 402 | 19 | 13 |
| 783 | | |
| | | |
| 783 | 26 | 9.5 |
| 1783 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 4.8<br>Max: 13 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

UKAS TESTING 10122

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

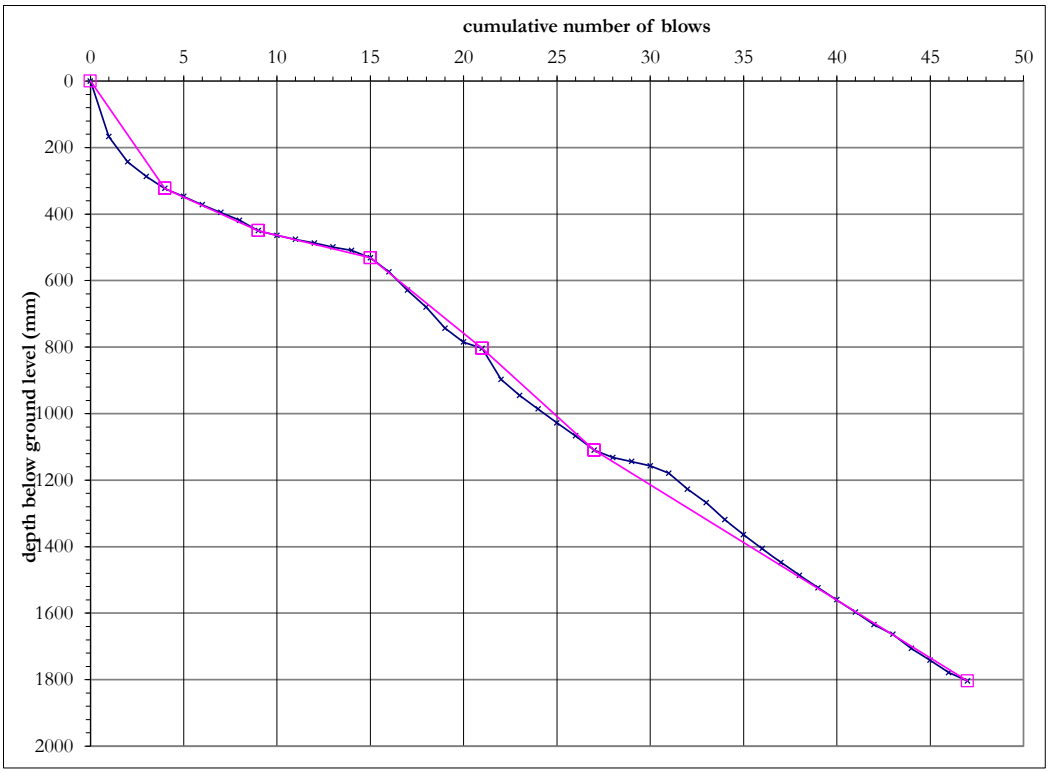
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Lifford |

| | |
|---|---|
| **Test Number** | CBR 015 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 25/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 81 | 2.9 |
| 323 | | |
| 323 | 25 | 9.9 |
| 450 | | |
| 450 | 14 | 19 |
| 531 | | |
| 531 | 46 | 5.3 |
| 804 | | |
| 804 | 51 | 4.7 |
| 1110 | | |
| 1110 | 35 | 7.1 |
| 1804 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 2.9<br>Max: 19 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

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|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

UKAS TESTING 10122

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

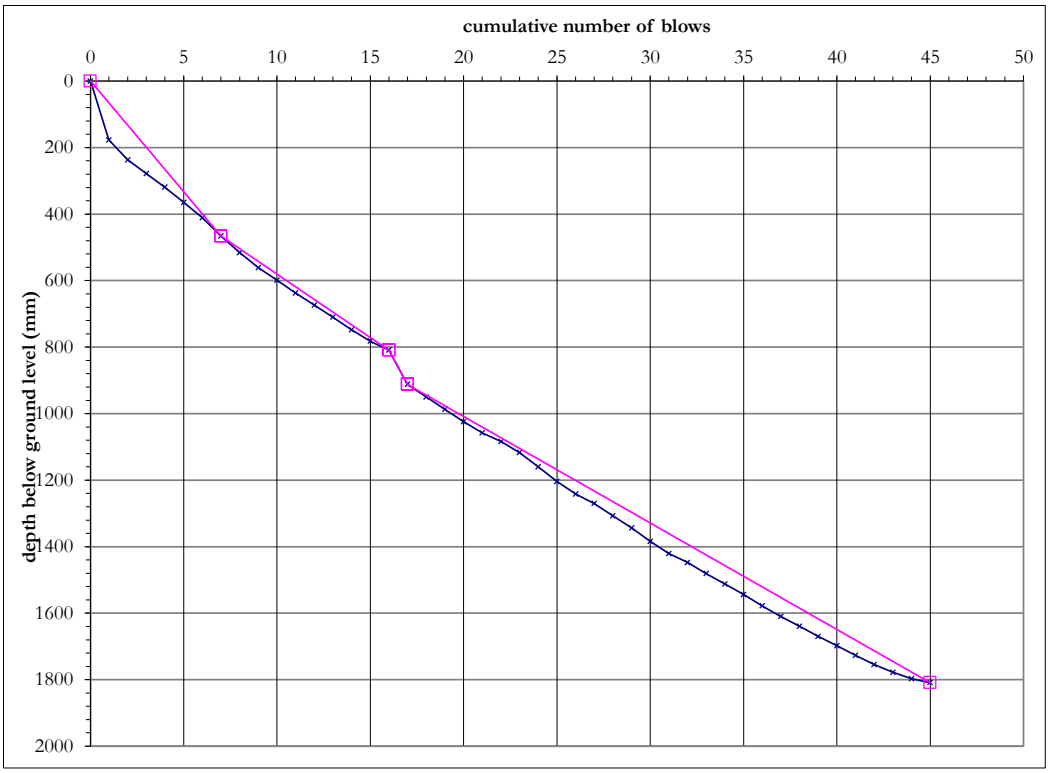
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Lifford |

| | |
|---|---|
| **Test Number** | CBR 016 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 25/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 67 | 3.6 |
| 466 | | |
| 466 | 38 | 6.4 |
| 809 | | |
| 809 | 103 | 2.3 |
| 912 | | |
| 912 | 32 | 7.7 |
| 1809 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 2.3<br>Max: 7.7 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

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|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

UKAS TESTING 10122

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

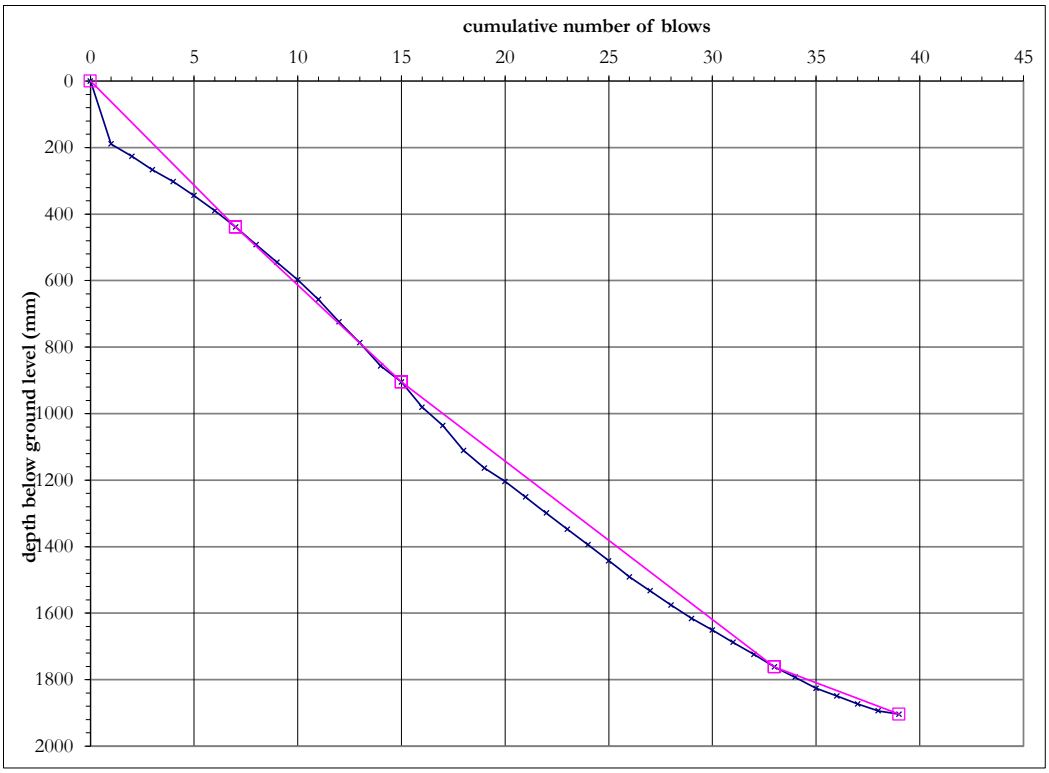
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Lifford |

| | |
|---|---|
| **Test Number** | CBR 017 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 25/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 63 | 3.8 |
| 439 | | |
| 439 | 58 | 4.1 |
| 905 | | |
| 905 | 48 | 5.1 |
| 1762 | | |
| 1762 | 24 | 11 |
| 1904 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 3.8<br>Max: 11 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

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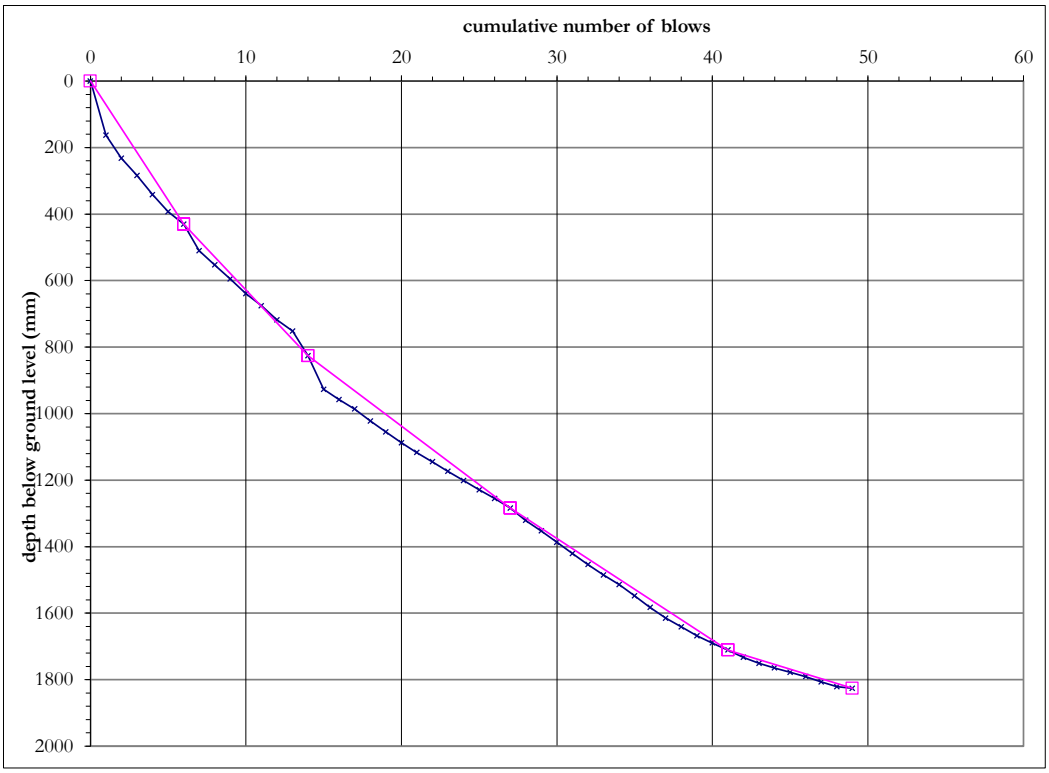
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Lifford |

| | |
|---|---|
| **Test Number** | CBR 018 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 24/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 72 | 3.3 |
| 430 | | |
| 430 | 50 | 4.9 |
| 826 | | |
| 826 | 35 | 7 |
| 1284 | | |
| 1284 | 31 | 8.1 |
| 1711 | | |
| 1711 | 14 | 18 |
| 1826 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 3.3<br>Max: 18 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

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|---|---|
| **Deviation(s) from standard procedure** | None |

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|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

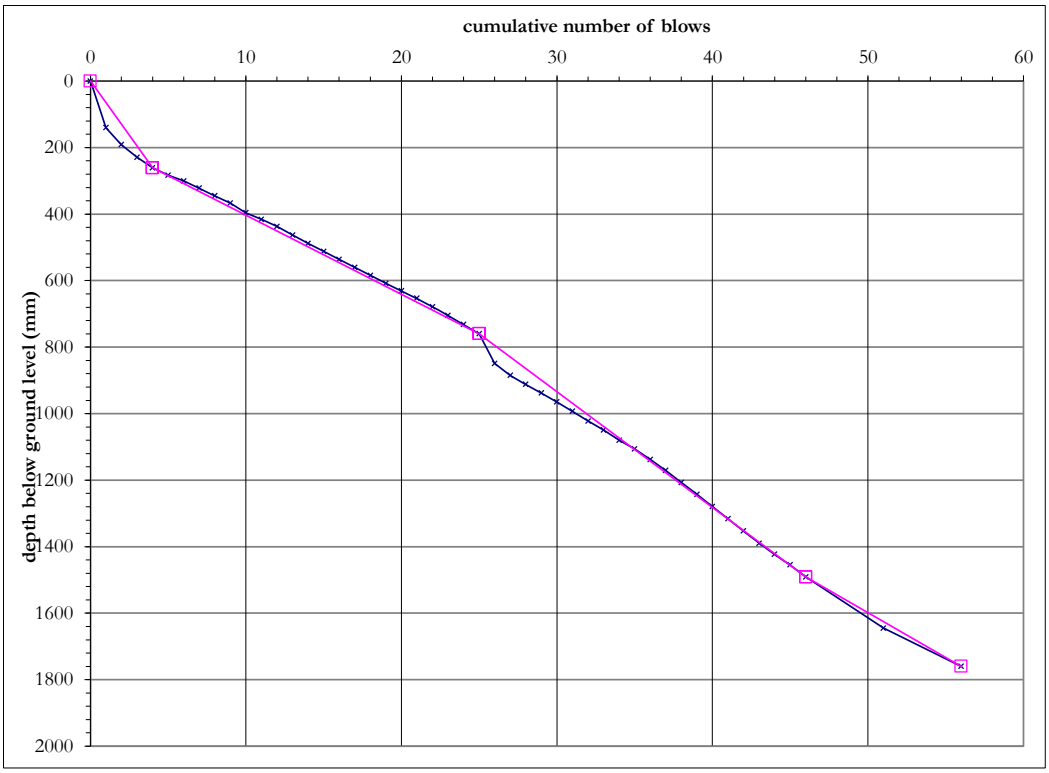
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Lifford |

| | |
|---|---|
| **Test Number** | CBR 019 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 24/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 65 | 3.6 |
| 261 | | |
| 261 | 24 | 11 |
| 760 | | |
| 760 | 35 | 7.1 |
| 1491 | | |
| 1491 | 27 | 9.3 |
| 1760 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 3.6<br>Max: 11 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

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|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

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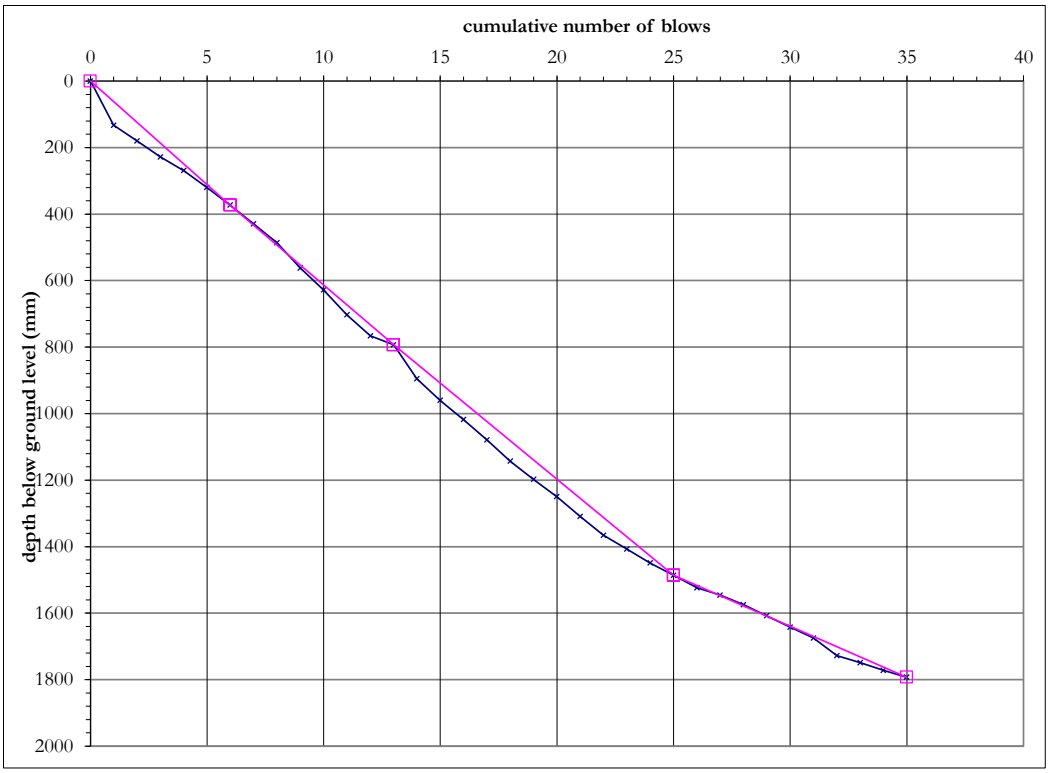
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Lifford |

| | |
|---|---|
| **Test Number** | CBR 020 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 25/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 62 | 3.8 |
| 373 | | |
| | | |
| 373 | 60 | 4 |
| 793 | | |
| | | |
| 793 | 58 | 4.1 |
| 1486 | | |
| | | |
| 1486 | 31 | 8.1 |
| 1793 | | |
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|---|---|---|
| **CBR Range** | Min: 3.8<br>Max: 8.1 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

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|---|---|
| **Deviation(s) from standard procedure** | None |

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|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

UKAS TESTING 10122

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

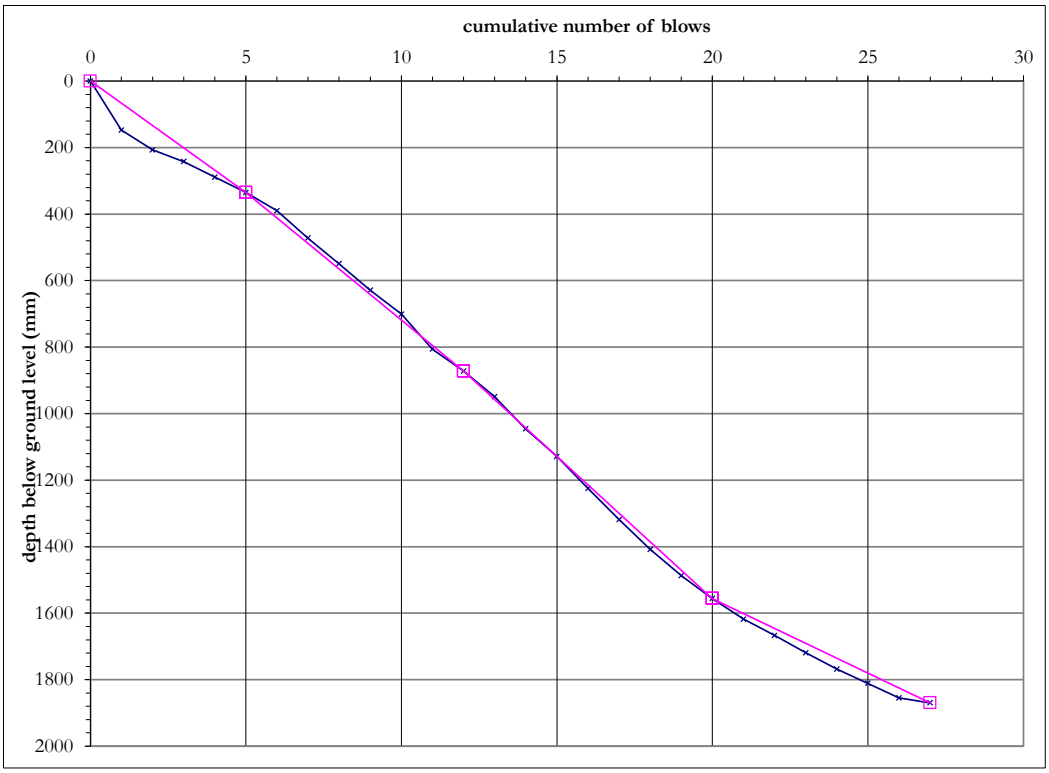
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Lifford |

| | |
|---|---|
| **Test Number** | CBR 021 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 25/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 67 | 3.5 |
| 335 | | |
| 335 | 77 | 3.1 |
| 872 | | |
| 872 | 86 | 2.7 |
| 1556 | | |
| 1556 | 45 | 5.4 |
| 1870 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 2.7<br>Max: 5.4 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

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|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

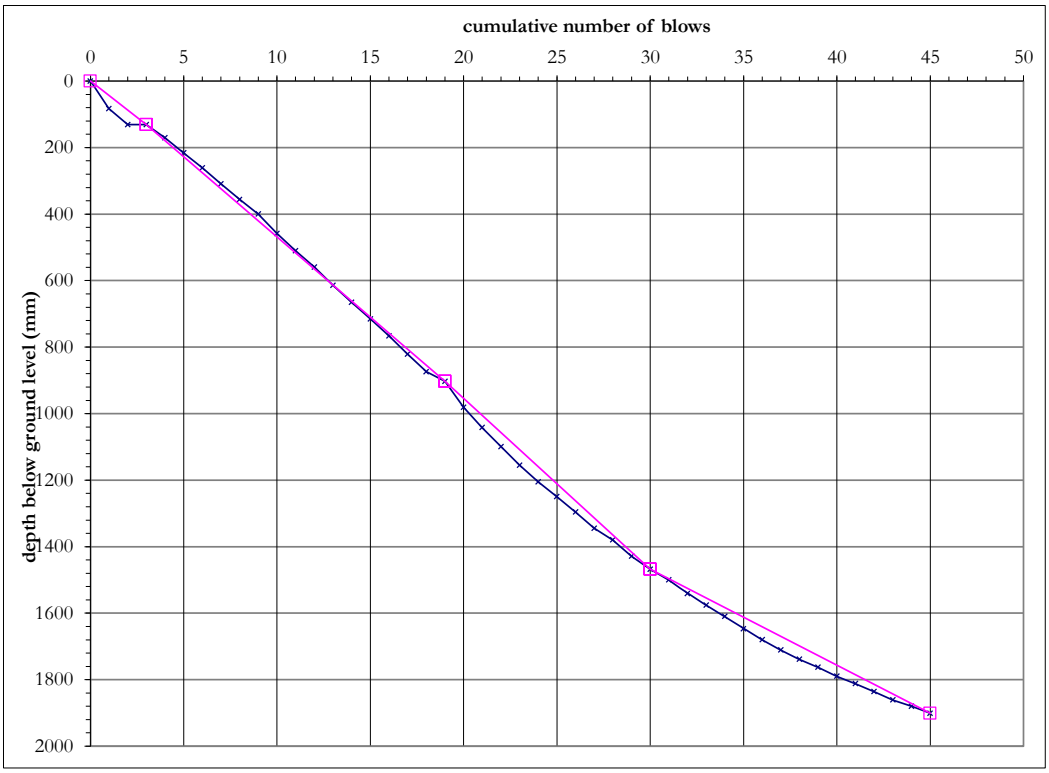
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Lifford |

| | |
|---|---|
| **Test Number** | CBR 022 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 25/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 44 | 5.6 |
| 131 | | |
| | | |
| 131 | 48 | 5 |
| 903 | | |
| | | |
| 903 | 51 | 4.7 |
| 1468 | | |
| | | |
| 1468 | 29 | 8.6 |
| 1901 | | |
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|---|---|---|
| **CBR Range** | Min: 4.7<br>Max: 8.6 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

UKAS TESTING 10122

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

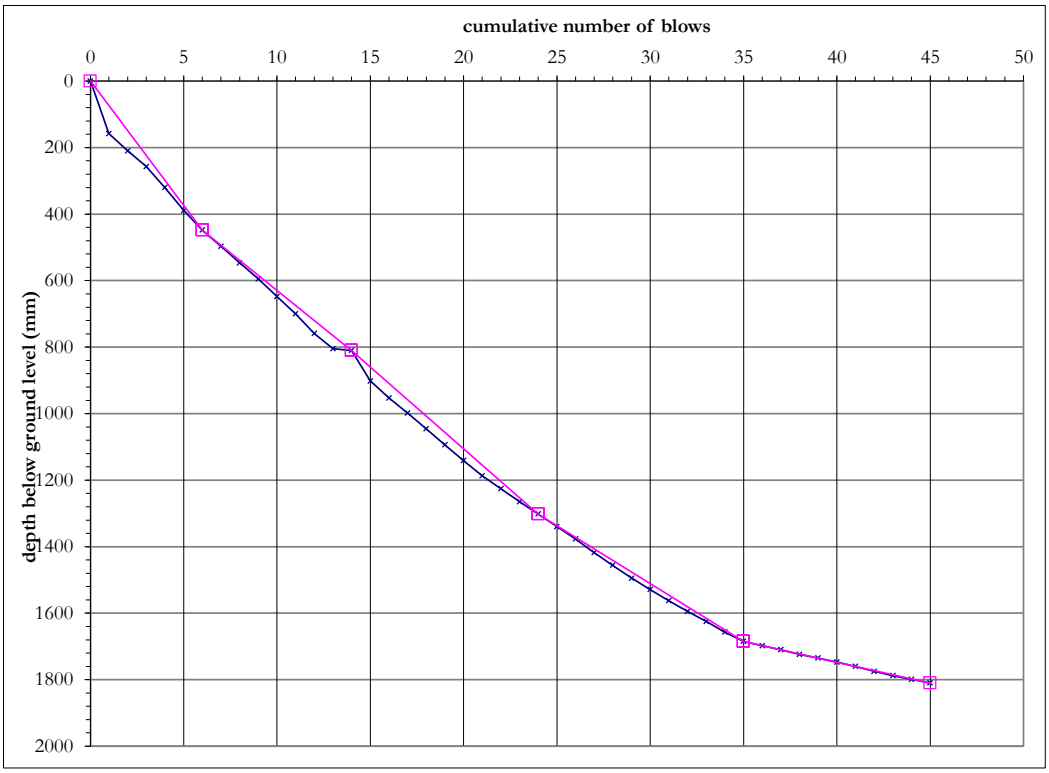
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Lifford |

| | |
|---|---|
| **Test Number** | CBR 023 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 24/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 75 | 3.2 |
| 448 | | |
| | | |
| 448 | 45 | 5.4 |
| 810 | | |
| | | |
| 810 | 49 | 4.9 |
| 1302 | | |
| | | |
| 1302 | 35 | 7.1 |
| 1685 | | |
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| 1685 | 13 | 21 |
| 1810 | | |
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|---|---|---|
| **CBR Range** | Min: 3.2<br>Max: 21 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

UKAS TESTING 10122

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Lifford |

| | |
|---|---|
| **Test Number** | CBR 024 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 24/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 81 | 2.9 |
| 407 | | |
| | | |
| 407 | 34 | 7.3 |
| 813 | | |
| | | |
| 813 | 29 | 8.5 |
| 1810 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 2.9<br>Max: 8.5 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

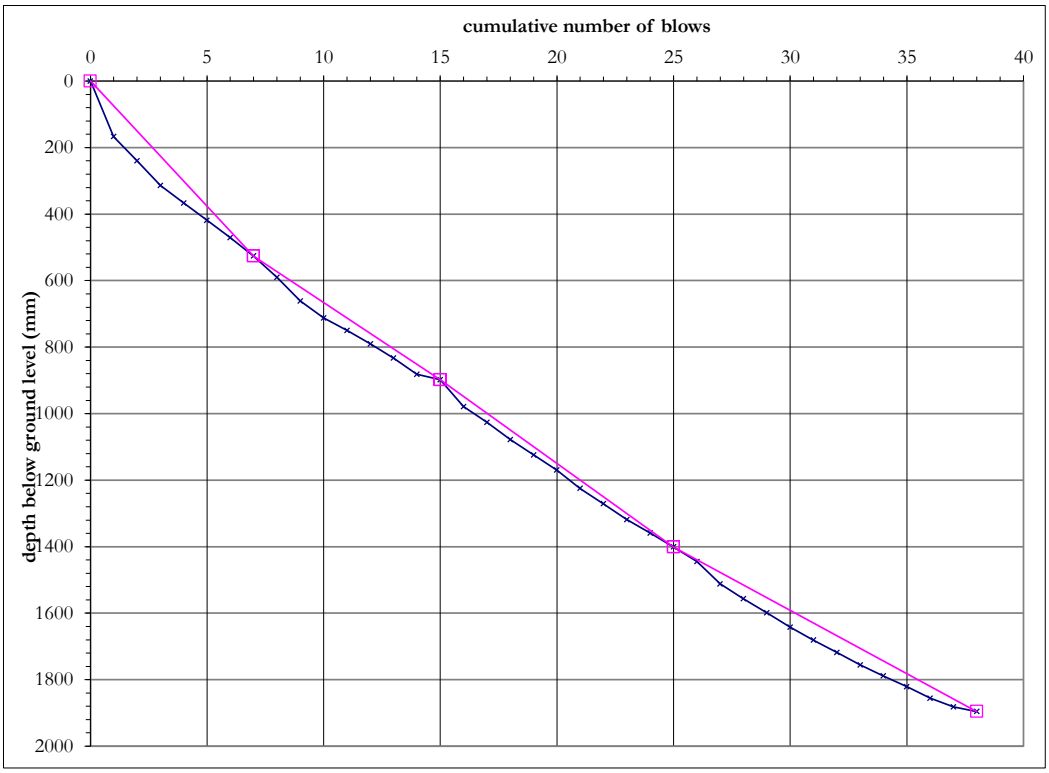
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Lifford |

| | |
|---|---|
| **Test Number** | CBR 025 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 25/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 75 | 3.1 |
| 526 | | |
| | | |
| 526 | 47 | 5.2 |
| 898 | | |
| | | |
| 898 | 50 | 4.8 |
| 1401 | | |
| | | |
| 1401 | 38 | 6.4 |
| 1896 | | |
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|---|---|---|
| **CBR Range** | Min: 3.1<br>Max: 6.4 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

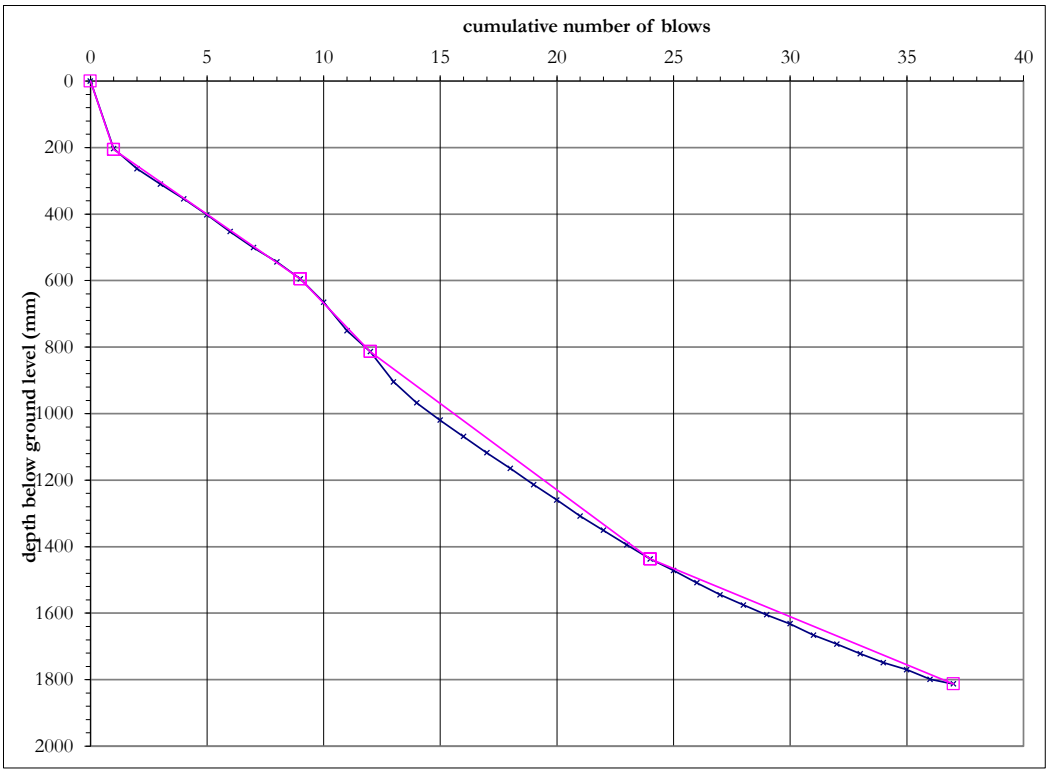
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Lifford |

| | |
|---|---|
| **Test Number** | CBR 026 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 24/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 206 | 1.1 |
| 206 | | |
| 206 | 49 | 5 |
| 595 | | |
| 595 | 73 | 3.2 |
| 814 | | |
| 814 | 52 | 4.6 |
| 1437 | | |
| 1437 | 29 | 8.6 |
| 1813 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 1.1<br>Max: 8.6 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

UKAS TESTING 10122

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

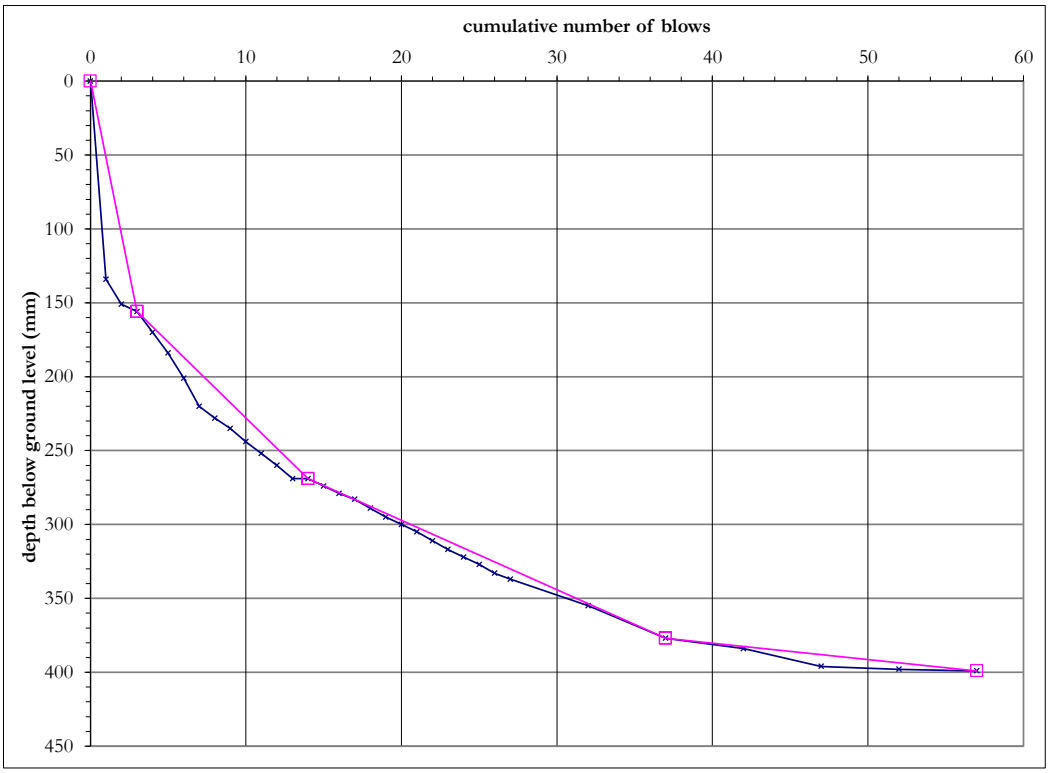
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Lifford |

| | |
|---|---|
| **Test Number** | CBR 027 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 24/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 52 | 4.6 |
| 156 | | |
| | | |
| 156 | 10 | 26 |
| 269 | | |
| | | |
| 269 | 4.7 | 59 |
| 377 | | |
| | | |
| 377 | 1.1 | >100 |
| 399 | | |
| | | |
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| | | |
|---|---|---|
| **CBR Range** | Min: 4.6<br>Max: >100 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

UKAS TESTING 10122

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Lifford |

| | |
|---|---|
| **Test Number** | CBR 028 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 24/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 56 | 4.3 |
| 394 | | |
| 394 | 20 | 12 |
| 618 | | |
| 618 | 28 | 9 |
| 785 | | |
| 785 | 38 | 6.5 |
| 1273 | | |
| 1273 | 30 | 8.3 |
| 1785 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 4.3<br>Max: 12 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

UKAS TESTING 10122

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

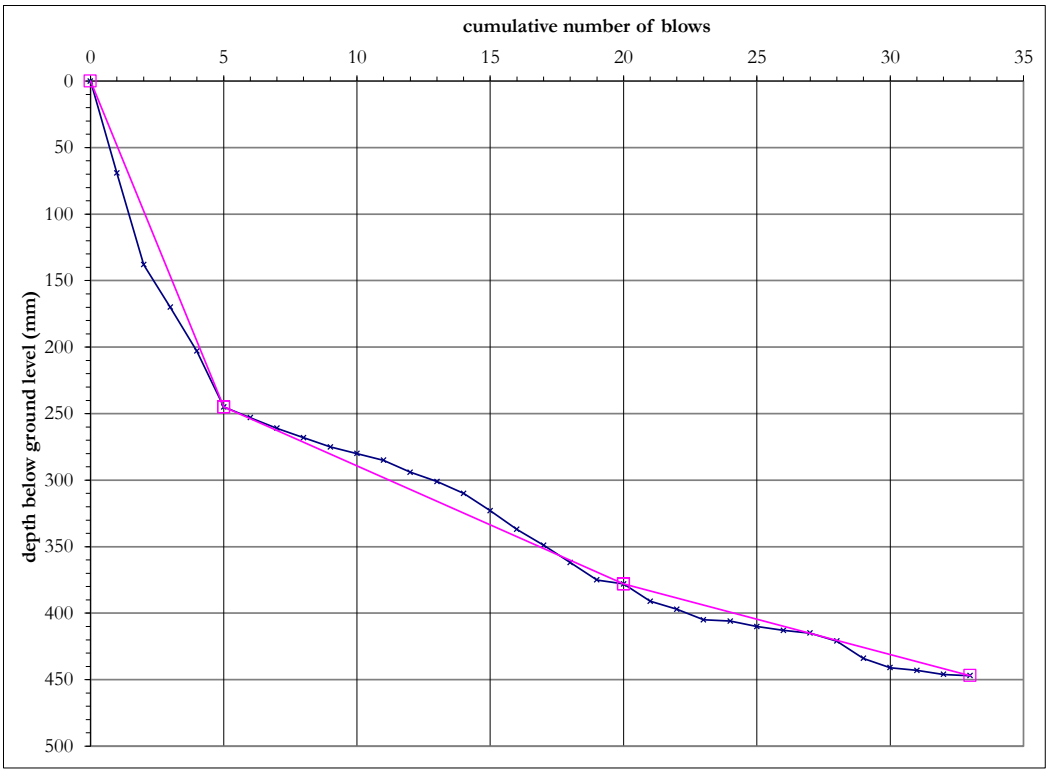
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park |
| **Site Location** | Lifford |

| | |
|---|---|
| **Test Number** | INFIL 001 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 21/05/2021 |
| **Weather** | Showers |

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

| Surface preparation | Description of surface material at test depth |
|---|---|
| Grass | Topsoil |




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 49 | 4.9 |
| 245 | | |
| | | |
| 245 | 8.9 | 30 |
| 378 | | |
| | | |
| 378 | 5.3 | 52 |
| 447 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 4.9<br>Max: 52 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

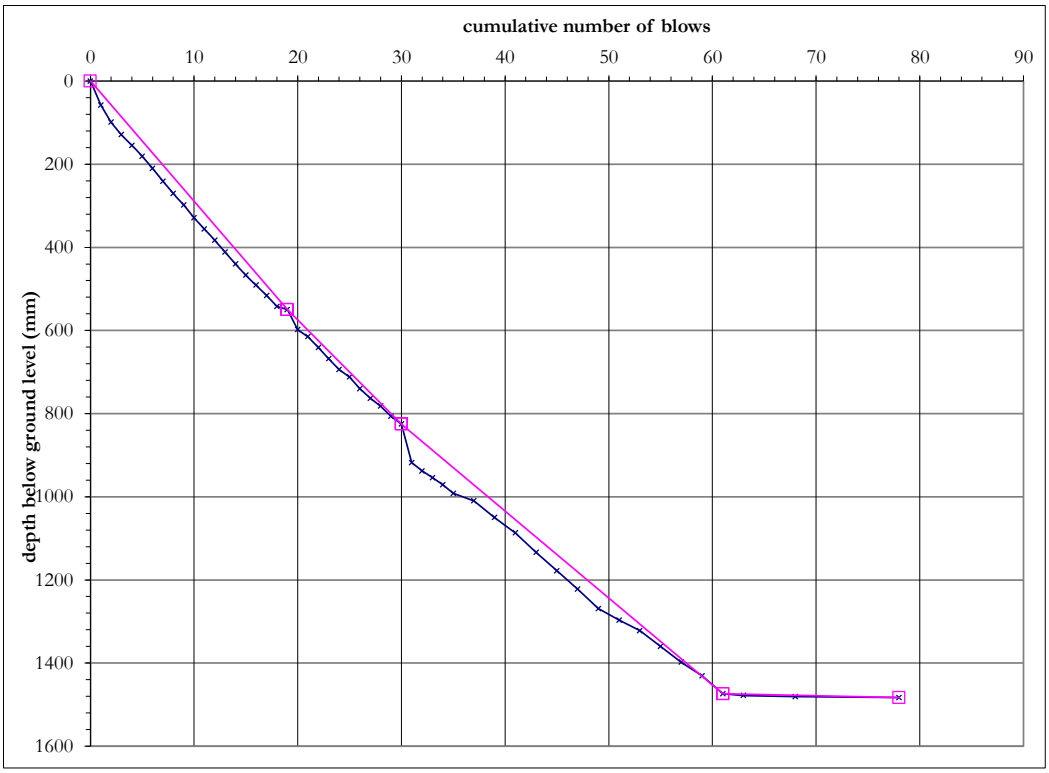
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park |
| **Site Location** | Lifford |

| | |
|---|---|
| **Test Number** | INFIL 002 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 21/05/2021 |
| **Weather** | Showers |

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

| Surface preparation | Description of surface material at test depth |
|---|---|
| Grass | Topsoil |




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 29 | 8.6 |
| 550 | | |
| | | |
| 550 | 25 | 10 |
| 825 | | |
| | | |
| 825 | 21 | 12 |
| 1474 | | |
| | | |
| 1474 | 0.5 | >100 |
| 1483 | | |
| | | |
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| | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 8.6<br>Max: >100 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

UKAS TESTING 10122

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

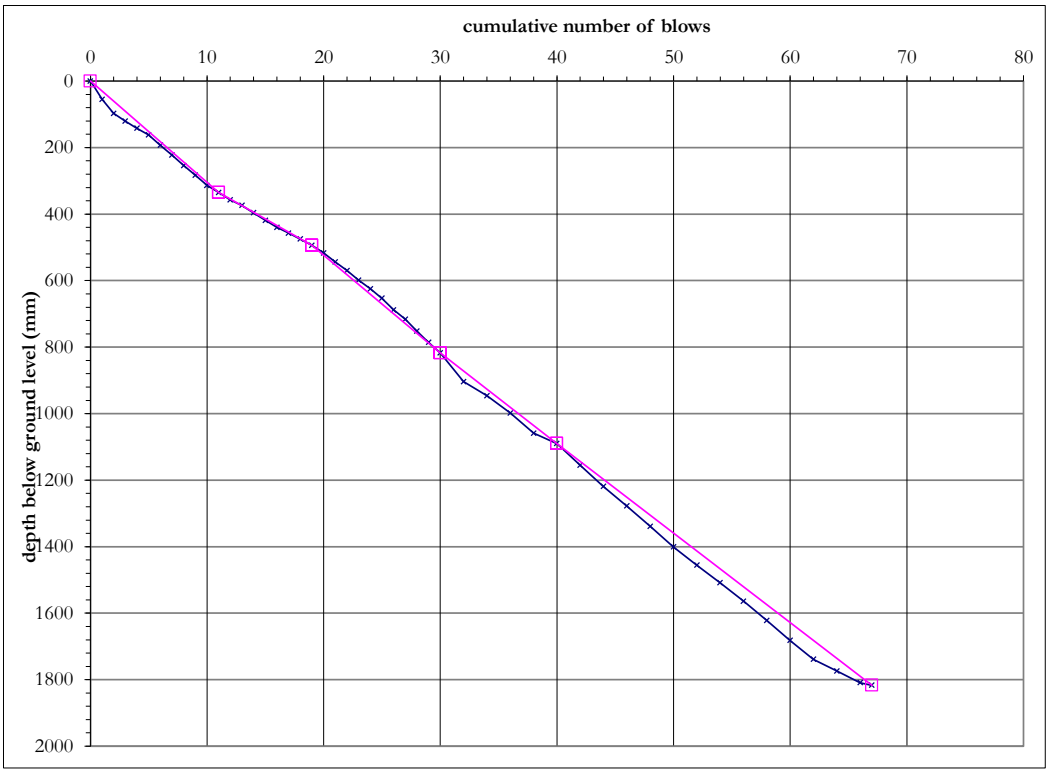
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park |
| **Site Location** | Lifford |

| | |
|---|---|
| **Test Number** | INFIL 003 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 21/05/2021 |
| **Weather** | Showers |

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

| Surface preparation | Description of surface material at test depth |
|---|---|
| Grass | Topsoil |




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 30 | 8.2 |
| 335 | | |
| 335 | 20 | 13 |
| 494 | | |
| 494 | 29 | 8.5 |
| 817 | | |
| 817 | 27 | 9.2 |
| 1090 | | |
| 1090 | 27 | 9.3 |
| 1817 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 8.2<br>Max: 13 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

UKAS TESTING 10122

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

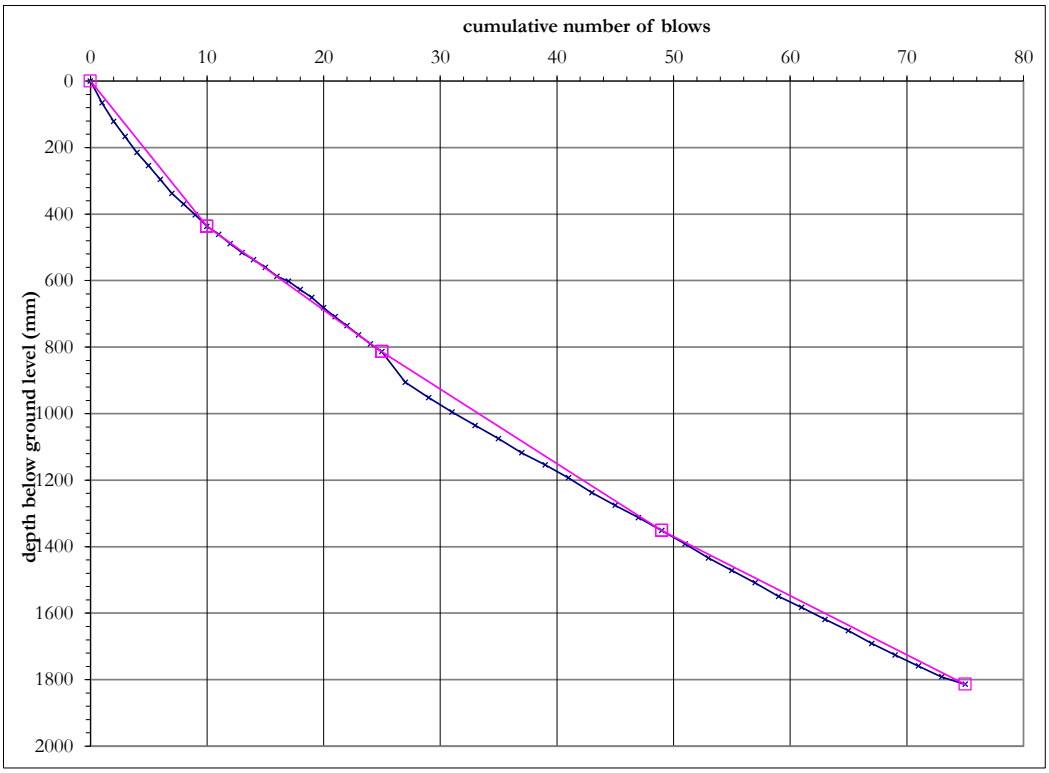
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park |
| **Site Location** | Lifford |

| | |
|---|---|
| **Test Number** | INFIL 004 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 21/05/2021 |
| **Weather** | Showers |

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

| Surface preparation | Description of surface material at test depth |
|---|---|
| Grass | Topsoil |




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 44 | 5.6 |
| 437 | | |
| | | |
| 437 | 25 | 10 |
| 814 | | |
| | | |
| 814 | 22 | 11 |
| 1352 | | |
| | | |
| 1352 | 18 | 14 |
| 1814 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 5.6<br>Max: 14 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

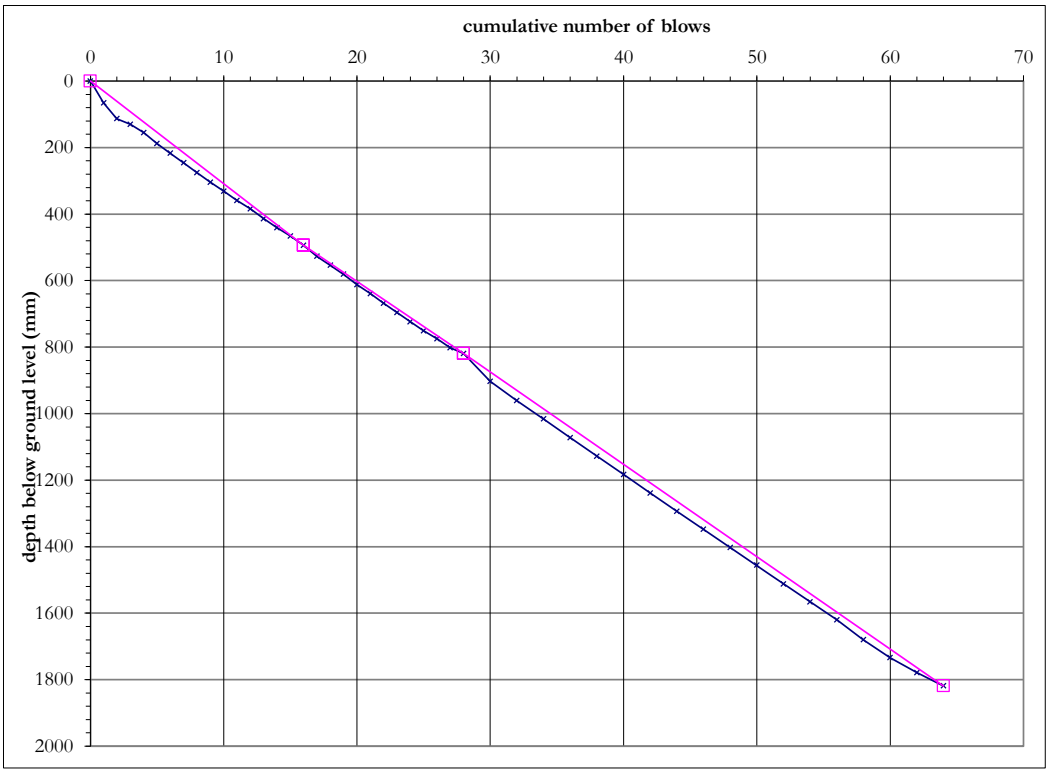
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park |
| **Site Location** | Lifford |

| | |
|---|---|
| **Test Number** | UT 001 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 21/05/2021 |
| **Weather** | Showers |

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

| Surface preparation | Description of surface material at test depth |
|---|---|
| Grass | Topsoil |




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 31 | 8 |
| 494 | | |
| | | |
| 494 | 27 | 9.2 |
| 819 | | |
| | | |
| 819 | 28 | 9 |
| 1819 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 8<br>Max: 9.2 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

UKAS TESTING 10122

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

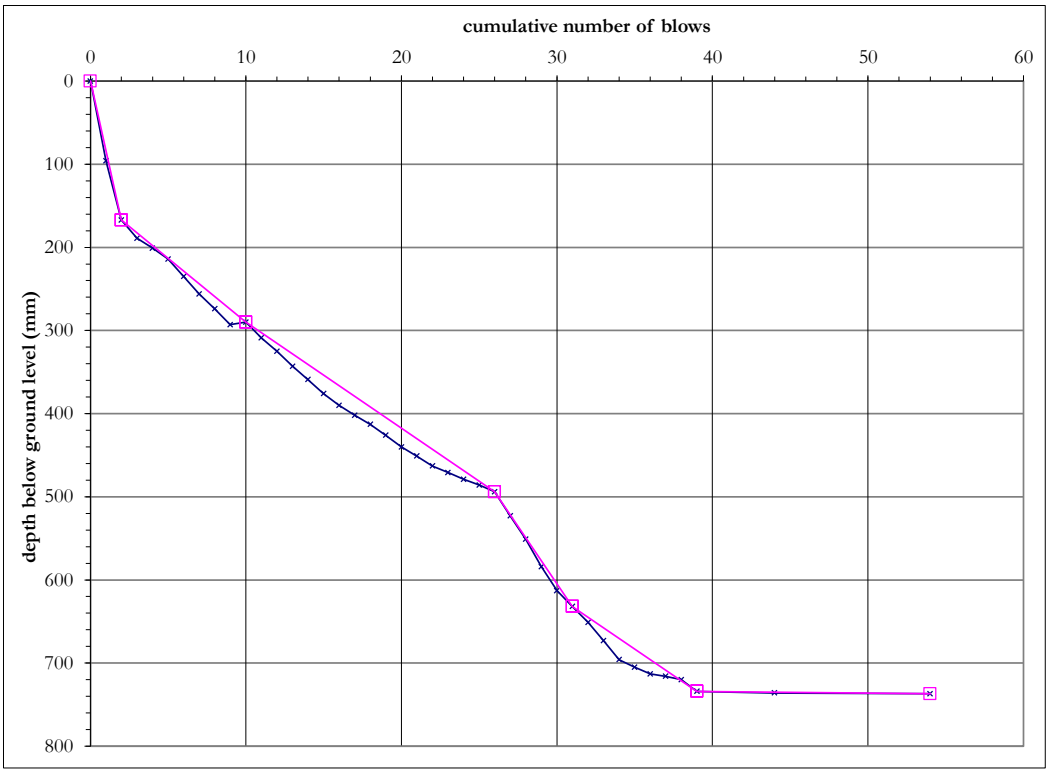
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park |
| **Site Location** | Lifford |

| | |
|---|---|
| **Test Number** | UT 002 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 20/05/2021 |
| **Weather** | Showers |

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

| Surface preparation | Description of surface material at test depth |
|---|---|
| TOPSOIL | TOPSOIL/silty gravelly sandy |




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 84 | 2.8 |
| 167 | | |
| 167 | 15 | 17 |
| 290 | | |
| 290 | 13 | 20 |
| 494 | | |
| 494 | 28 | 9.1 |
| 632 | | |
| 632 | 13 | 20 |
| 734 | | |
| 734 | 0.2 | >100 |
| 737 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 2.8<br>Max: >100 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

UKAS TESTING 10122

CAUSEWAY GEOTECH

# APPENDIX H

# GROUNDWATER MONITORING RECORDS

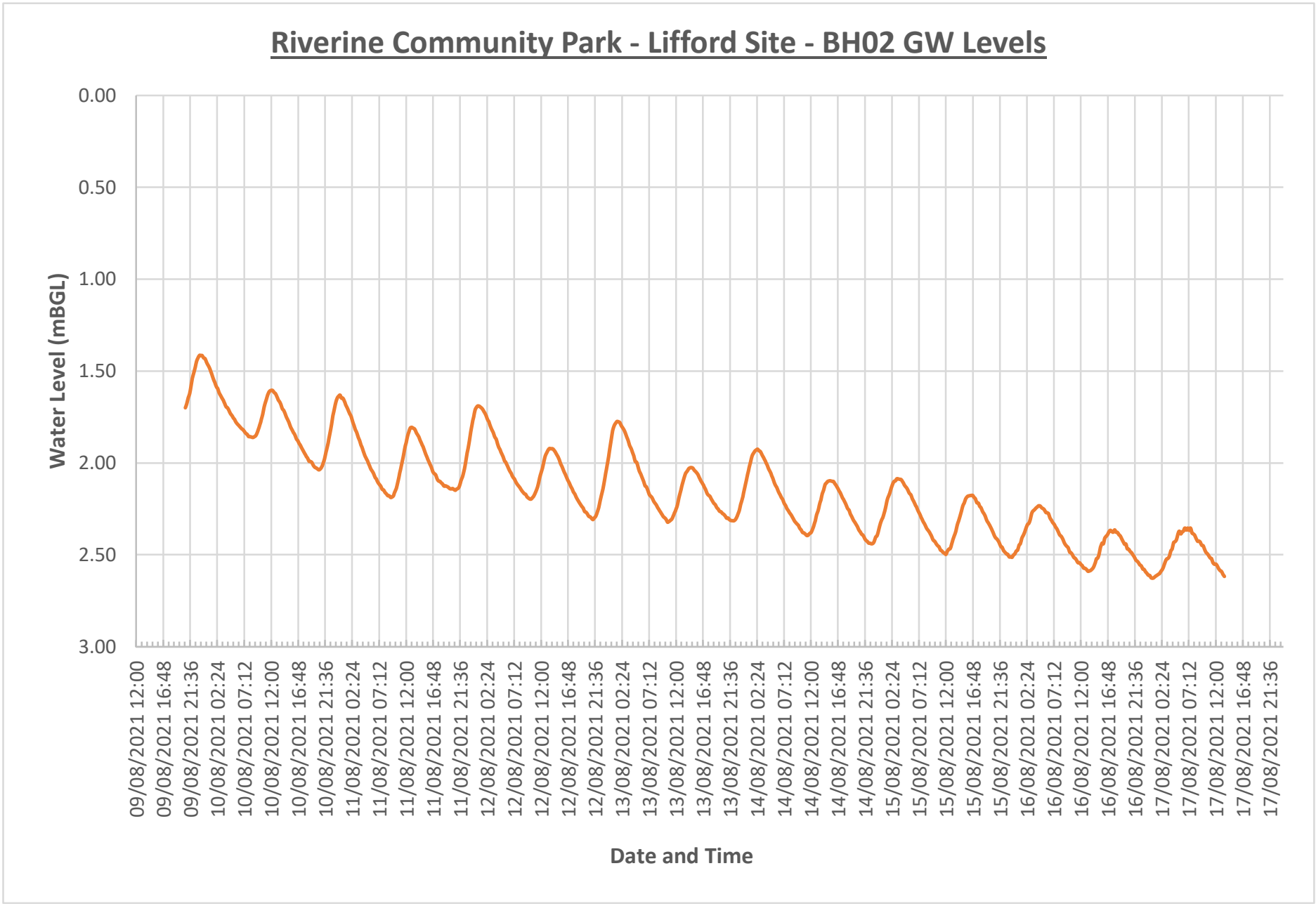


**Job No: 21-0553A**

**Job Name: Riverine Community Park, Lifford - Site Investigation**

**Liffrord Site Ground Water Monitoring Results**

| EH No: | Depth to base at end of fieldwork (mbgl) | Water Level (mbgl) | | | |
|---|---|---|---|---|---|
| | | ROUND 1 13.07.2021 | ROUND 2 27.07.2021 | ROUND 3 09.08.2021 | ROUND 4 17.08.2021 |
| BH02 (rz 1.00-10.00mbgl) | 10.00m | 2.58m | 2.11m | 1.70m | 2.62m |
| BH05 (rz 1.00-6.00mbgl) | 6.00m | 3.08m | 2.68m | 2.34m | 3.11m |


Riverine Community Park - Lifford Site - BH02 GW Levels
Water Level (mBGL)
0.00
0.50
1.00
1.50
2.00
2.50
3.00
09/08/2021 12:00
09/08/2021 16:48
09/08/2021 21:36
10/08/2021 02:24
10/08/2021 07:12
10/08/2021 12:00
10/08/2021 16:48
10/08/2021 21:36
11/08/2021 02:24
11/08/2021 07:12
11/08/2021 12:00
11/08/2021 16:48
11/08/2021 21:36
12/08/2021 02:24
12/08/2021 07:12
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12/08/2021 16:48
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14/08/2021 02:24
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17/08/2021 02:24
17/08/2021 07:12
17/08/2021 12:00
17/08/2021 16:48
17/08/2021 21:36
Date and Time

CAUSEWAY GEOTECH

# APPENDIX I

# GEOTECHNICAL LABORATORY TEST RESULTS



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

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

www.causewaygeotech.com

**SOIL AND ROCK SAMPLE ANALYSIS**
**LABORATORY TEST REPORT**

9 August 2021

| | |
|---|---|
| **Project Name:** | Riverine Community Park, Lifford Site |
| **Project No.:** | 21-0553A |
| **Client:** | Donegal County Council |
| **Engineer:** | McAdam Design Ltd |

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.

Stephen Watson

Laboratory Manager

Signed for and on behalf of Causeway Geotech Ltd



SCS ISO 9001 CERTIFIED
SCS ISO 14001 CERTIFIED
SCS ISO 45001 CERTIFIED
UKAS MANAGEMENT SYSTEMS 9235
UKAS TESTING 10122
AGS
BRITISH DRILLING ASSOCIATION

**Project Name:** Riverine Community Park, Lifford Site

**Report Reference:** Schedule 1

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

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

| Material tested | Type of test/Properties measured/Range of measurement | Standard specifications | No. of results included in the report |
|---|---|---|---|
| SOIL | Moisture Content of Soil | BS 1377-2: 1990: Cl 3.2 | 8 |
| SOIL | Liquid and Plastic Limits of soil-1 point cone penetrometer method | BS 1377-2: 1990: Cl 4.4, 5.3 & 5.4 | 7 |
| SOIL | Particle size distribution - wet sieving | BS 1377-2: 1990: Cl 9.2 | 24 |
| SOIL | Particle size distribution - sedimentation hydrometer method | BS 1377-2: 1990: Cl 9.5 | 7 |
| SOIL | Consolidation properties in oedometer - Using 5 pressures (up to 5 days total duration) | BS 1377-5: 1990: Cl 3: 1 | 3 |
| SOIL | Undrained shear strength – triaxial compression without measurement of pore pressure (loads from 0.12 to 24 kN) | BS 1377-7: 1990: Cl 8 | 3 |
| SOIL | Direct Shear Test using 60mm Small Shearbox (up to 3 days) | BS EN ISO 17892-10:2018 | 10 |
| | Extra over days (more than initial 3 days) | | 1 |

## SUB-CONTRACTED TESTS

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

| Material tested | Type of test/Properties measured/Range of measurement | Standard specifications | No. of results included in the report |
|---|---|---|---|
| SOIL – Subcontracted to Eurofins Chemtest Ltd *(UKAS 2183)* | BRE Test - Suite A | | 17 |
| SOIL – Subcontracted to Eurofins Chemtest Ltd *(UKAS 2183)* | BRE Test - Suite C | | 5 |

# Summary of Classification Test Results

CAUSEWAY GEOTECH

| Project No. | Project Name |
|---|---|
| 21-0553 | Riverine Community Park, Lifford |

| Hole No. | Sample | | | | Soil Description | Density bulk | Density dry | w | Passing 425µm | LL | PL | PI | Particle density | Casagrande Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ref | Top | Base | Type | | Mg/m3 | | % | % | % | % | % | Mg/m3 | |
| BH02 | 10 | 1.00 | | D | Brown silty fine to coarse SAND. | | | 28.0 | 88 | 31 -1pt | 23 | 8 | | ML/CL |
| BH05 | 10 | 1.00 | | D | Greyish brown sandy slightly gravelly silty CLAY. | | | 28.0 | 83 | 33 -1pt | 21 | 12 | | CL |
| BH05 | 23 | 10.50 | | D | Brown sandy gravelly clayey SILT. | | | 12.0 | 62 | 21 -1pt | 17 | 4 | | ML |
| BH06 | 10 | 0.50 | | D | Brown silty fine to coarse SAND. | | | 16.0 | 82 | 33 -1pt | 24 | 9 | | ML/CL |
| BH06 | 12 | 2.00 | | D | Brown very sandy silty CLAY. | | | 32.0 | 98 | 35 -1pt | NP | | | |
| BH06 | 16 | 6.00 | | D | Greyish brown sandy subangular fine to coarse GRAVEL | | | 5.8 | | | | | | |
| BH07 | 5 | 0.50 | | D | Brown sandy clayey SILT. | | | 41.0 | 95 | 52 -1pt | 37 | 15 | | MH |
| BH08 | 5 | 0.50 | | D | Brown sandy clayey SILT. | | | 48.0 | 97 | 53 -1pt | 31 | 22 | | MH |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |

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

LAB 01R Version 4

Key

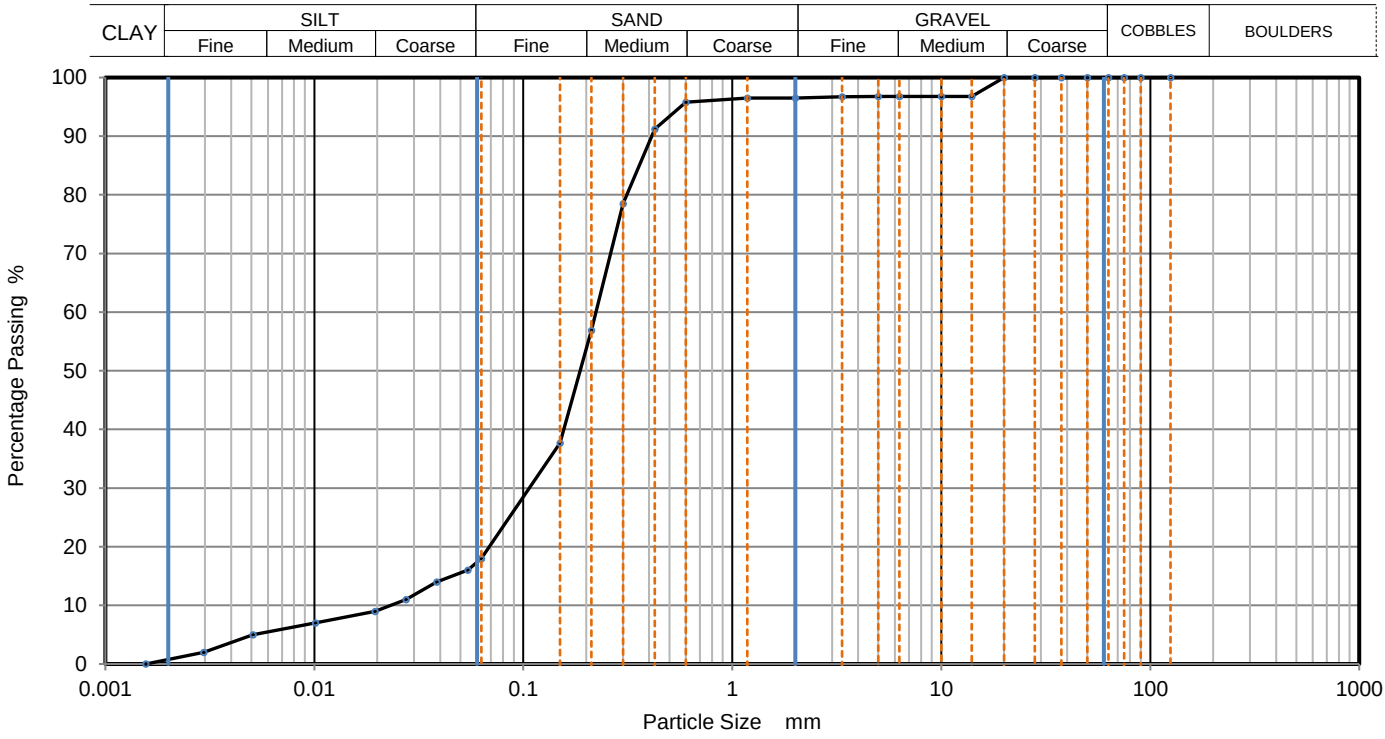
| | | |
|---|---|---|
| Density test | Liquid Limit | Particle density |
| Linear measurement unless : | 4pt cone unless : | sp - small pyknometer |
| wd - water displacement | cas - Casagrande method | gj - gas jar |
| wi - immersion in water | 1pt - single point test | |

Date Printed: 08/06/2021 00:00

Approved By: Stephen.Watson

UKAS TESTING 10122

| | | | | | |
|---|---|---|---|---|---|
| CAUSEWAY GEOTECH | **PARTICLE SIZE DISTRIBUTION** | | | Job Ref | **21-0553** |
| | | | | Borehole/Pit No. | BH02 |
| Site Name | Riverine Community Park, Lifford | | | Sample No. | 2 |
| Soil Description | Brown silty fine to coarse SAND. | | | Depth, m | 1.00 |
| Specimen Reference | 2 | Specimen Depth | 1 m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clauses 9.2 and 9.5 | | | KeyLAB ID | Caus2021070611 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | 0.06300 | 18 |
| 90 | 100 | 0.05425 | 16 |
| 75 | 100 | 0.03857 | 14 |
| 63 | 100 | 0.02741 | 11 |
| 50 | 100 | 0.01949 | 9 |
| 37.5 | 100 | 0.01011 | 7 |
| 28 | 100 | 0.00508 | 5 |
| 20 | 100 | 0.00295 | 2 |
| 14 | 97 | 0.00156 | 0 |
| 10 | 97 | | |
| 6.3 | 97 | | |
| 5 | 97 | | |
| 3.35 | 97 | | |
| 2 | 97 | | |
| 1.18 | 97 | | |
| 0.6 | 96 | Particle density | (assumed) |
| 0.425 | 91 | 2.65 | Mg/m3 |
| 0.3 | 79 | | |
| 0.212 | 57 | | |
| 0.15 | 38 | | |
| 0.063 | 18 | | |

| | |
|---|---|
| Dry Mass of sample, g | 202 |

| **Sample Proportions** | % dry mass |
|---|---|
| Cobbles | 0.0 |
| Gravel | 3.5 |
| Sand | 78.5 |
| Silt | 17.1 |
| Clay | 0.9 |

| **Grading Analysis** | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 0.223 |
| D30 | mm | 0.107 |
| D10 | mm | 0.0227 |
| Uniformity Coefficient | | 9.8 |
| Curvature Coefficient | | 2.3 |

Remarks

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

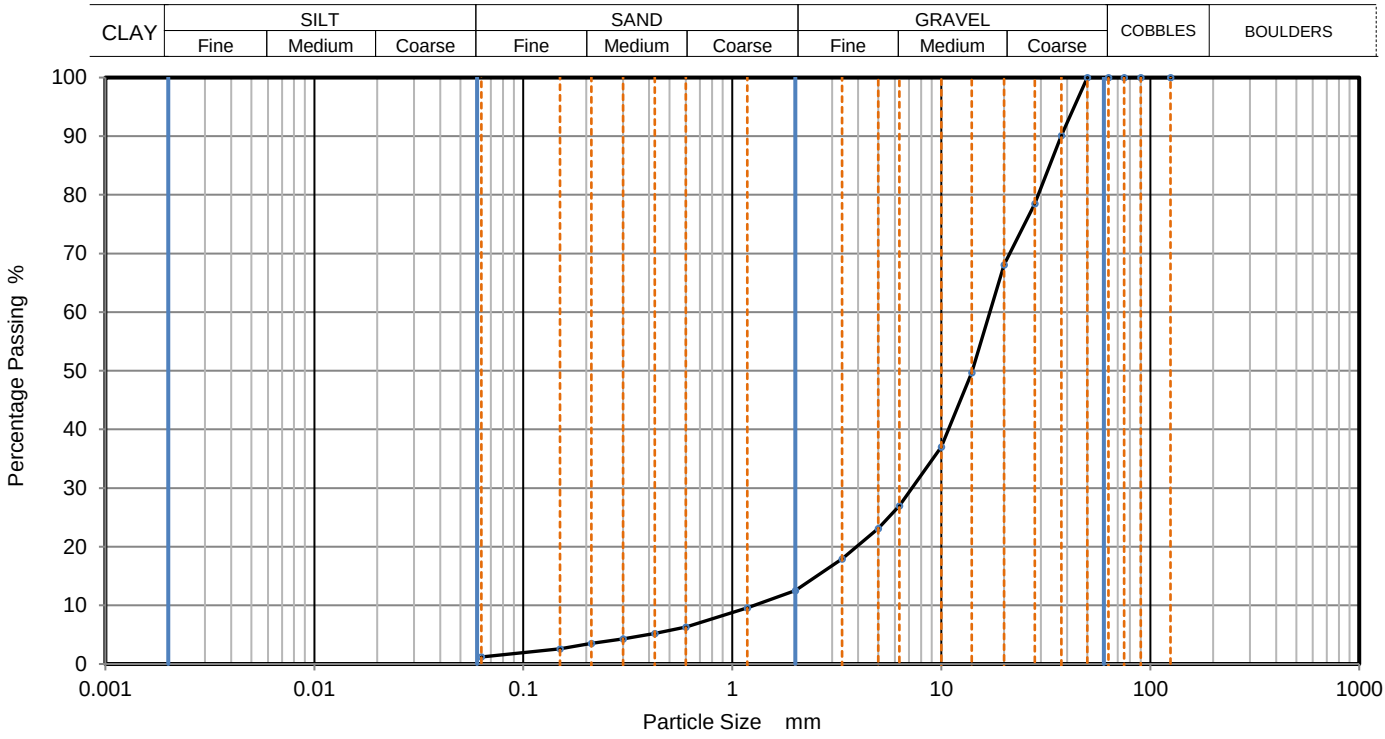
| |
|---|
| Approved |
| Stephen.Watson |

LAB 05R Version 4

UKAS TESTING

10122

| CAUSEWAY GEOTECH | PARTICLE SIZE DISTRIBUTION | | | | Job Ref | 21-0553 |
|---|---|---|---|---|---|---|
| | | | | | Borehole/Pit No. | BH02 |
| Site Name | Riverine Community Park, Lifford | | | | Sample No. | 4 |
| Soil Description | Brown slightly sandy silty subangular fine to coarse GRAVEL. | | | | Depth, m | 3.00 |
| Specimen Reference | 2 | Specimen Depth | 3 | m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clause 9.2 | | | | KeyLAB ID | Caus2021070612 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | | |
| 90 | 100 | | |
| 75 | 100 | | |
| 63 | 100 | | |
| 50 | 100 | | |
| 37.5 | 90 | | |
| 28 | 79 | | |
| 20 | 68 | | |
| 14 | 50 | | |
| 10 | 37 | | |
| 6.3 | 27 | | |
| 5 | 23 | | |
| 3.35 | 18 | | |
| 2 | 13 | | |
| 1.18 | 10 | | |
| 0.6 | 6 | | |
| 0.425 | 5 | | |
| 0.3 | 4 | | |
| 0.212 | 4 | | |
| 0.15 | 3 | | |
| 0.063 | 1 | | |

| Dry Mass of sample, g | 2586 |
|---|---|

| Sample Proportions | % dry mass |
|---|---|
| Cobbles | 0.0 |
| Gravel | 87.5 |
| Sand | 11.4 |
| | |
| Fines <0.063mm | 1.0 |

| Grading Analysis | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 17.1 |
| D30 | mm | 7.25 |
| D10 | mm | 1.27 |
| Uniformity Coefficient | | 13 |
| Curvature Coefficient | | 2.4 |

Remarks

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

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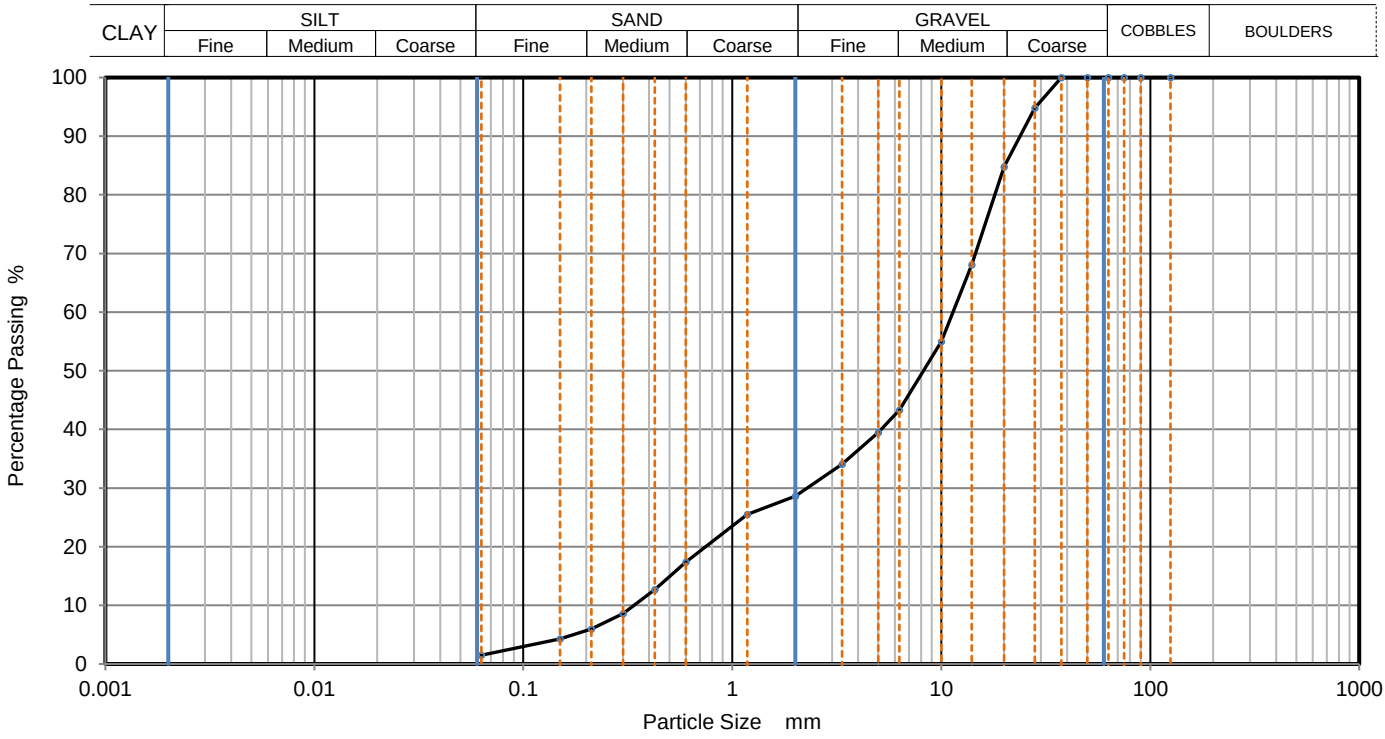
| CAUSEWAY GEOTECH | PARTICLE SIZE DISTRIBUTION | | | Job Ref | 21-0553 |
|---|---|---|---|---|---|
| | | | | Borehole/Pit No. | BH02 |
| Site Name | Riverine Community Park, Lifford | | | Sample No. | 6 |
| Soil Description | Brown sandy silty subangular fine to coarse GRAVEL. | | | Depth, m | 5.00 |
| Specimen Reference | 3 | Specimen Depth | 5 m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clause 9.2 | | | KeyLAB ID | Caus2021070614 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | | |
| 90 | 100 | | |
| 75 | 100 | | |
| 63 | 100 | | |
| 50 | 100 | | |
| 37.5 | 100 | | |
| 28 | 95 | | |
| 20 | 85 | | |
| 14 | 68 | | |
| 10 | 55 | | |
| 6.3 | 43 | | |
| 5 | 40 | | |
| 3.35 | 34 | | |
| 2 | 29 | | |
| 1.18 | 26 | | |
| 0.6 | 17 | | |
| 0.425 | 13 | | |
| 0.3 | 9 | | |
| 0.212 | 6 | | |
| 0.15 | 4 | | |
| 0.063 | 2 | | |

| Dry Mass of sample, g | 2377 |
|---|---|

| Sample Proportions | % dry mass |
|---|---|
| Cobbles | 0.0 |
| Gravel | 71.4 |
| Sand | 27.1 |
| | |
| Fines <0.063mm | 1.0 |

| Grading Analysis | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 11.4 |
| D30 | mm | 2.28 |
| D10 | mm | 0.337 |
| Uniformity Coefficient | | 34 |
| Curvature Coefficient | | 1.4 |

Remarks

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

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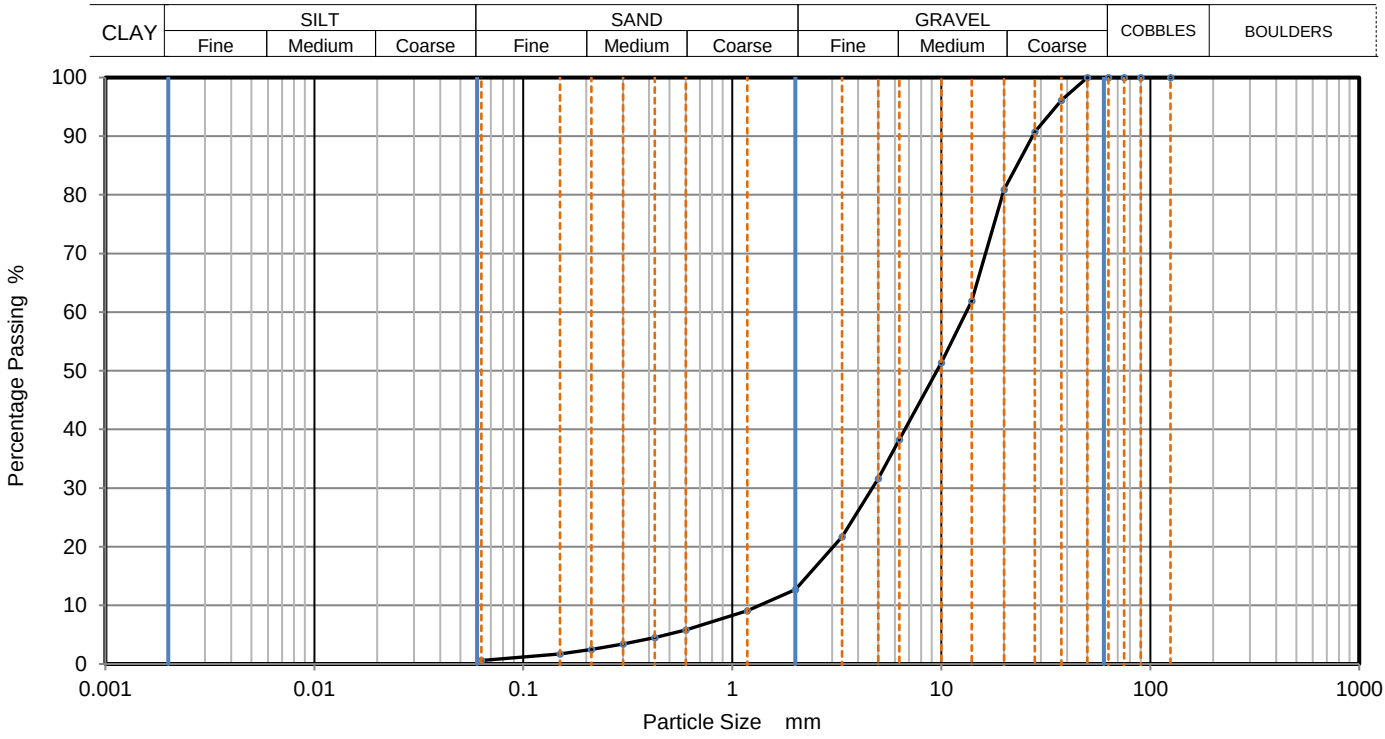
UKAS TESTING 10122

# PARTICLE SIZE DISTRIBUTION

| | | | | | |
|---|---|---|---|---|---|
| CAUSEWAY GEOTECH | | | | Job Ref | **21-0553** |
| | | | | Borehole/Pit No. | BH02 |
| Site Name | Riverine Community Park, Lifford | | | Sample No. | 18 |
| Soil Description | Brown sandy silty subangular fine to coarse GRAVEL. | | | Depth, m | 10.50 |
| Specimen Reference | 2 | Specimen Depth | 10.5 m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clause 9.2 | | | KeyLAB ID | Caus2021070617 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | | |
| 90 | 100 | | |
| 75 | 100 | | |
| 63 | 100 | | |
| 50 | 100 | | |
| 37.5 | 96 | | |
| 28 | 91 | | |
| 20 | 81 | | |
| 14 | 62 | | |
| 10 | 51 | | |
| 6.3 | 38 | | |
| 5 | 32 | | |
| 3.35 | 22 | | |
| 2 | 13 | | |
| 1.18 | 9 | | |
| 0.6 | 6 | | |
| 0.425 | 5 | | |
| 0.3 | 3 | | |
| 0.212 | 3 | | |
| 0.15 | 2 | | |
| 0.063 | 1 | | |

| | |
|---|---|
| Dry Mass of sample, g | 2551 |

| **Sample Proportions** | % dry mass |
|---|---|
| Cobbles | 0.0 |
| Gravel | 87.3 |
| Sand | 12.1 |
| | |
| Fines <0.063mm | 1.0 |

| **Grading Analysis** | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 13.2 |
| D30 | mm | 4.69 |
| D10 | mm | 1.34 |
| Uniformity Coefficient | | 9.8 |
| Curvature Coefficient | | 1.2 |

Remarks

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

| |
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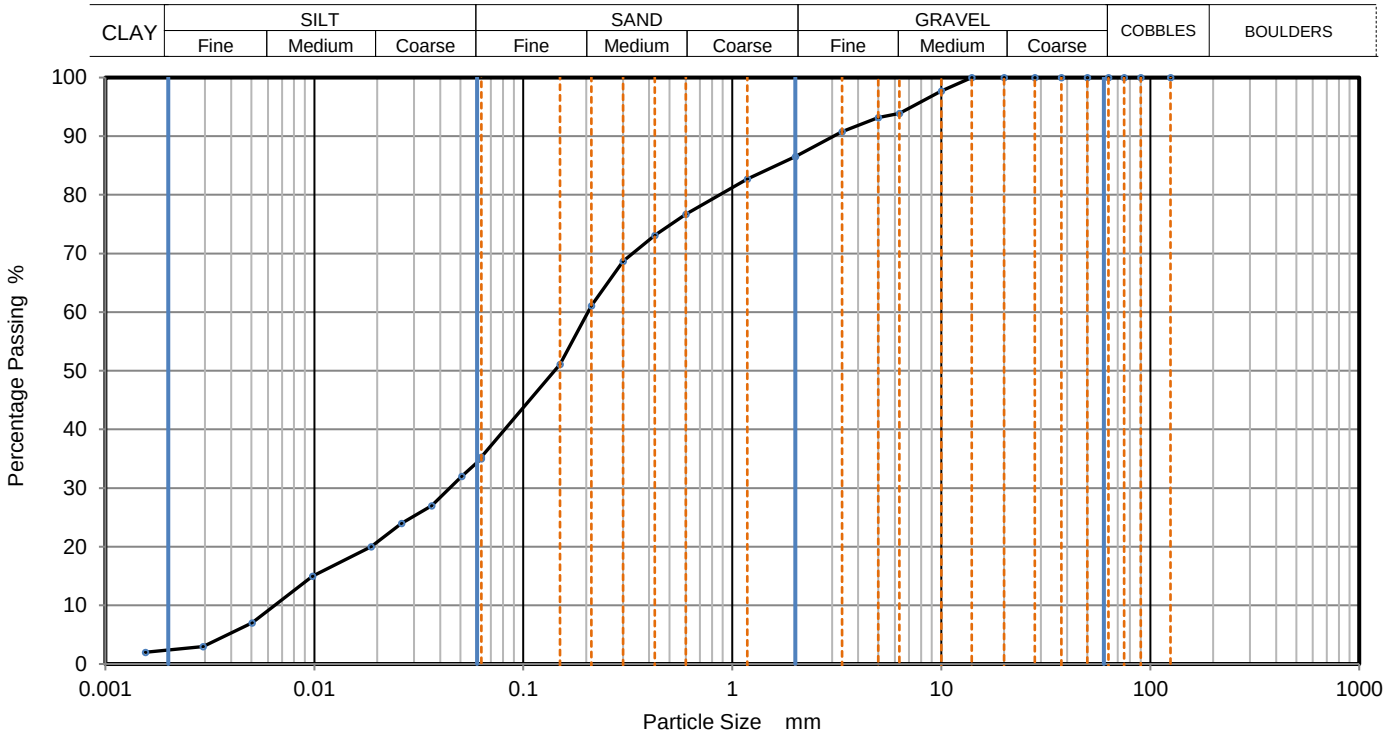
UKAS TESTING

10122

| CAUSEWAY GEOTECH | PARTICLE SIZE DISTRIBUTION | | | | Job Ref | 21-0553 |
|---|---|---|---|---|---|---|
| | | | | | Borehole/Pit No. | BH05 |
| Site Name | Riverine Community Park, Lifford | | | | Sample No. | 2 |
| Soil Description | Greyish brown sandy slightly gravelly silty CLAY. | | | | Depth, m | 1.00 |
| Specimen Reference | 2 | Specimen Depth | 1 | m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clauses 9.2 and 9.5 | | | | KeyLAB ID | Caus2021070628 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | 0.06300 | 35 |
| 90 | 100 | 0.05065 | 32 |
| 75 | 100 | 0.03647 | 27 |
| 63 | 100 | 0.02609 | 24 |
| 50 | 100 | 0.01866 | 20 |
| 37.5 | 100 | 0.00980 | 15 |
| 28 | 100 | 0.00503 | 7 |
| 20 | 100 | 0.00293 | 3 |
| 14 | 100 | 0.00155 | 2 |
| 10 | 98 | | |
| 6.3 | 94 | | |
| 5 | 93 | | |
| 3.35 | 91 | | |
| 2 | 87 | | |
| 1.18 | 83 | | |
| 0.6 | 77 | Particle density | (assumed) |
| 0.425 | 73 | 2.65 | Mg/m3 |
| 0.3 | 69 | | |
| 0.212 | 61 | | |
| 0.15 | 51 | | |
| 0.063 | 35 | | |

| Dry Mass of sample, g | 210 |
|---|---|

| Sample Proportions | % dry mass |
|---|---|
| Cobbles | 0.0 |
| Gravel | 13.5 |
| Sand | 51.2 |
| Silt | 33.0 |
| Clay | 2.3 |

| Grading Analysis | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 0.204 |
| D30 | mm | 0.0446 |
| D10 | mm | 0.00652 |
| Uniformity Coefficient | | 31 |
| Curvature Coefficient | | 1.5 |

Remarks

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

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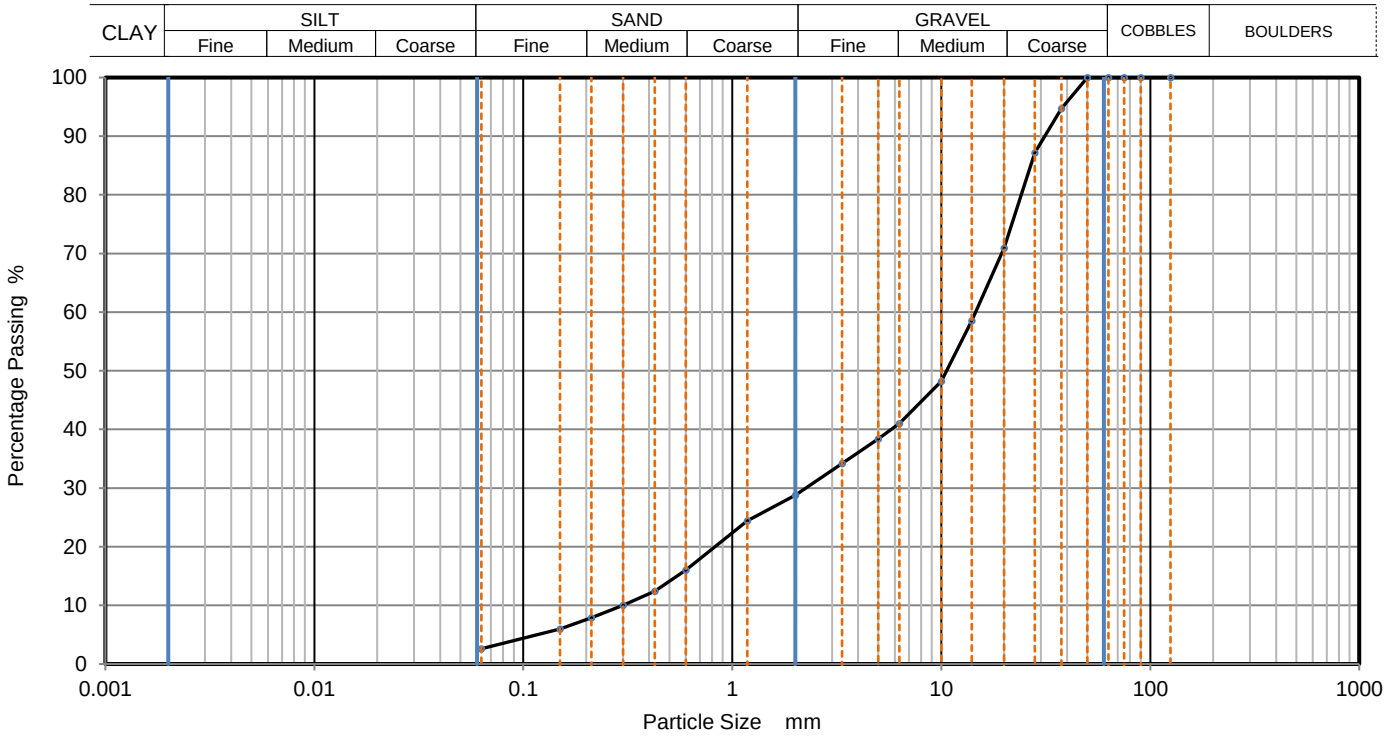
UKAS TESTING 10122

| CAUSEWAY GEOTECH | PARTICLE SIZE DISTRIBUTION | | | Job Ref | 21-0553 |
|---|---|---|---|---|---|
| | | | | Borehole/Pit No. | BH05 |
| Site Name | Riverine Community Park, Lifford | | | Sample No. | 5 |
| Soil Description | Brown sandy subangular fine to coarse GRAVEL. | | | Depth, m | 4.00 |
| Specimen Reference | 2 | Specimen Depth | 4 m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clause 9.2 | | | KeyLAB ID | Caus2021070630 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | | |
| 90 | 100 | | |
| 75 | 100 | | |
| 63 | 100 | | |
| 50 | 100 | | |
| 37.5 | 95 | | |
| 28 | 87 | | |
| 20 | 71 | | |
| 14 | 59 | | |
| 10 | 48 | | |
| 6.3 | 41 | | |
| 5 | 38 | | |
| 3.35 | 34 | | |
| 2 | 29 | | |
| 1.18 | 24 | | |
| 0.6 | 16 | | |
| 0.425 | 12 | | |
| 0.3 | 10 | | |
| 0.212 | 8 | | |
| 0.15 | 6 | | |
| 0.063 | 3 | | |

| Dry Mass of sample, g | 2612 |
|---|---|

| Sample Proportions | % dry mass |
|---|---|
| Cobbles | 0.0 |
| Gravel | 71.2 |
| Sand | 26.2 |
| | |
| Fines <0.063mm | 3.0 |

| Grading Analysis | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 14.6 |
| D30 | mm | 2.24 |
| D10 | mm | 0.299 |
| Uniformity Coefficient | | 49 |
| Curvature Coefficient | | 1.1 |

Remarks

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

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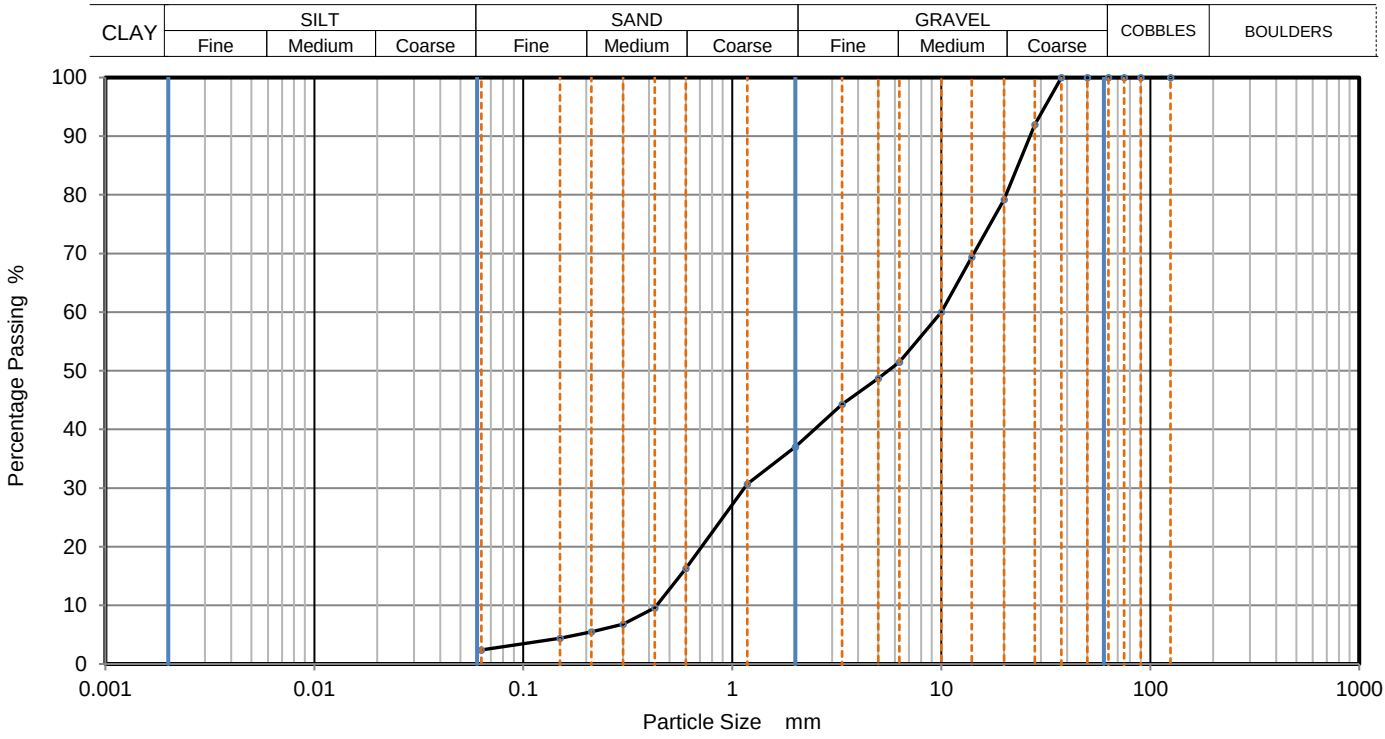
10122

| CAUSEWAY GEOTECH | PARTICLE SIZE DISTRIBUTION | | | | Job Ref | 21-0553 |
|---|---|---|---|---|---|---|
| | | | | | Borehole/Pit No. | BH05 |
| Site Name | Riverine Community Park, Lifford | | | | Sample No. | 8 |
| Soil Description | Brown sandy subangular fine to coarse GRAVEL. | | | | Depth, m | 7.50 |
| Specimen Reference | 2 | Specimen Depth | 7.5 | m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clause 9.2 | | | | KeyLAB ID | Caus2021070634 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | | |
| 90 | 100 | | |
| 75 | 100 | | |
| 63 | 100 | | |
| 50 | 100 | | |
| 37.5 | 100 | | |
| 28 | 92 | | |
| 20 | 79 | | |
| 14 | 69 | | |
| 10 | 60 | | |
| 6.3 | 52 | | |
| 5 | 49 | | |
| 3.35 | 44 | | |
| 2 | 37 | | |
| 1.18 | 31 | | |
| 0.6 | 16 | | |
| 0.425 | 10 | | |
| 0.3 | 7 | | |
| 0.212 | 6 | | |
| 0.15 | 4 | | |
| 0.063 | 2 | | |

| Dry Mass of sample, g | 2050 |
|---|---|

| Sample Proportions | % dry mass |
|---|---|
| Cobbles | 0.0 |
| Gravel | 63.0 |
| Sand | 34.6 |
| | |
| Fines <0.063mm | 2.0 |

| Grading Analysis | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 10 |
| D30 | mm | 1.14 |
| D10 | mm | 0.433 |
| Uniformity Coefficient | | 23 |
| Curvature Coefficient | | 0.3 |

Remarks

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

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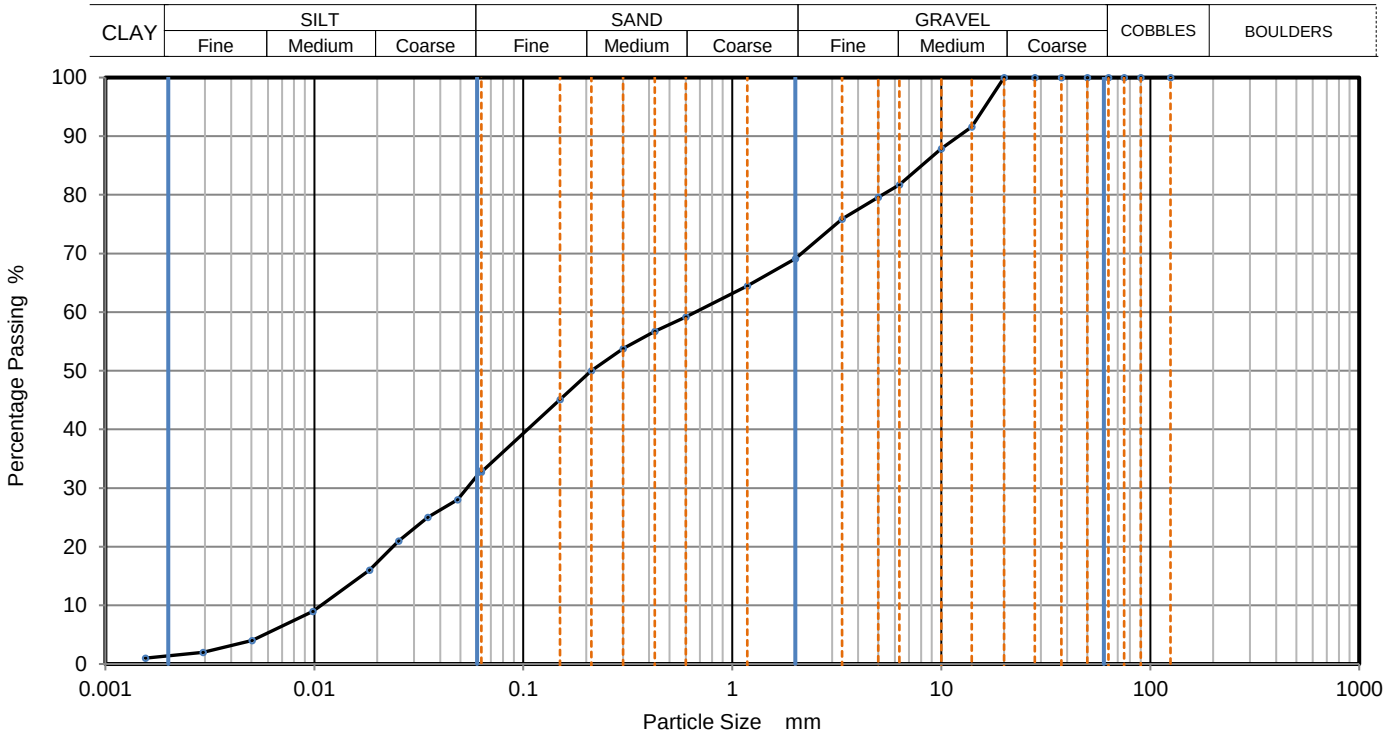
| Stephen.Watson |



UKAS TESTING 10122

| | | | | | |
|---|---|---|---|---|---|
| CAUSEWAY GEOTECH | **PARTICLE SIZE DISTRIBUTION** | | | Job Ref | **21-0553** |
| | | | | Borehole/Pit No. | BH05 |
| Site Name | Riverine Community Park, Lifford | | | Sample No. | 19 |
| Soil Description | Brown sandy gravelly clayey SILT. | | | Depth, m | 10.50 |
| Specimen Reference | 2 | Specimen Depth | 10.5 m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clauses 9.2 and 9.5 | | | KeyLAB ID | Caus2021070636 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | 0.06300 | 33 |
| 90 | 100 | 0.04843 | 28 |
| 75 | 100 | 0.03492 | 25 |
| 63 | 100 | 0.02532 | 21 |
| 50 | 100 | 0.01834 | 16 |
| 37.5 | 100 | 0.00985 | 9 |
| 28 | 100 | 0.00503 | 4 |
| 20 | 100 | 0.00293 | 2 |
| 14 | 92 | 0.00155 | 1 |
| 10 | 88 | | |
| 6.3 | 82 | | |
| 5 | 80 | | |
| 3.35 | 76 | | |
| 2 | 69 | | |
| 1.18 | 65 | | |
| 0.6 | 59 | Particle density | (assumed) |
| 0.425 | 57 | 2.65 | Mg/m3 |
| 0.3 | 54 | | |
| 0.212 | 50 | | |
| 0.15 | 45 | | |
| 0.063 | 33 | | |

| | |
|---|---|
| Dry Mass of sample, g | 1164 |

| **Sample Proportions** | % dry mass |
|---|---|
| Cobbles | 0.0 |
| Gravel | 30.9 |
| Sand | 36.4 |
| Silt | 31.2 |
| Clay | 1.5 |

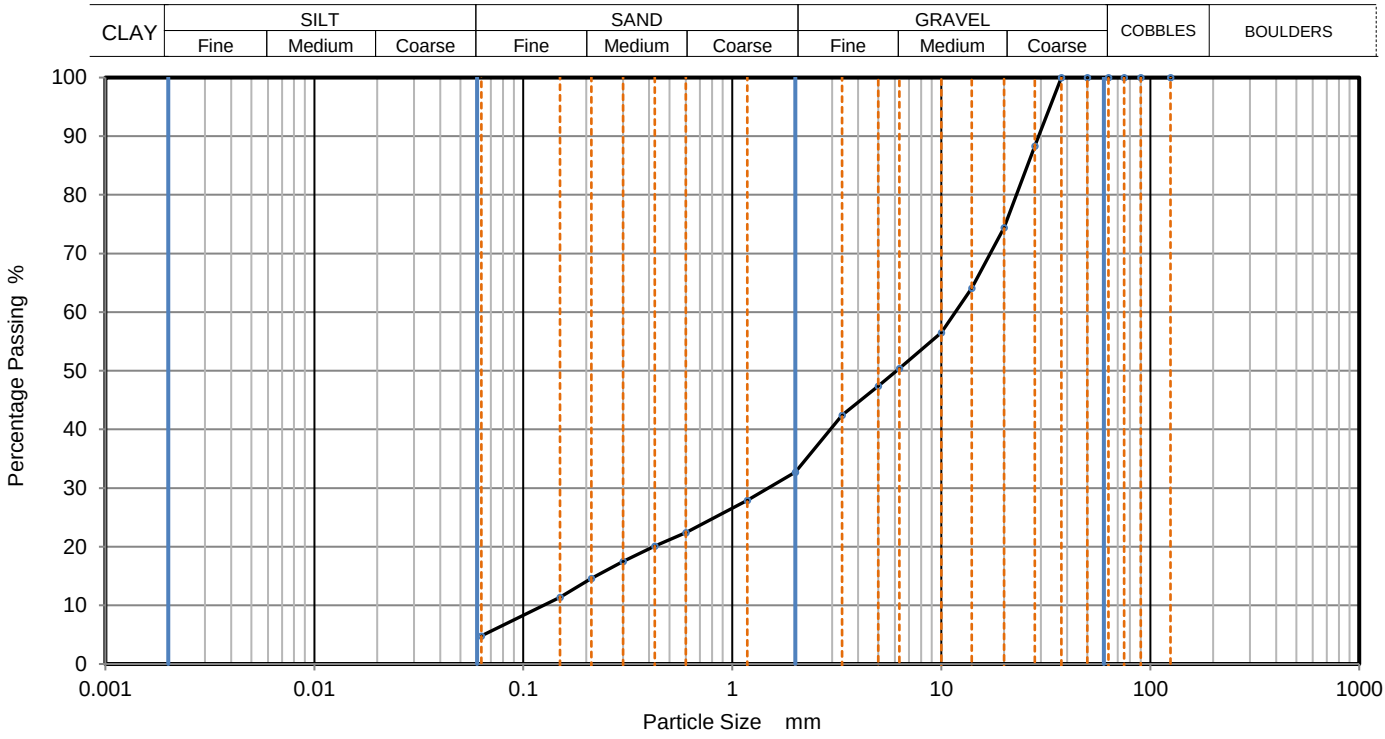
| **Grading Analysis** | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 0.666 |
| D30 | mm | 0.0535 |
| D10 | mm | 0.0109 |
| Uniformity Coefficient | | 61 |
| Curvature Coefficient | | 0.39 |

Remarks

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

| |
|---|
| Approved |
| Stephen.Watson |

| | | | | | |
|---|---|---|---|---|---|
| CAUSEWAY GEOTECH | **PARTICLE SIZE DISTRIBUTION** | | | Job Ref | **21-0553** |
| | | | | Borehole/Pit No. | BH05 |
| Site Name | Riverine Community Park, Lifford | | | Sample No. | 21 |
| Soil Description | Brown sandy slightly silty subangular fine to coarse GRAVEL. | | | Depth, m | 13.50 |
| Specimen Reference | 2 | Specimen Depth | 13.5 m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clause 9.2 | | | KeyLAB ID | Caus2021070639 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | | |
| 90 | 100 | | |
| 75 | 100 | | |
| 63 | 100 | | |
| 50 | 100 | | |
| 37.5 | 100 | | |
| 28 | 88 | | |
| 20 | 74 | | |
| 14 | 64 | | |
| 10 | 57 | | |
| 6.3 | 50 | | |
| 5 | 47 | | |
| 3.35 | 42 | | |
| 2 | 33 | | |
| 1.18 | 28 | | |
| 0.6 | 22 | | |
| 0.425 | 20 | | |
| 0.3 | 18 | | |
| 0.212 | 15 | | |
| 0.15 | 11 | | |
| 0.063 | 5 | | |

| | |
|---|---|
| Dry Mass of sample, g | 2523 |

| **Sample Proportions** | % dry mass |
|---|---|
| Cobbles | 0.0 |
| Gravel | 67.3 |
| Sand | 27.9 |
| | |
| Fines <0.063mm | 5.0 |

| **Grading Analysis** | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 11.7 |
| D30 | mm | 1.49 |
| D10 | mm | 0.125 |
| Uniformity Coefficient | | 94 |
| Curvature Coefficient | | 1.5 |

Remarks

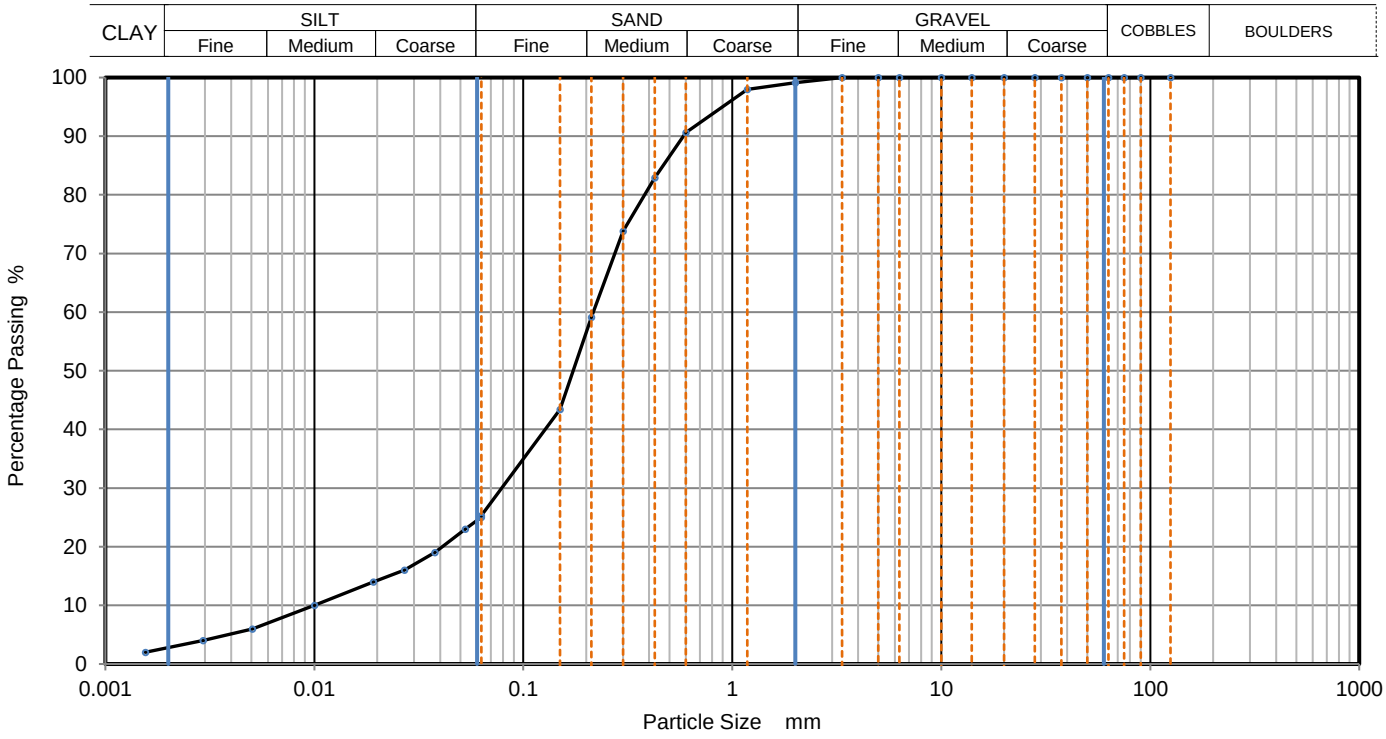
Preparation and testing in accordance with BS1377-2 :1990 unless noted below

| |
|---|
| Approved |
| Stephen.Watson |



UKAS TESTING 10122

| CAUSEWAY GEOTECH | PARTICLE SIZE DISTRIBUTION | | | | Job Ref | 21-0553 |
|---|---|---|---|---|---|---|
| | | | | | Borehole/Pit No. | BH06 |
| Site Name | Riverine Community Park, Lifford | | | | Sample No. | 1 |
| Soil Description | Brown silty fine to coarse SAND. | | | | Depth, m | 0.50 |
| Specimen Reference | 2 | Specimen Depth | 0.5 | m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clauses 9.2 and 9.5 | | | | KeyLAB ID | Caus2021070640 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | 0.06300 | 25 |
| 90 | 100 | 0.05278 | 23 |
| 75 | 100 | 0.03774 | 19 |
| 63 | 100 | 0.02698 | 16 |
| 50 | 100 | 0.01918 | 14 |
| 37.5 | 100 | 0.01001 | 10 |
| 28 | 100 | 0.00506 | 6 |
| 20 | 100 | 0.00293 | 4 |
| 14 | 100 | 0.00155 | 2 |
| 10 | 100 | | |
| 6.3 | 100 | | |
| 5 | 100 | | |
| 3.35 | 100 | | |
| 2 | 99 | | |
| 1.18 | 98 | | |
| 0.6 | 91 | Particle density | (assumed) |
| 0.425 | 83 | 2.65 | Mg/m3 |
| 0.3 | 74 | | |
| 0.212 | 59 | | |
| 0.15 | 43 | | |
| 0.063 | 25 | | |

| Dry Mass of sample, g | 213 |
|---|---|

| Sample Proportions | % dry mass |
|---|---|
| Cobbles | 0.0 |
| Gravel | 0.9 |
| Sand | 73.8 |
| Silt | 22.6 |
| Clay | 2.7 |

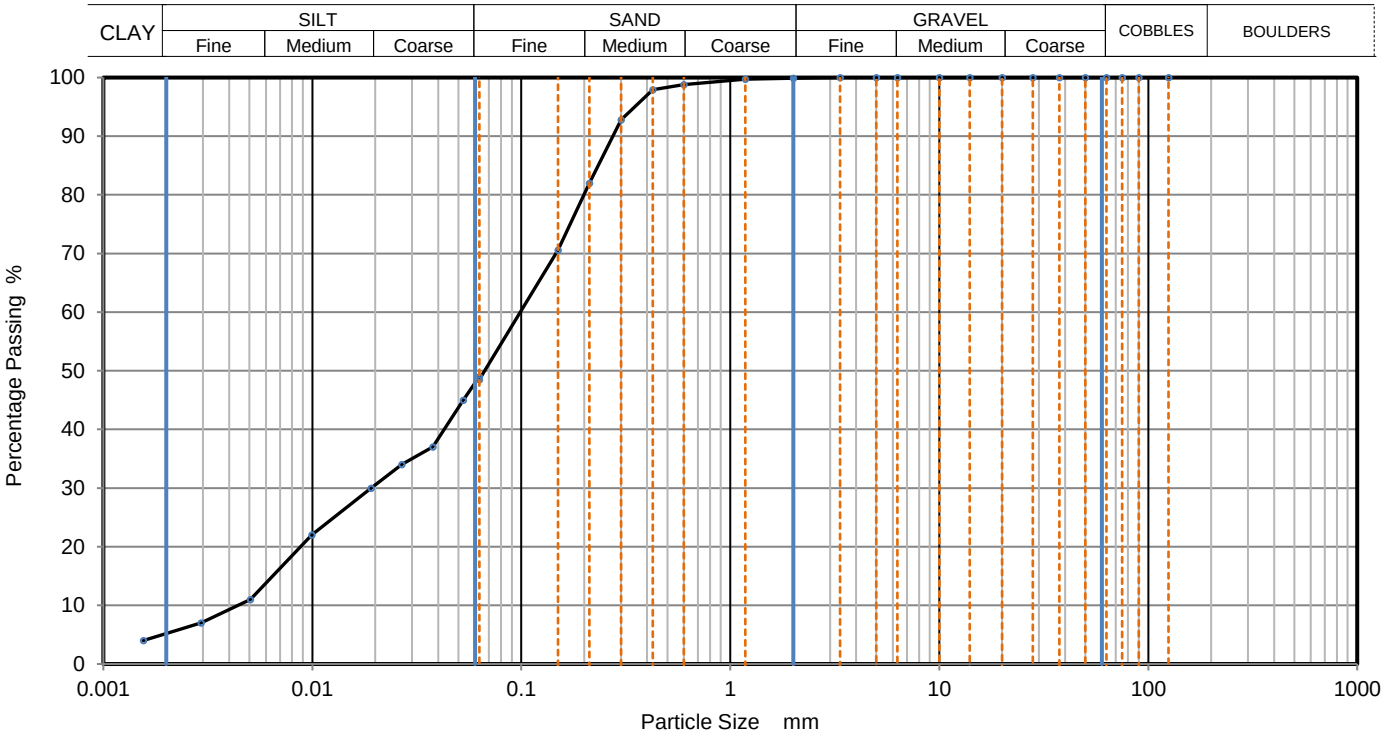
| Grading Analysis | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 0.216 |
| D30 | mm | 0.079 |
| D10 | mm | 0.0105 |
| Uniformity Coefficient | | 21 |
| Curvature Coefficient | | 2.8 |

Remarks

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

| Approved |
|---|
| Stephen.Watson |

| CAUSEWAY GEOTECH | PARTICLE SIZE DISTRIBUTION | | | Job Ref | 21-0553 |
|---|---|---|---|---|---|
| | | | | Borehole/Pit No. | BH06 |
| Site Name | Riverine Community Park, Lifford | | | Sample No. | 3 |
| Soil Description | Brown very sandy silty CLAY. | | | Depth, m | 2.00 |
| Specimen Reference | 2 | Specimen Depth | 2 m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clauses 9.2 and 9.5 | | | KeyLAB ID | Caus2021070642 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | 0.06300 | 49 |
| 90 | 100 | 0.05278 | 45 |
| 75 | 100 | 0.03774 | 37 |
| 63 | 100 | 0.02683 | 34 |
| 50 | 100 | 0.01908 | 30 |
| 37.5 | 100 | 0.00996 | 22 |
| 28 | 100 | 0.00506 | 11 |
| 20 | 100 | 0.00293 | 7 |
| 14 | 100 | 0.00155 | 4 |
| 10 | 100 | | |
| 6.3 | 100 | | |
| 5 | 100 | | |
| 3.35 | 100 | | |
| 2 | 100 | | |
| 1.18 | 100 | | |
| 0.6 | 99 | Particle density | (assumed) |
| 0.425 | 98 | 2.65 | Mg/m3 |
| 0.3 | 93 | | |
| 0.212 | 82 | | |
| 0.15 | 71 | | |
| 0.063 | 49 | | |

| Dry Mass of sample, g | 217 |
|---|---|

| Sample Proportions | % dry mass |
|---|---|
| Cobbles | 0.0 |
| Gravel | 0.1 |
| Sand | 51.5 |
| Silt | 43.2 |
| Clay | 5.2 |

| Grading Analysis | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 0.0991 |
| D30 | mm | 0.0193 |
| D10 | mm | 0.00425 |
| Uniformity Coefficient | | 23 |
| Curvature Coefficient | | 0.89 |

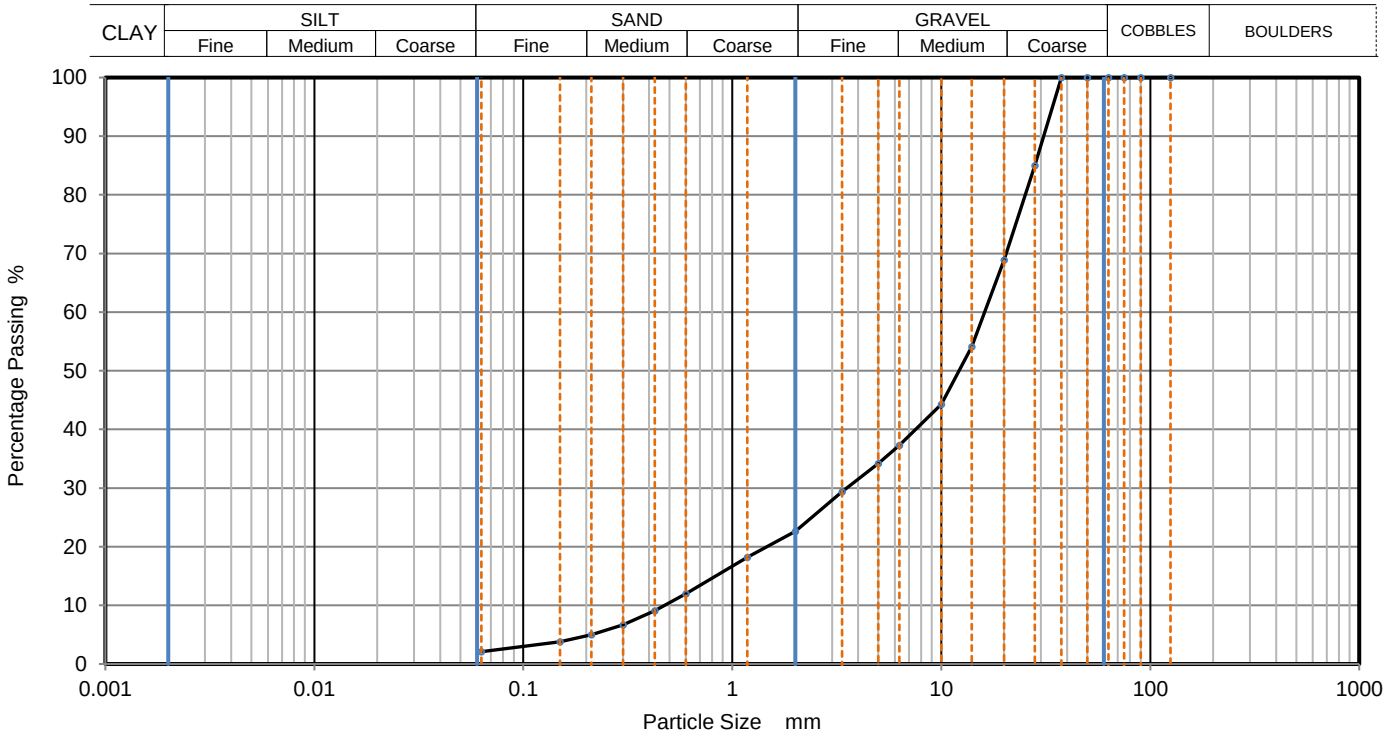
Remarks

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

| Approved |
|---|
| Stephen.Watson |

# PARTICLE SIZE DISTRIBUTION

| | | | | | |
|---|---|---|---|---|---|
| CAUSEWAY GEOTECH | | | | Job Ref | **21-0553** |
| | | | | Borehole/Pit No. | BH06 |
| Site Name | Riverine Community Park, Lifford | | | Sample No. | 5 |
| Soil Description | Greyish brown sandy subangular fine to coarse GRAVEL | | | Depth, m | 4.00 |
| Specimen Reference | 3 | Specimen Depth | 4 m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clause 9.2 | | | KeyLAB ID | Caus2021070645 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | | |
| 90 | 100 | | |
| 75 | 100 | | |
| 63 | 100 | | |
| 50 | 100 | | |
| 37.5 | 100 | | |
| 28 | 85 | | |
| 20 | 69 | | |
| 14 | 54 | | |
| 10 | 44 | | |
| 6.3 | 37 | | |
| 5 | 34 | | |
| 3.35 | 29 | | |
| 2 | 23 | | |
| 1.18 | 18 | | |
| 0.6 | 12 | | |
| 0.425 | 9 | | |
| 0.3 | 7 | | |
| 0.212 | 5 | | |
| 0.15 | 4 | | |
| 0.063 | 2 | | |

| Dry Mass of sample, g | 2551 |
|---|---|

| **Sample Proportions** | % dry mass |
|---|---|
| Cobbles | 0.0 |
| Gravel | 77.4 |
| Sand | 20.5 |
| | |
| Fines <0.063mm | 2.0 |

| **Grading Analysis** | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 16.1 |
| D30 | mm | 3.51 |
| D10 | mm | 0.475 |
| Uniformity Coefficient | | 34 |
| Curvature Coefficient | | 1.6 |

Remarks

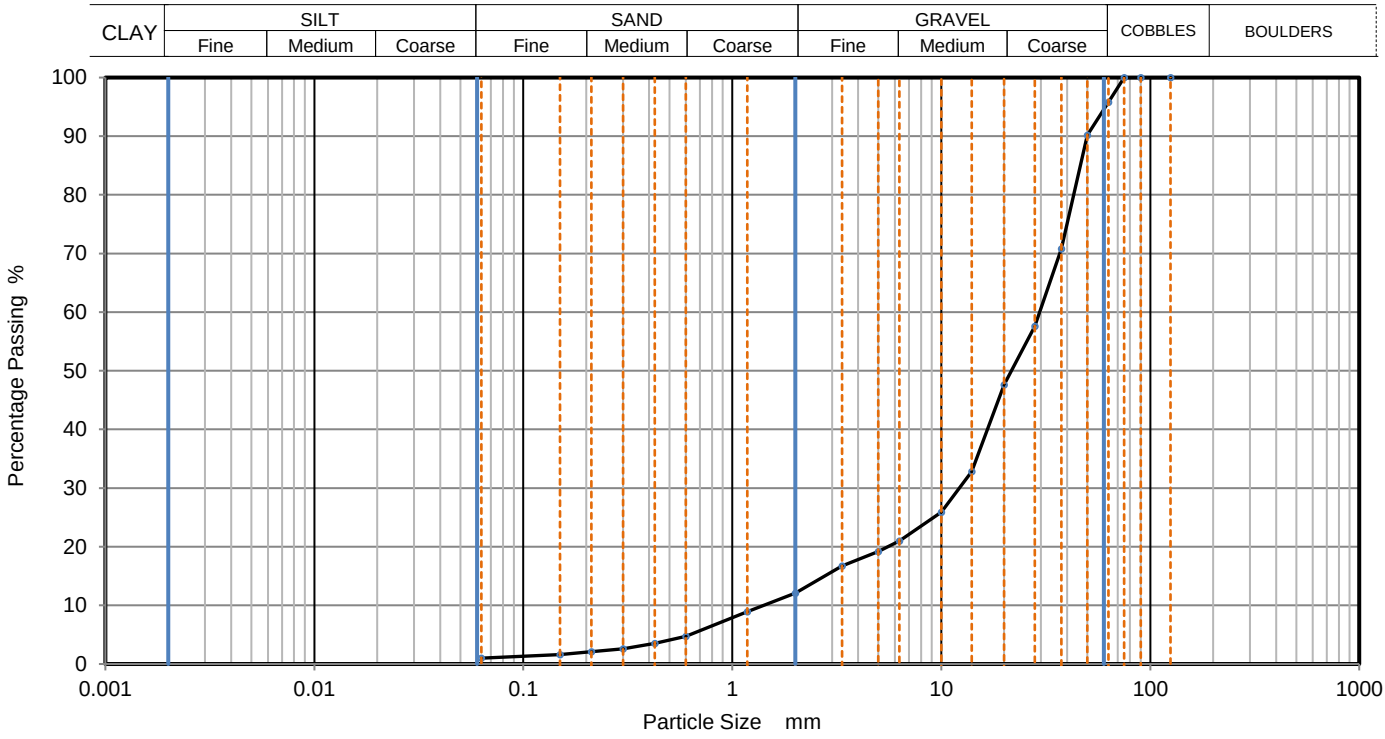
Preparation and testing in accordance with BS1377-2 :1990 unless noted below

| Approved |
|---|
| Stephen.Watson |



UKAS TESTING 10122

| CAUSEWAY GEOTECH | PARTICLE SIZE DISTRIBUTION | | | Job Ref | 21-0553 |
|---|---|---|---|---|---|
| | | | | Borehole/Pit No. | BH06 |
| Site Name | Riverine Community Park, Lifford | | | Sample No. | 7 |
| Soil Description | Greyish brown sandy subangular fine to coarse GRAVEL | | | Depth, m | 6.00 |
| Specimen Reference | 2 | Specimen Depth | 6 m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clause 9.2 | | | KeyLAB ID | Caus2021070647 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | | |
| 90 | 100 | | |
| 75 | 100 | | |
| 63 | 96 | | |
| 50 | 90 | | |
| 37.5 | 71 | | |
| 28 | 58 | | |
| 20 | 48 | | |
| 14 | 33 | | |
| 10 | 26 | | |
| 6.3 | 21 | | |
| 5 | 19 | | |
| 3.35 | 17 | | |
| 2 | 12 | | |
| 1.18 | 9 | | |
| 0.6 | 5 | | |
| 0.425 | 4 | | |
| 0.3 | 3 | | |
| 0.212 | 2 | | |
| 0.15 | 2 | | |
| 0.063 | 1 | | |

| Dry Mass of sample, g | 12076 |
|---|---|

| Sample Proportions | % dry mass |
|---|---|
| Cobbles | 4.2 |
| Gravel | 83.7 |
| Sand | 11.2 |
| | |
| Fines <0.063mm | 1.0 |

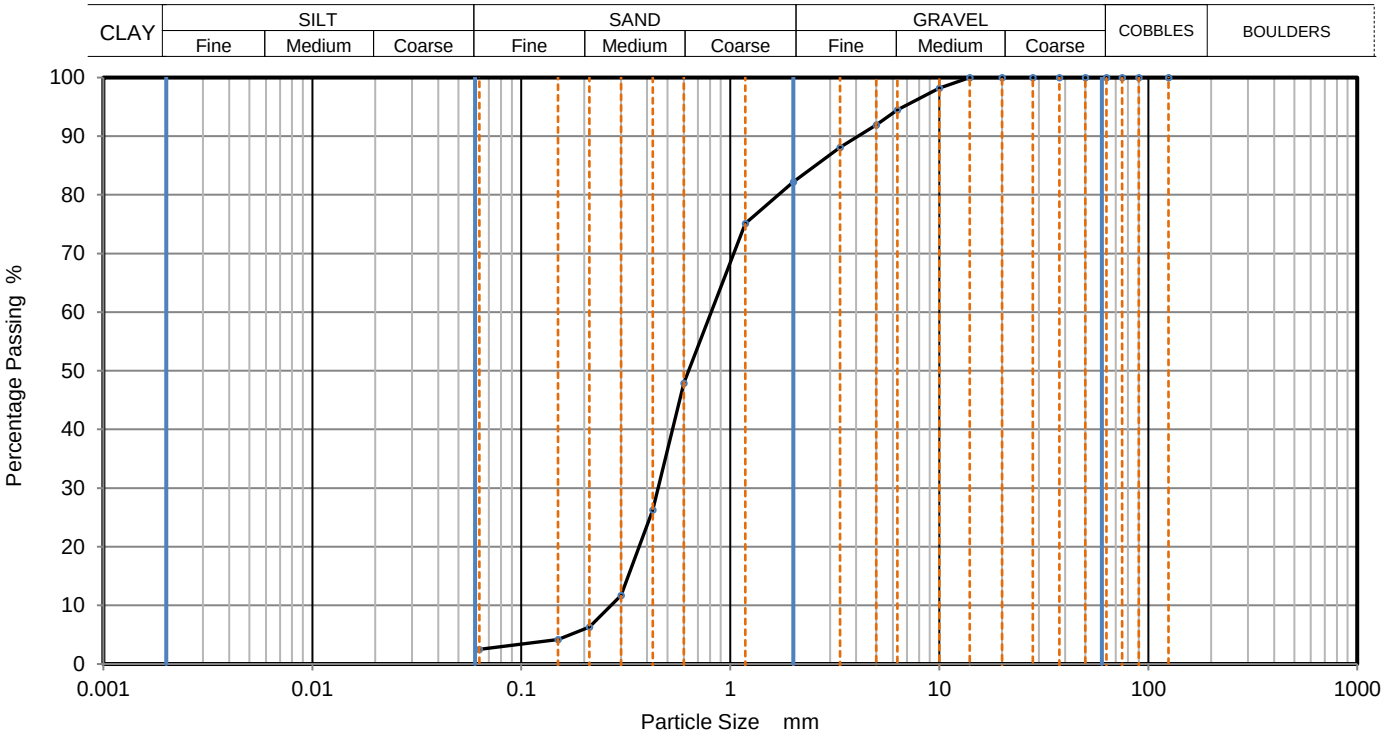
| Grading Analysis | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 29.5 |
| D30 | mm | 12.2 |
| D10 | mm | 1.41 |
| Uniformity Coefficient | | 21 |
| Curvature Coefficient | | 3.6 |

Remarks

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

| Approved |
|---|
| Stephen.Watson |

| CAUSEWAY GEOTECH | PARTICLE SIZE DISTRIBUTION | | | Job Ref | 21-0553 |
|---|---|---|---|---|---|
| | | | | Borehole/Pit No. | BH06 |
| Site Name | Riverine Community Park, Lifford | | | Sample No. | 21 |
| Soil Description | Greyish brown slightly silty fine to coarse SAND. | | | Depth, m | 12.00 |
| Specimen Reference | 2 | Specimen Depth | 12 m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clause 9.2 | | | KeyLAB ID | Caus2021070651 |




| 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 | 100 | | |
| 10 | 98 | | |
| 6.3 | 95 | | |
| 5 | 92 | | |
| 3.35 | 88 | | |
| 2 | 82 | | |
| 1.18 | 75 | | |
| 0.6 | 48 | | |
| 0.425 | 26 | | |
| 0.3 | 12 | | |
| 0.212 | 6 | | |
| 0.15 | 4 | | |
| 0.063 | 3 | | |

| Dry Mass of sample, g | 215 |
|---|---|

| Sample Proportions | % dry mass |
|---|---|
| Cobbles | 0.0 |
| Gravel | 17.8 |
| Sand | 79.7 |
| | |
| Fines <0.063mm | 3.0 |

| Grading Analysis | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 0.81 |
| D30 | mm | 0.451 |
| D10 | mm | 0.269 |
| Uniformity Coefficient | | 3 |
| Curvature Coefficient | | 0.93 |

Remarks

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

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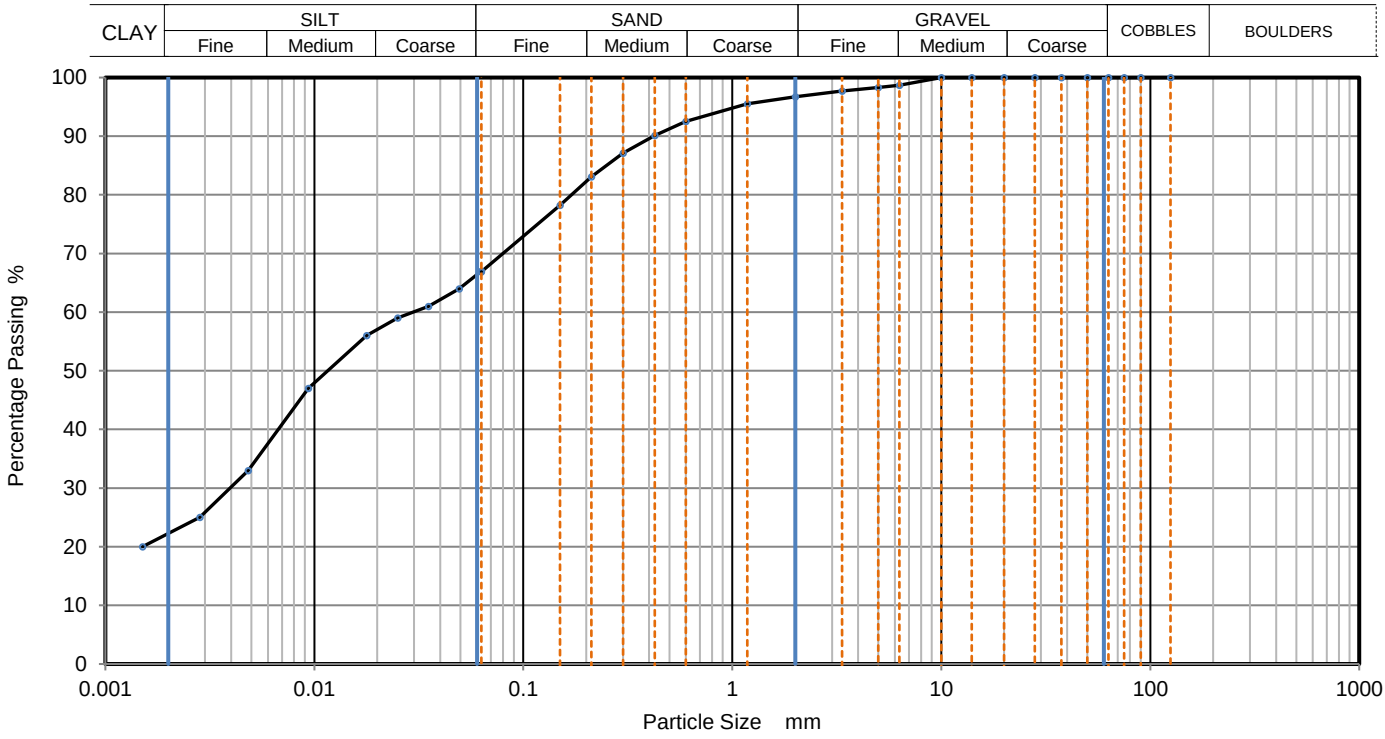
|---|
| Stephen.Watson |



UKAS TESTING 10122

| CAUSEWAY GEOTECH | PARTICLE SIZE DISTRIBUTION | | | | Job Ref | 21-0553 |
|---|---|---|---|---|---|---|
| | | | | | Borehole/Pit No. | BH07 |
| Site Name | Riverine Community Park, Lifford | | | | Sample No. | 1 |
| Soil Description | Brown sandy clayey SILT. | | | | Depth, m | 0.50 |
| Specimen Reference | 2 | Specimen Depth | 0.5 | m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clauses 9.2 and 9.5 | | | | KeyLAB ID | Caus2021070653 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | 0.06300 | 67 |
| 90 | 100 | 0.04939 | 64 |
| 75 | 100 | 0.03515 | 61 |
| 63 | 100 | 0.02501 | 59 |
| 50 | 100 | 0.01780 | 56 |
| 37.5 | 100 | 0.00936 | 47 |
| 28 | 100 | 0.00482 | 33 |
| 20 | 100 | 0.00283 | 25 |
| 14 | 100 | 0.00150 | 20 |
| 10 | 100 | | |
| 6.3 | 99 | | |
| 5 | 98 | | |
| 3.35 | 98 | | |
| 2 | 97 | | |
| 1.18 | 96 | | |
| 0.6 | 93 | Particle density | (assumed) |
| 0.425 | 90 | 2.65 | Mg/m3 |
| 0.3 | 87 | | |
| 0.212 | 83 | | |
| 0.15 | 78 | | |
| 0.063 | 67 | | |

| Dry Mass of sample, g | 206 |
|---|---|

| Sample Proportions | % dry mass |
|---|---|
| Cobbles | 0.0 |
| Gravel | 3.3 |
| Sand | 29.8 |
| Silt | 44.9 |
| Clay | 22.0 |

| Grading Analysis | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 0.0299 |
| D30 | mm | 0.00387 |
| D10 | mm | |
| Uniformity Coefficient | | |
| Curvature Coefficient | | |

Remarks

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

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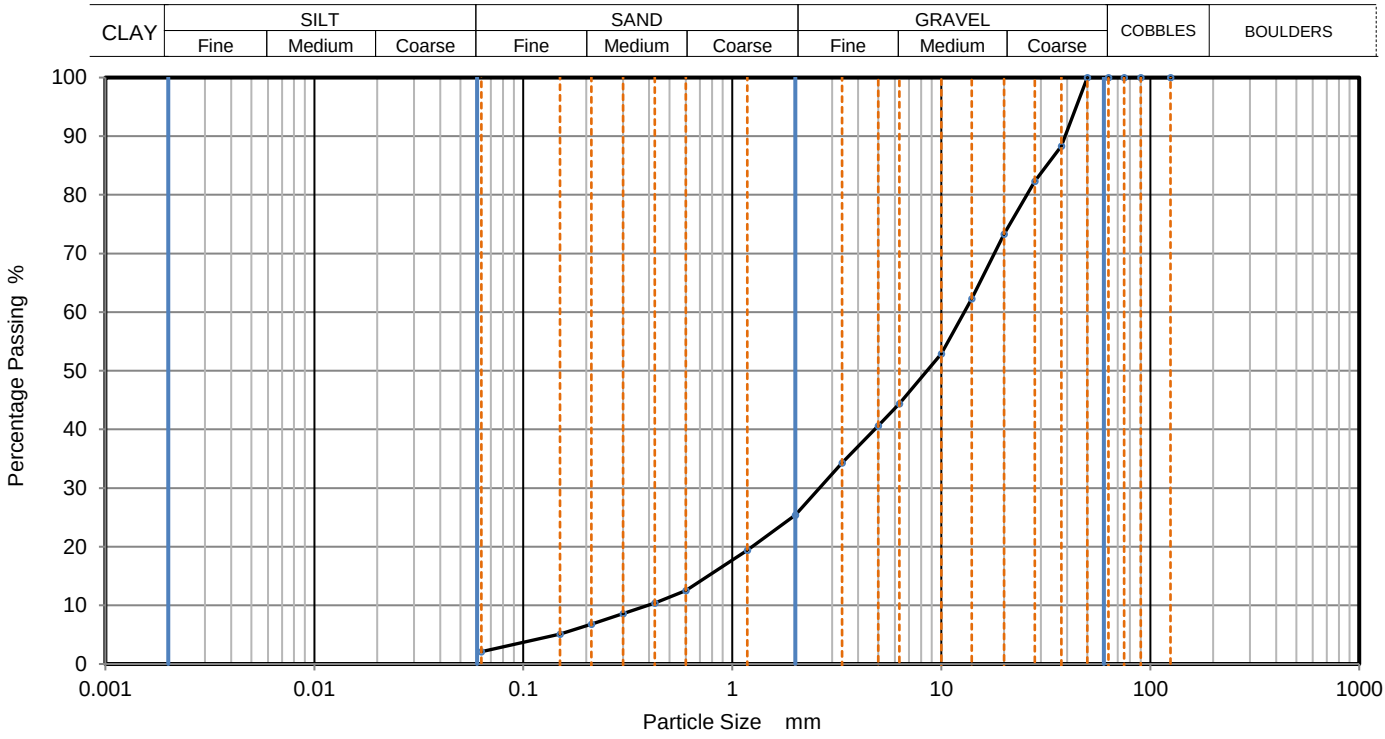
| CAUSEWAY GEOTECH | PARTICLE SIZE DISTRIBUTION | | | Job Ref | 21-0553 |
|---|---|---|---|---|---|
| | | | | Borehole/Pit No. | BH07 |
| Site Name | Riverine Community Park, Lifford | | | Sample No. | 3 |
| Soil Description | Greyish brown gravelly fine to coarse SAND. | | | Depth, m | 2.00 |
| Specimen Reference | 2 | Specimen Depth | 2 m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clause 9.2 | | | KeyLAB ID | Caus2021070655 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | | |
| 90 | 100 | | |
| 75 | 100 | | |
| 63 | 100 | | |
| 50 | 100 | | |
| 37.5 | 88 | | |
| 28 | 82 | | |
| 20 | 73 | | |
| 14 | 62 | | |
| 10 | 53 | | |
| 6.3 | 44 | | |
| 5 | 41 | | |
| 3.35 | 34 | | |
| 2 | 25 | | |
| 1.18 | 19 | | |
| 0.6 | 13 | | |
| 0.425 | 10 | | |
| 0.3 | 9 | | |
| 0.212 | 7 | | |
| 0.15 | 5 | | |
| 0.063 | 2 | | |

| Dry Mass of sample, g | 2773 |
|---|---|

| Sample Proportions | % dry mass |
|---|---|
| Cobbles | 0.0 |
| Gravel | 74.6 |
| Sand | 23.3 |
| | |
| Fines <0.063mm | 2.0 |

| Grading Analysis | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 12.9 |
| D30 | mm | 2.61 |
| D10 | mm | 0.393 |
| Uniformity Coefficient | | 33 |
| Curvature Coefficient | | 1.3 |

Remarks

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

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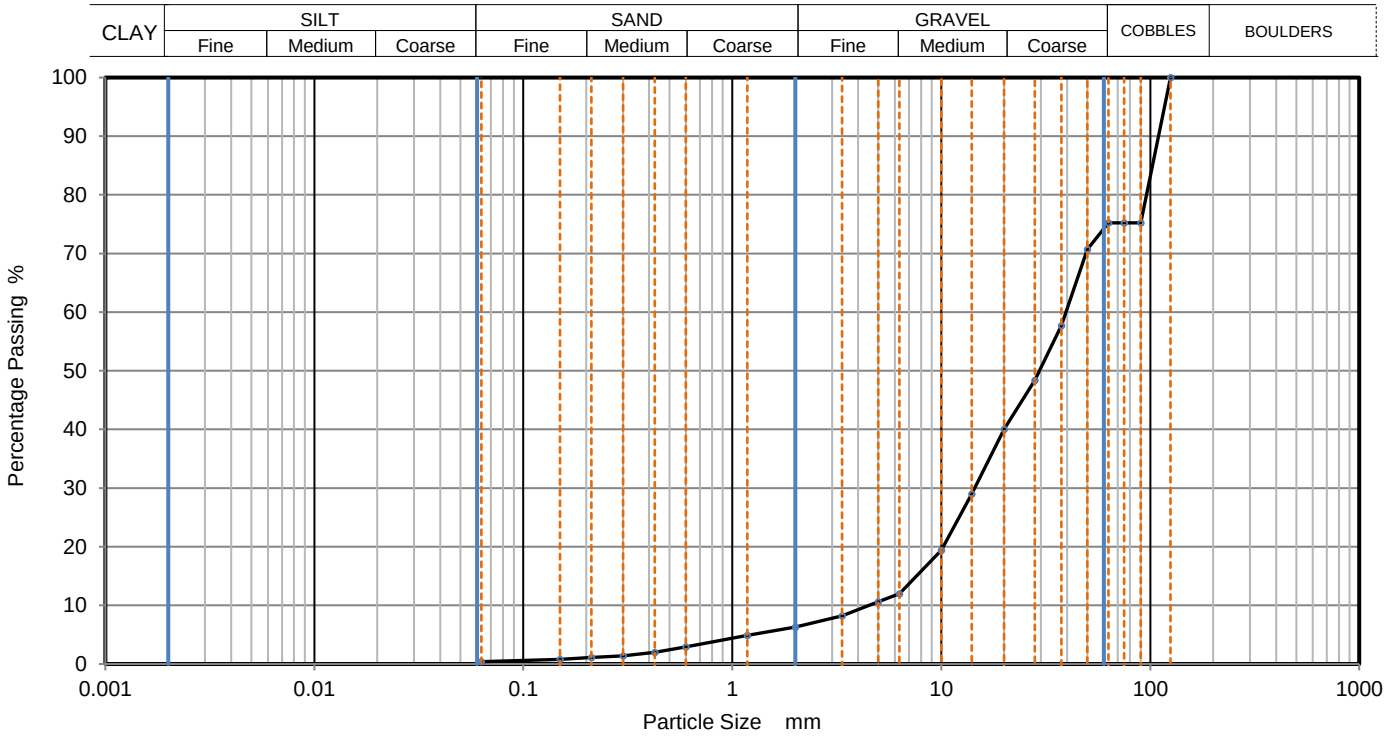
| CAUSEWAY GEOTECH | PARTICLE SIZE DISTRIBUTION | | | Job Ref | 21-0553 |
|---|---|---|---|---|---|
| | | | | Borehole/Pit No. | BH07 |
| Site Name | Riverine Community Park, Lifford | | | Sample No. | 10 |
| Soil Description | Grey slightly sandy subangular fine to coarse GRAVEL. | | | Depth, m | 5.00 |
| Specimen Reference | 3 | Specimen Depth | 5 m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clause 9.2 | | | KeyLAB ID | Caus2021070657 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | | |
| 90 | 75 | | |
| 75 | 75 | | |
| 63 | 75 | | |
| 50 | 71 | | |
| 37.5 | 58 | | |
| 28 | 48 | | |
| 20 | 40 | | |
| 14 | 29 | | |
| 10 | 19 | | |
| 6.3 | 12 | | |
| 5 | 11 | | |
| 3.35 | 8 | | |
| 2 | 6 | | |
| 1.18 | 5 | | |
| 0.6 | 3 | | |
| 0.425 | 2 | | |
| 0.3 | 1 | | |
| 0.212 | 1 | | |
| 0.15 | 1 | | |
| 0.063 | 0 | | |

| Dry Mass of sample, g | 9662 |
|---|---|

| Sample Proportions | % dry mass |
|---|---|
| Cobbles | 24.8 |
| Gravel | 68.8 |
| Sand | 6.0 |
| | |
| Fines <0.063mm | 0.0 |

| Grading Analysis | | |
|---|---|---|
| D100 | mm | 125 |
| D60 | mm | 39.5 |
| D30 | mm | 14.5 |
| D10 | mm | 4.55 |
| Uniformity Coefficient | | 8.7 |
| Curvature Coefficient | | 1.2 |

Remarks

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

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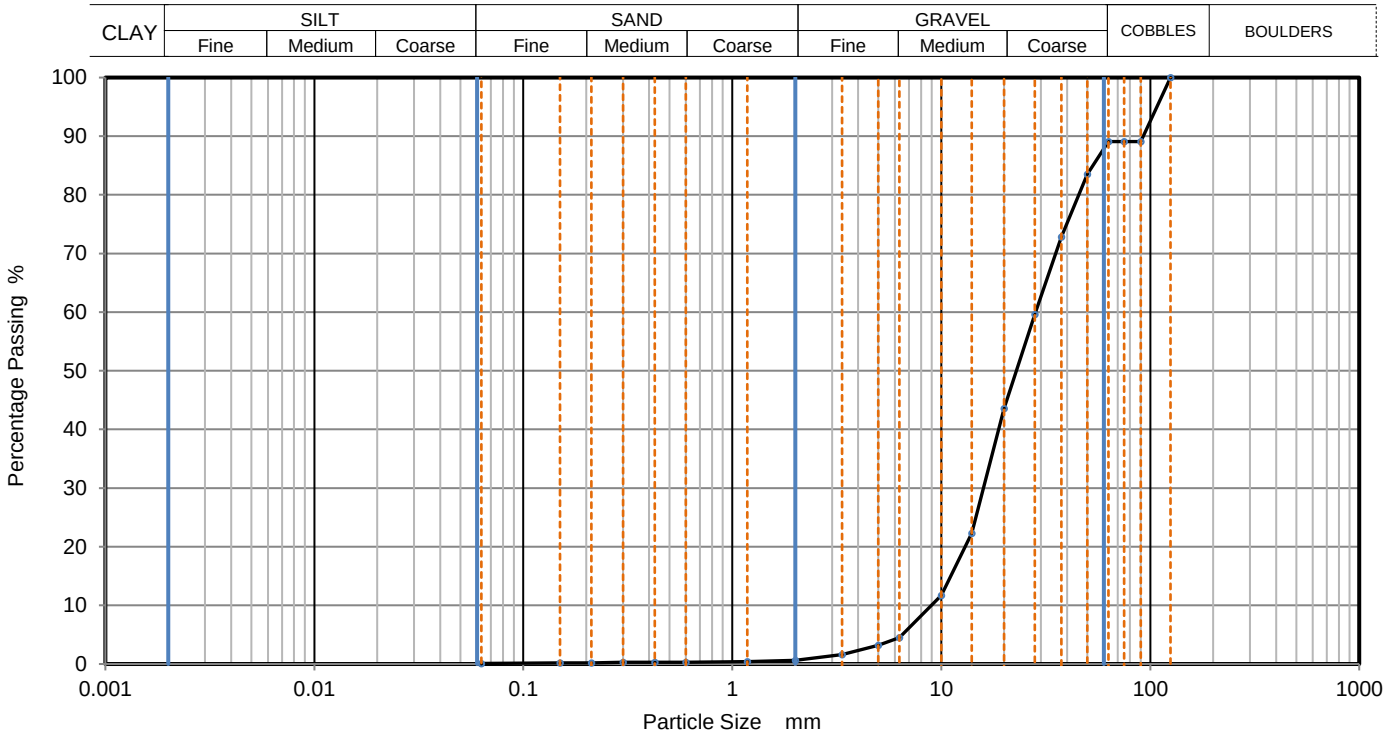
|---|
| Stephen.Watson |

| | | | | | |
|---|---|---|---|---|---|
| CAUSEWAY GEOTECH | **PARTICLE SIZE DISTRIBUTION** | | | Job Ref | **21-0553** |
| | | | | Borehole/Pit No. | BH07 |
| Site Name | Riverine Community Park, Lifford | | | Sample No. | 12 |
| Soil Description | Grey subangular fine to coarse GRAVEL. | | | Depth, m | 7.50 |
| Specimen Reference | 2 | Specimen Depth | 7.5 m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clause 9.2 | | | KeyLAB ID | Caus2021070659 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | | |
| 90 | 89 | | |
| 75 | 89 | | |
| 63 | 89 | | |
| 50 | 84 | | |
| 37.5 | 73 | | |
| 28 | 60 | | |
| 20 | 44 | | |
| 14 | 22 | | |
| 10 | 12 | | |
| 6.3 | 5 | | |
| 5 | 3 | | |
| 3.35 | 2 | | |
| 2 | 1 | | |
| 1.18 | 0 | | |
| 0.6 | 0 | | |
| 0.425 | 0 | | |
| 0.3 | 0 | | |
| 0.212 | 0 | | |
| 0.15 | 0 | | |
| 0.063 | 0 | | |

| | |
|---|---|
| Dry Mass of sample, g | 11208 |

| **Sample Proportions** | % dry mass |
|---|---|
| Cobbles | 10.9 |
| Gravel | 88.5 |
| Sand | 0.5 |
| | |
| Fines <0.063mm | 0.0 |

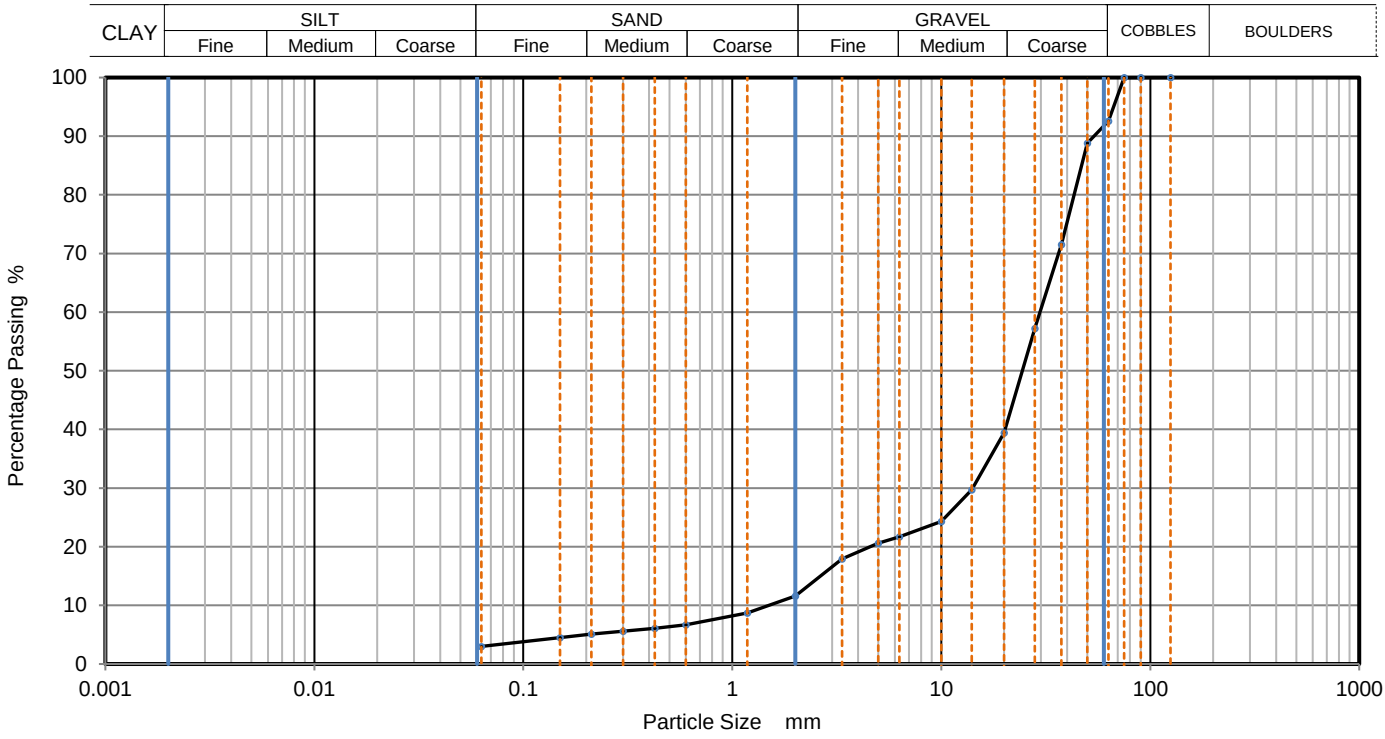
| **Grading Analysis** | | |
|---|---|---|
| D100 | mm | 125 |
| D60 | mm | 28.3 |
| D30 | mm | 15.9 |
| D10 | mm | 8.95 |
| Uniformity Coefficient | | 3.2 |
| Curvature Coefficient | | 1 |

Remarks

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

| |
|---|
| Approved |
| Stephen.Watson |

| CAUSEWAY GEOTECH | PARTICLE SIZE DISTRIBUTION | | | | Job Ref | 21-0553 |
|---|---|---|---|---|---|---|
| | | | | | Borehole/Pit No. | BH07 |
| Site Name | Riverine Community Park, Lifford | | | | Sample No. | 14 |
| Soil Description | Grey subangular fine to coarse GRAVEL. | | | | Depth, m | 10.50 |
| Specimen Reference | 3 | Specimen Depth | 10.5 | m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clause 9.2 | | | | KeyLAB ID | Caus2021070661 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | | |
| 90 | 100 | | |
| 75 | 100 | | |
| 63 | 93 | | |
| 50 | 89 | | |
| 37.5 | 72 | | |
| 28 | 57 | | |
| 20 | 39 | | |
| 14 | 30 | | |
| 10 | 24 | | |
| 6.3 | 22 | | |
| 5 | 21 | | |
| 3.35 | 18 | | |
| 2 | 12 | | |
| 1.18 | 9 | | |
| 0.6 | 7 | | |
| 0.425 | 6 | | |
| 0.3 | 6 | | |
| 0.212 | 5 | | |
| 0.15 | 5 | | |
| 0.063 | 3 | | |

| Dry Mass of sample, g | 9982 |
|---|---|

| Sample Proportions | % dry mass |
|---|---|
| Cobbles | 7.4 |
| Gravel | 80.9 |
| Sand | 8.6 |
| | |
| Fines <0.063mm | 3.0 |

| Grading Analysis | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 29.6 |
| D30 | mm | 14.2 |
| D10 | mm | 1.49 |
| Uniformity Coefficient | | 20 |
| Curvature Coefficient | | 4.6 |

Remarks

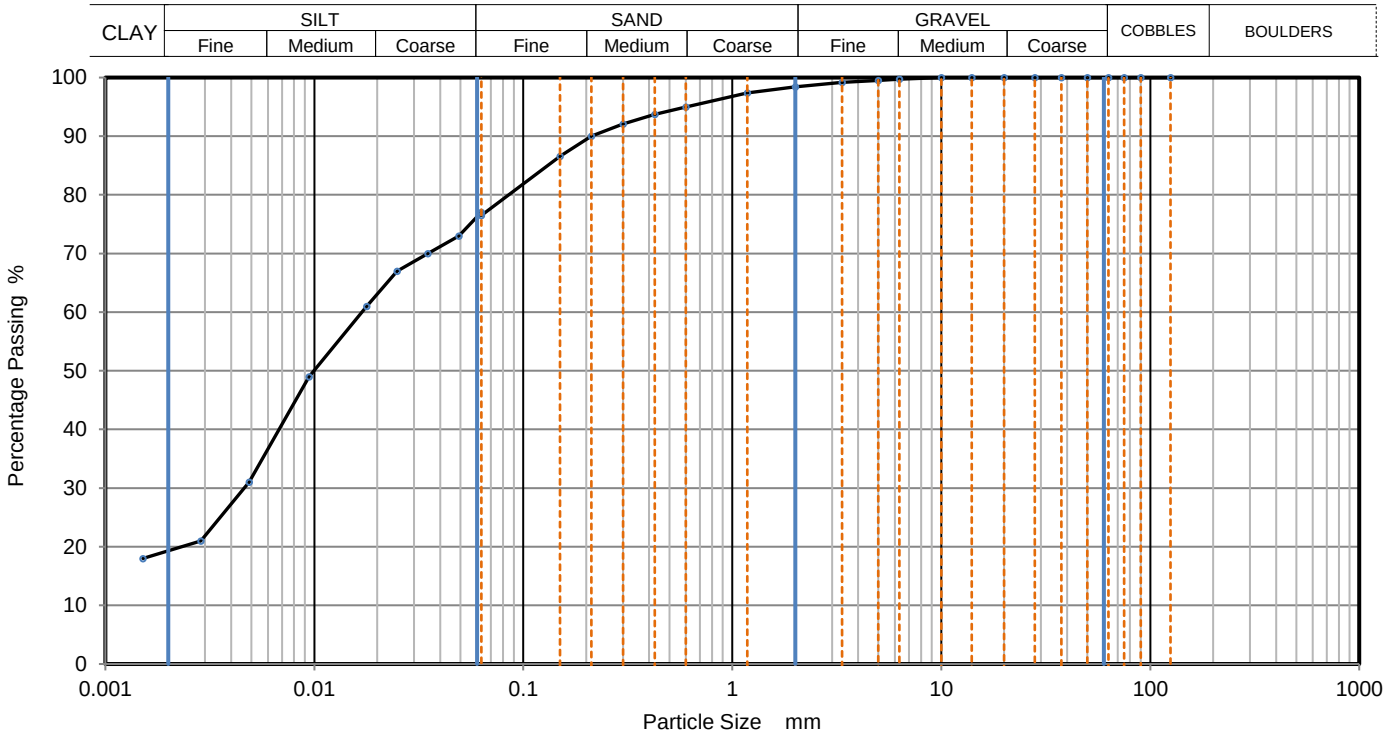
Preparation and testing in accordance with BS1377-2 :1990 unless noted below

| Approved |
|---|
| Stephen.Watson |



UKAS TESTING 10122

| CAUSEWAY GEOTECH | PARTICLE SIZE DISTRIBUTION | | | | Job Ref | 21-0553 |
|---|---|---|---|---|---|---|
| | | | | | Borehole/Pit No. | BH08 |
| Site Name | Riverine Community Park, Lifford | | | | Sample No. | 1 |
| Soil Description | Brown sandy clayey SILT. | | | | Depth, m | 0.50 |
| Specimen Reference | 2 | Specimen Depth | 0.5 | m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clauses 9.2 and 9.5 | | | | KeyLAB ID | Caus2021070662 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | 0.06300 | 77 |
| 90 | 100 | 0.04907 | 73 |
| 75 | 100 | 0.03492 | 70 |
| 63 | 100 | 0.02485 | 67 |
| 50 | 100 | 0.01780 | 61 |
| 37.5 | 100 | 0.00942 | 49 |
| 28 | 100 | 0.00487 | 31 |
| 20 | 100 | 0.00286 | 21 |
| 14 | 100 | 0.00151 | 18 |
| 10 | 100 | | |
| 6.3 | 100 | | |
| 5 | 100 | | |
| 3.35 | 99 | | |
| 2 | 98 | | |
| 1.18 | 97 | | |
| 0.6 | 95 | Particle density | (assumed) |
| 0.425 | 94 | 2.65 | Mg/m3 |
| 0.3 | 92 | | |
| 0.212 | 90 | | |
| 0.15 | 87 | | |
| 0.063 | 77 | | |

| Dry Mass of sample, g | 205 |
|---|---|

| Sample Proportions | % dry mass |
|---|---|
| Cobbles | 0.0 |
| Gravel | 1.6 |
| Sand | 21.9 |
| Silt | 56.8 |
| Clay | 19.7 |

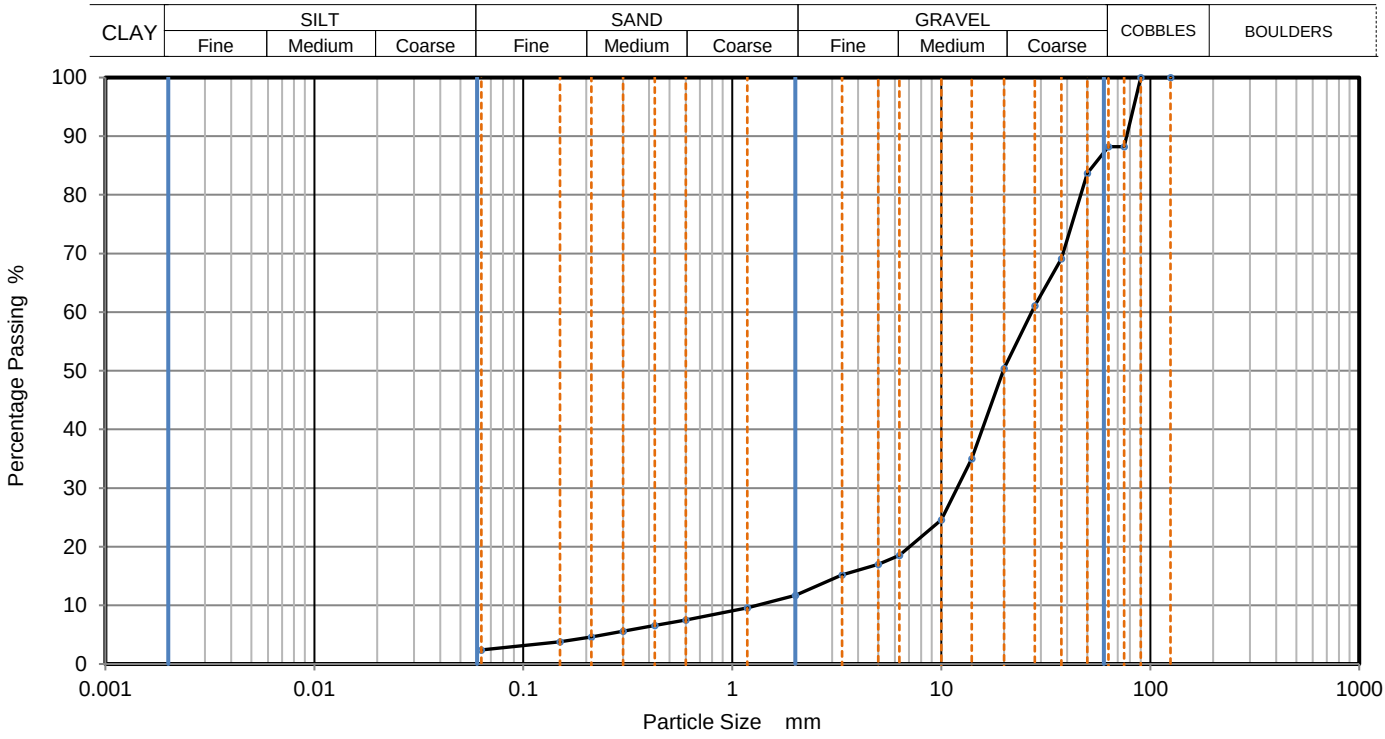
| Grading Analysis | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 0.0167 |
| D30 | mm | 0.00471 |
| D10 | mm | |
| Uniformity Coefficient | | |
| Curvature Coefficient | | |

Remarks

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

| Approved |
|---|
| Stephen.Watson |

| CAUSEWAY GEOTECH | PARTICLE SIZE DISTRIBUTION | | | | Job Ref | 21-0553 |
|---|---|---|---|---|---|---|
| | | | | | Borehole/Pit No. | BH08 |
| Site Name | Riverine Community Park, Lifford | | | | Sample No. | 4 |
| Soil Description | Greyish brown subangular fine to coarse GRAVEL. | | | | Depth, m | 3.00 |
| Specimen Reference | 2 | Specimen Depth | 3 | m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clause 9.2 | | | | KeyLAB ID | Caus2021070665 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | | |
| 90 | 100 | | |
| 75 | 88 | | |
| 63 | 88 | | |
| 50 | 84 | | |
| 37.5 | 69 | | |
| 28 | 61 | | |
| 20 | 50 | | |
| 14 | 35 | | |
| 10 | 25 | | |
| 6.3 | 19 | | |
| 5 | 17 | | |
| 3.35 | 15 | | |
| 2 | 12 | | |
| 1.18 | 10 | | |
| 0.6 | 8 | | |
| 0.425 | 7 | | |
| 0.3 | 6 | | |
| 0.212 | 5 | | |
| 0.15 | 4 | | |
| 0.063 | 2 | | |

| Dry Mass of sample, g | 10321 |
|---|---|

| Sample Proportions | % dry mass |
|---|---|
| Cobbles | 11.8 |
| Gravel | 76.5 |
| Sand | 9.2 |
| | |
| Fines <0.063mm | 2.0 |

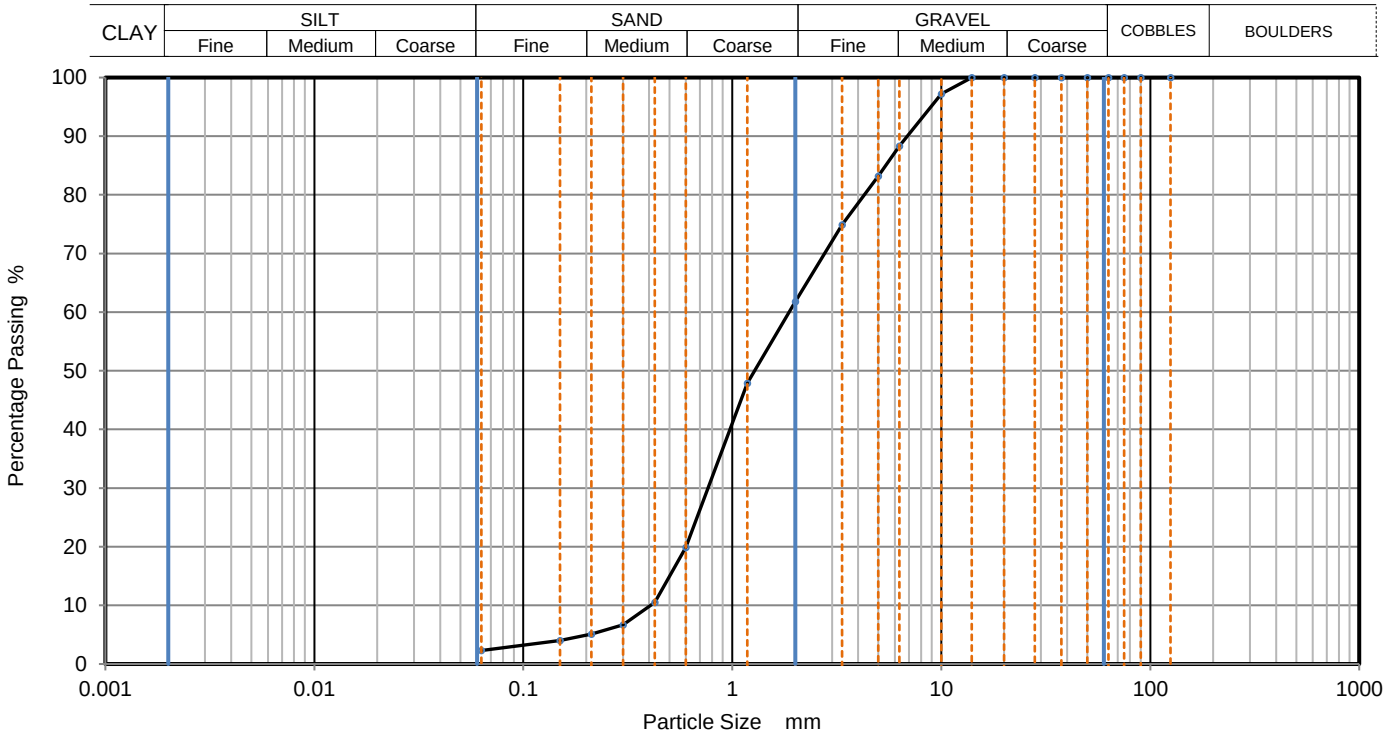
| Grading Analysis | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 27.1 |
| D30 | mm | 11.9 |
| D10 | mm | 1.3 |
| Uniformity Coefficient | | 21 |
| Curvature Coefficient | | 4 |

Remarks

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

| Approved |
|---|
| Stephen.Watson |

| CAUSEWAY GEOTECH | PARTICLE SIZE DISTRIBUTION | | | Job Ref | 21-0553 |
|---|---|---|---|---|---|
| | | | | Borehole/Pit No. | BH08 |
| Site Name | Riverine Community Park, Lifford | | | Sample No. | 12 |
| Soil Description | Greyish brown slightly gravelly fine to coarse SAND | | | Depth, m | 6.00 |
| Specimen Reference | 2 | Specimen Depth | 6 m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clause 9.2 | | | KeyLAB ID | Caus2021070668 |




| 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 | 100 | | |
| 10 | 97 | | |
| 6.3 | 88 | | |
| 5 | 83 | | |
| 3.35 | 75 | | |
| 2 | 62 | | |
| 1.18 | 48 | | |
| 0.6 | 20 | | |
| 0.425 | 11 | | |
| 0.3 | 7 | | |
| 0.212 | 5 | | |
| 0.15 | 4 | | |
| 0.063 | 2 | | |

| Dry Mass of sample, g | 1073 |
|---|---|

| Sample Proportions | % dry mass |
|---|---|
| Cobbles | 0.0 |
| Gravel | 38.2 |
| Sand | 59.5 |
| | |
| Fines <0.063mm | 2.0 |

| Grading Analysis | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 1.87 |
| D30 | mm | 0.765 |
| D10 | mm | 0.406 |
| Uniformity Coefficient | | 4.6 |
| Curvature Coefficient | | 0.77 |

Remarks

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

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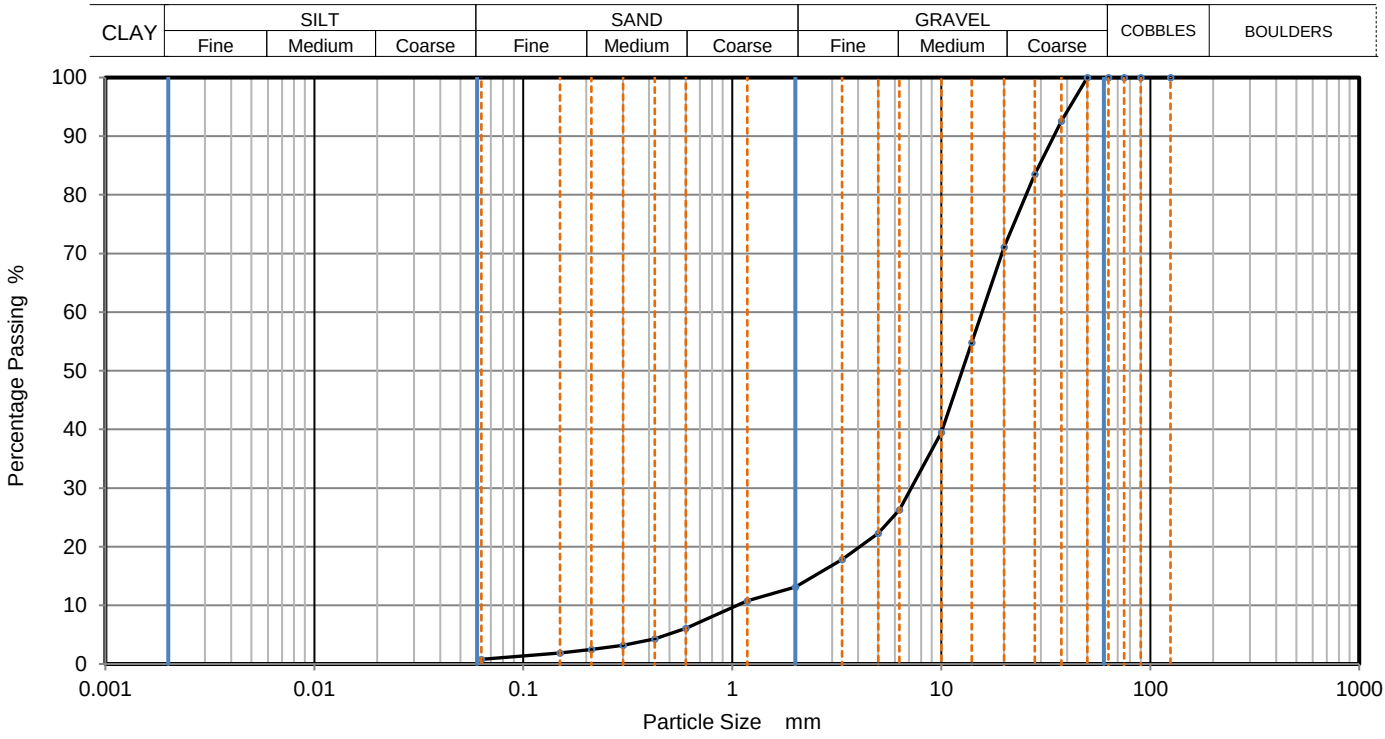
| CAUSEWAY GEOTECH | PARTICLE SIZE DISTRIBUTION | | | | Job Ref | 21-0553 |
|---|---|---|---|---|---|---|
| | | | | | Borehole/Pit No. | BH08 |
| Site Name | Riverine Community Park, Lifford | | | | Sample No. | 14 |
| Soil Description | Greyish brown slightly sandy subangular fine to coarse GRAVEL. | | | | Depth, m | 9.00 |
| Specimen Reference | 2 | Specimen Depth | 9 | m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clause 9.2 | | | | KeyLAB ID | Caus2021070670 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | | |
| 90 | 100 | | |
| 75 | 100 | | |
| 63 | 100 | | |
| 50 | 100 | | |
| 37.5 | 93 | | |
| 28 | 84 | | |
| 20 | 71 | | |
| 14 | 55 | | |
| 10 | 40 | | |
| 6.3 | 26 | | |
| 5 | 22 | | |
| 3.35 | 18 | | |
| 2 | 13 | | |
| 1.18 | 11 | | |
| 0.6 | 6 | | |
| 0.425 | 4 | | |
| 0.3 | 3 | | |
| 0.212 | 3 | | |
| 0.15 | 2 | | |
| 0.063 | 1 | | |

| Dry Mass of sample, g | 2598 |
|---|---|

| Sample Proportions | % dry mass |
|---|---|
| Cobbles | 0.0 |
| Gravel | 86.9 |
| Sand | 12.4 |
| | |
| Fines <0.063mm | 1.0 |

| Grading Analysis | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 15.7 |
| D30 | mm | 7.16 |
| D10 | mm | 1.05 |
| Uniformity Coefficient | | 15 |
| Curvature Coefficient | | 3.1 |

Remarks

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

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|---|
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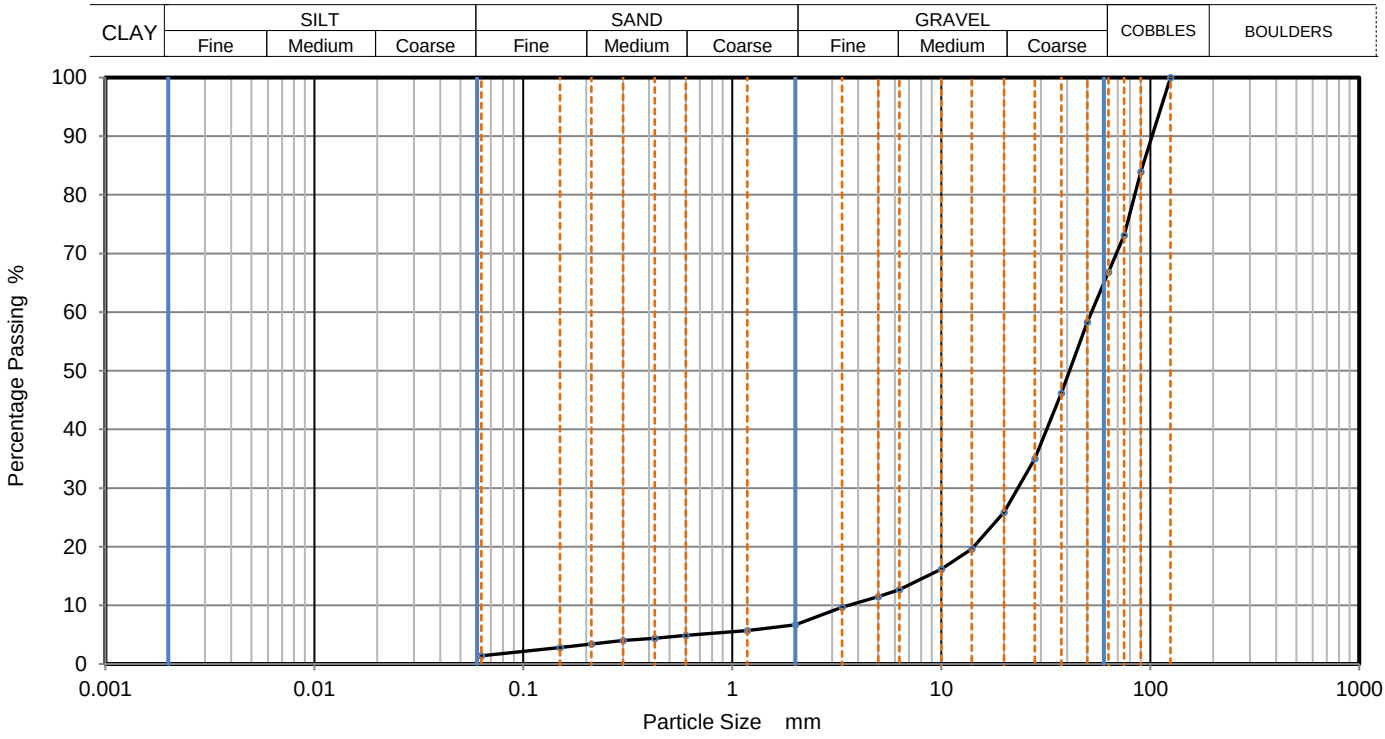
| | | | | | |
|---|---|---|---|---|---|
| CAUSEWAY GEOTECH | **PARTICLE SIZE DISTRIBUTION** | | | Job Ref | **21-0553** |
| | | | | Borehole/Pit No. | BH08 |
| Site Name | Riverine Community Park, Lifford | | | Sample No. | 16 |
| Soil Description | Greyish brown subangular fine to coarse GRAVEL. | | | Depth, m | 12.00 |
| Specimen Reference | 3 | Specimen Depth | 12 m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clause 9.2 | | | KeyLAB ID | Caus2021070672 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | | |
| 90 | 84 | | |
| 75 | 73 | | |
| 63 | 67 | | |
| 50 | 58 | | |
| 37.5 | 46 | | |
| 28 | 35 | | |
| 20 | 26 | | |
| 14 | 20 | | |
| 10 | 16 | | |
| 6.3 | 13 | | |
| 5 | 12 | | |
| 3.35 | 10 | | |
| 2 | 7 | | |
| 1.18 | 6 | | |
| 0.6 | 5 | | |
| 0.425 | 4 | | |
| 0.3 | 4 | | |
| 0.212 | 3 | | |
| 0.15 | 3 | | |
| 0.063 | 1 | | |

| | |
|---|---|
| Dry Mass of sample, g | 9146 |

| **Sample Proportions** | % dry mass |
|---|---|
| Cobbles | 33.2 |
| Gravel | 60.1 |
| Sand | 5.2 |
| | |
| Fines <0.063mm | 1.0 |

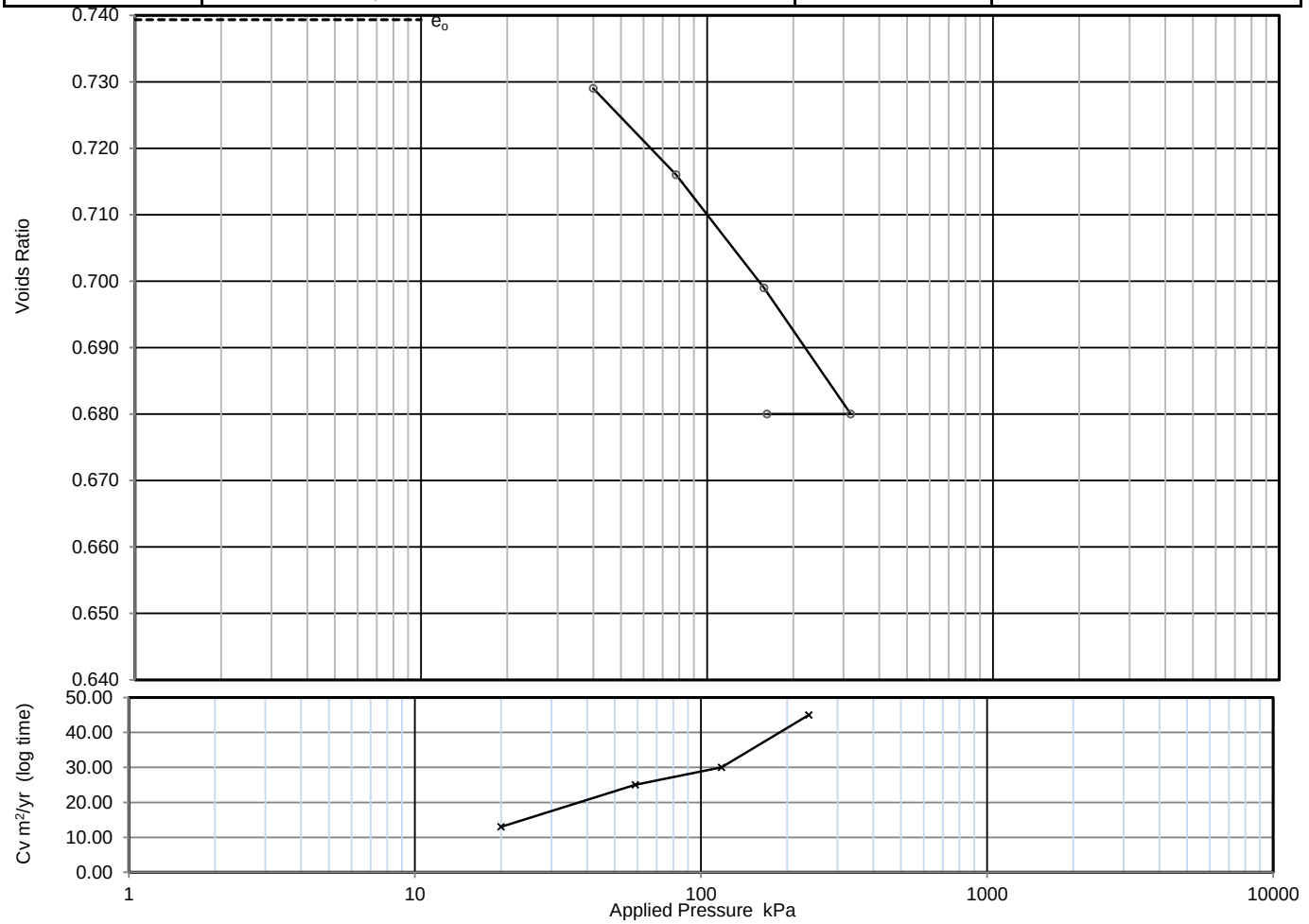
| **Grading Analysis** | | |
|---|---|---|
| D100 | mm | 125 |
| D60 | mm | 52.3 |
| D30 | mm | 23.3 |
| D10 | mm | 3.59 |
| Uniformity Coefficient | | 15 |
| Curvature Coefficient | | 2.9 |

Remarks

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

| |
|---|
| Approved |
| Stephen.Watson |

| CAUSEWAY GEOTECH | ONE DIMENSIONAL CONSOLIDATION TEST<br>BS1377:Part 5:1990, clause 3 | | | | Job Ref | 21-0553 |
|---|---|---|---|---|---|---|
| | | | | | Borehole/Pit No. | BH05 |
| Site Name | Riverine Community Park, Lifford | | | | Sample No. | 17 |
| Soil Description | Greyish brown sandy slightly gravelly silty CLAY. | | | | Depth | 2 |
| Specimen Reference | 3 | Specimen Depth | 2.05 | m | Sample Type | UT |
| Specimen Description | Greyish brown sandy slightly gravelly silty CLAY. | | | | KeyLAB ID | Caus2021070629 |
| Test Method | BS1377:Part 5:1990, clause 3 | | | | Date started | 23/07/2021 |




| Applied Pressure kPa | Voids ratio | Mv m2/MN | Cv ( t50, log ) m2/yr | Cv ( t90, root ) m2/yr | Csec |
|---|---|---|---|---|---|
| 0.0 | 0.739 | - | - | - | - |
| 40 | 0.729 | 0.15 | 13 | 13 | 0.00081 |
| 78 | 0.716 | 0.2 | 25 | | 0.00069 |
| 158 | 0.699 | 0.12 | 30 | | 0.00078 |
| 318 | 0.680 | 0.073 | 45 | | 0.00097 |
| 162 | 0.680 | 0.0012 | | | |
| | | | | | |
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| | | | | | |

Preparation

Index tests Liquid limit % Plastic limit %

Particle density assumed 2.65 Mg/m3

| Specimen details | Initial | Final | |
|---|---|---|---|
| Diameter | 75.06 | - | mm |
| Height | 19.82 | 19.14 | mm |
| Moisture Content | 28.6 | 27.4 | % |
| Bulk density | 1.96 | 2.01 | Mg/m3 |
| Dry density | 1.52 | 1.58 | Mg/m3 |
| Voids Ratio | 0.739 | 0.680 | |
| Saturation | 102 | 107 | % |
| Average temperature for test | | | oC |
| Swelling Pressure | | | kPa |
| Settlement on saturation | | | % |

Remarks

Final values should be used with caution

Cv plotted at mid point of load increments

Cv corrected to 20oC

Approved

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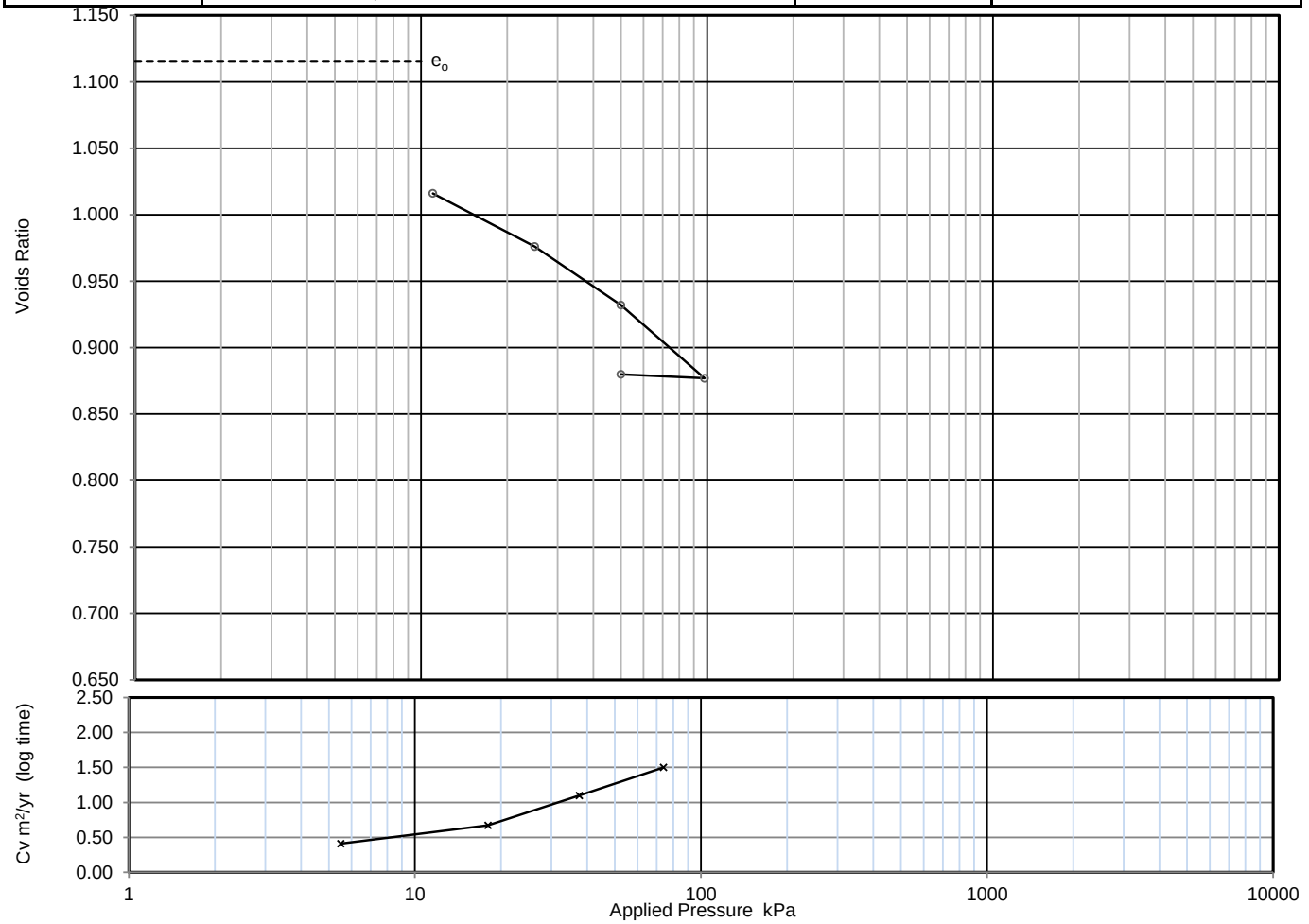
| CAUSEWAY GEOTECH | ONE DIMENSIONAL CONSOLIDATION TEST<br>BS1377:Part 5:1990, clause 3 | | | | Job Ref | 21-0553 |
|---|---|---|---|---|---|---|
| | | | | | Borehole/Pit No. | BH06 |
| Site Name | Riverine Community Park, Lifford | | | | Sample No. | 19 |
| Soil Description | Brown very sandy silty CLAY. | | | | Depth | 2 |
| Specimen Reference | 3 | Specimen Depth | 2.05 | m | Sample Type | U |
| Specimen Description | Brown very sandy silty CLAY. | | | | KeyLAB ID | Caus2021070644 |
| Test Method | BS1377:Part 5:1990, clause 3 | | | | Date started | 23/07/2021 |




| Applied Pressure kPa | Voids ratio | Mv m2/MN | Cv ( t50, log ) m2/yr | Cv ( t90, root ) m2/yr | Csec |
|---|---|---|---|---|---|
| 0.0 | 1.115 | - | - | - | - |
| 11 | 1.016 | 4.3 | 0.41 | 0.38 | 0.0047 |
| 25 | 0.976 | 1.4 | 0.67 | 0.79 | 0.0027 |
| 50 | 0.932 | 0.9 | 1.1 | 1.5 | 0.003 |
| 98 | 0.877 | 0.59 | 1.5 | 1.9 | 0.0026 |
| 50 | 0.880 | 0.033 | | | |
| | | | | | |
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| | | | | | |
| | | | | | |

Preparation

Index tests Liquid limit % Plastic limit %

Particle density assumed 2.65 Mg/m3

| Specimen details | Initial | Final | |
|---|---|---|---|
| Diameter | 75.10 | - | mm |
| Height | 20.00 | 17.77 | mm |
| Moisture Content | 43.3 | 35.1 | % |
| Bulk density | 1.80 | 1.90 | Mg/m3 |
| Dry density | 1.25 | 1.41 | Mg/m3 |
| Voids Ratio | 1.115 | 0.880 | |
| Saturation | 103 | 106 | % |
| Average temperature for test | | | oC |
| Swelling Pressure | | | kPa |
| Settlement on saturation | | | % |

Remarks

Final values should be used with caution

Cv plotted at mid point of load increments

Cv corrected to 20oC

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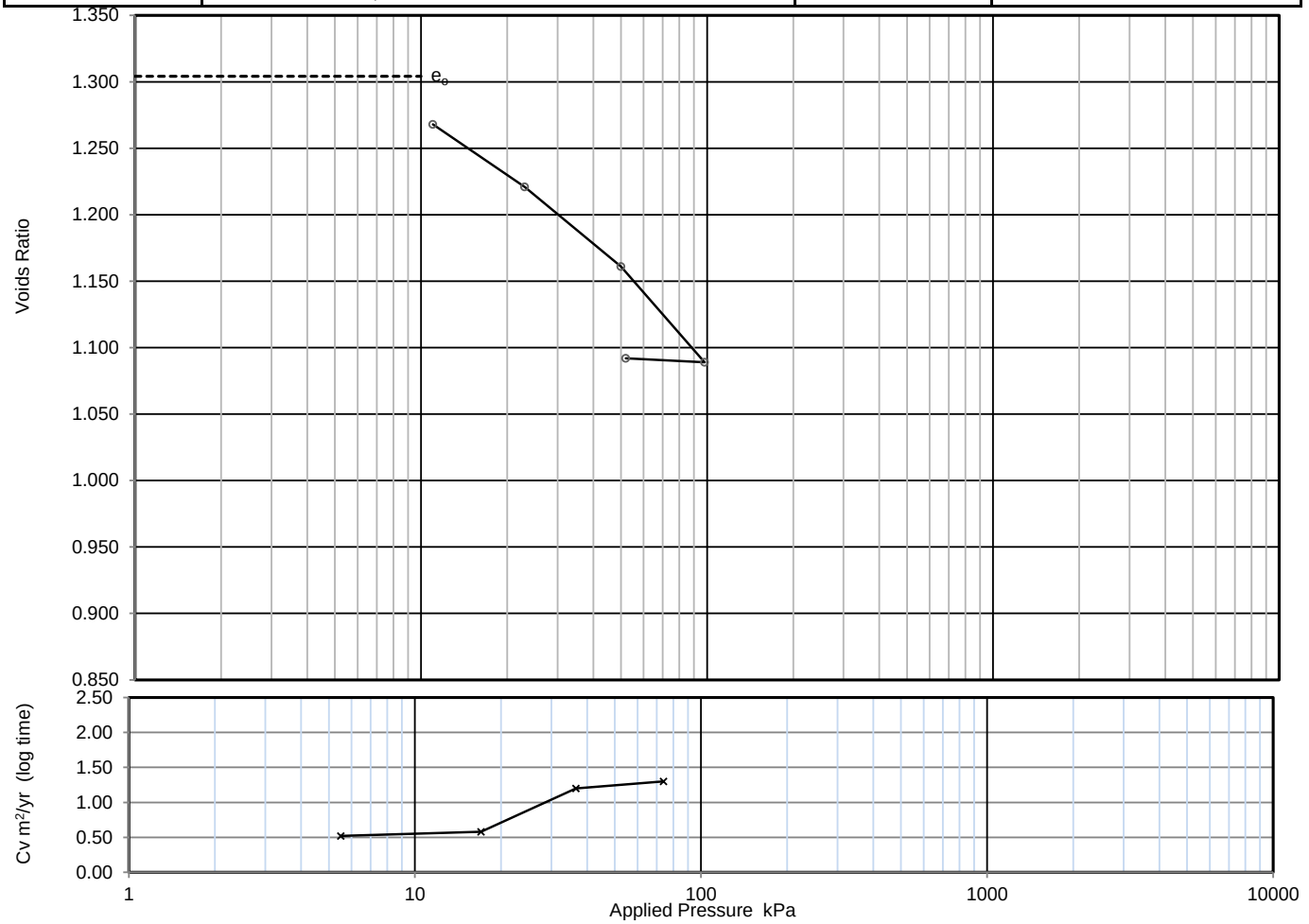
| CAUSEWAY GEOTECH | ONE DIMENSIONAL CONSOLIDATION TEST<br>BS1377:Part 5:1990, clause 3 | | | | Job Ref | 21-0553 |
|---|---|---|---|---|---|---|
| | | | | | Borehole/Pit No. | BH08 |
| Site Name | Riverine Community Park, Lifford | | | | Sample No. | 9 |
| Soil Description | Brown sandy clayey SILT. | | | | Depth | 1.2 |
| Specimen Reference | 3 | Specimen Depth | 1.25 | m | Sample Type | UT |
| Specimen Description | Brown sandy clayey SILT. | | | | KeyLAB ID | Caus2021070664 |
| Test Method | BS1377:Part 5:1990, clause 3 | | | | Date started | 26/07/2021 |




| Applied Pressure kPa | Voids ratio | Mv m2/MN | Cv ( t50, log ) m2/yr | Cv ( t90, root ) m2/yr | Csec |
|---|---|---|---|---|---|
| 0.0 | 1.304 | - | - | - | - |
| 11 | 1.268 | 1.4 | 0.52 | 0.78 | 0.0018 |
| 23 | 1.221 | 1.7 | 0.58 | 3.1 | 0.0022 |
| 50 | 1.161 | 1 | 1.2 | 6.1 | 0.0024 |
| 98 | 1.089 | 0.69 | 1.3 | 2.1 | 0.0017 |
| 52 | 1.092 | 0.032 | | | |

Preparation

Index tests Liquid limit % Plastic limit %

Particle density assumed 2.65 Mg/m3

| Specimen details | Initial | Final | |
|---|---|---|---|
| Diameter | 75.00 | - | mm |
| Height | 19.75 | 17.93 | mm |
| Moisture Content | 51.4 | 45.4 | % |
| Bulk density | 1.74 | 1.84 | Mg/m3 |
| Dry density | 1.15 | 1.27 | Mg/m3 |
| Voids Ratio | 1.304 | 1.092 | |
| Saturation | 104 | 110 | % |
| Average temperature for test | | | oC |
| Swelling Pressure | | | kPa |
| Settlement on saturation | | | % |

Remarks

Final values should be used with caution

Cv plotted at mid point of load increments

Cv corrected to 20oC

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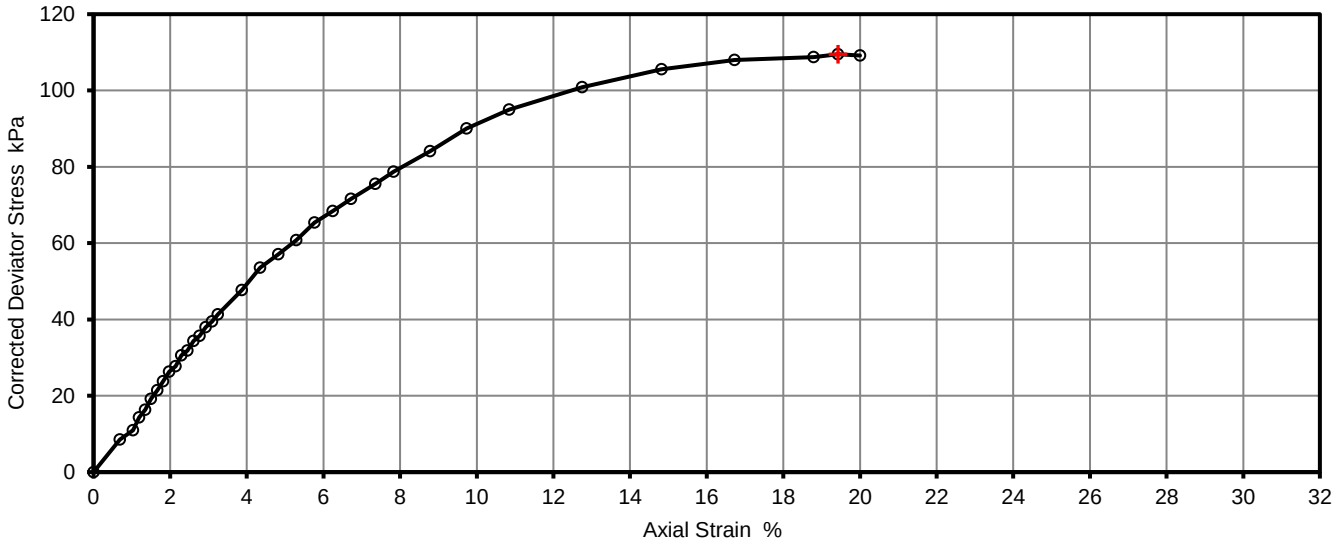
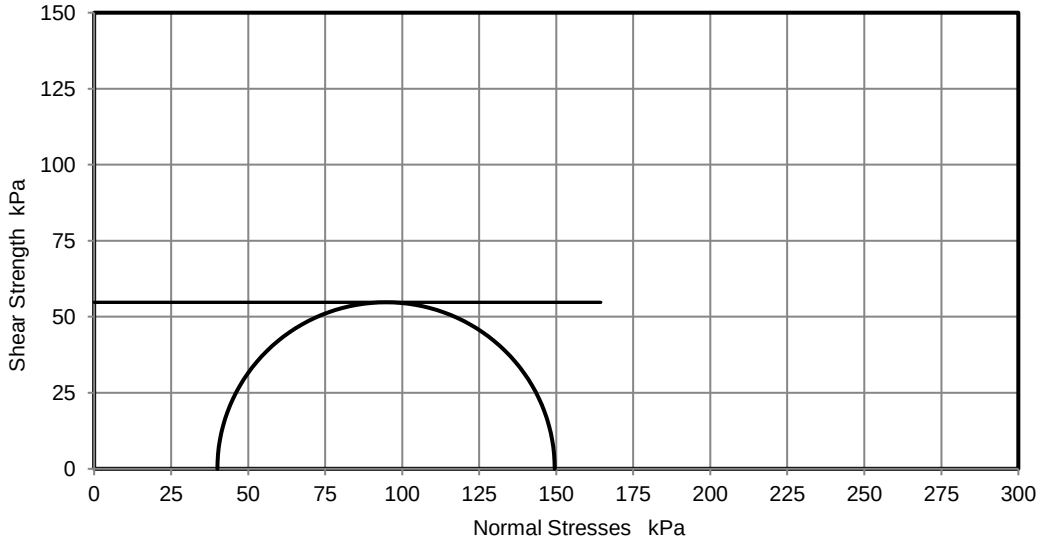
| | | | | | |
|---|---|---|---|---|---|
| CAUSEWAY GEOTECH | **Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen** | | | Job Ref | 21-0553 |
| | | | | Borehole/Pit No. | BH05 |
| Site Name | Riverine Community Park, Lifford | | | Sample No. | 17 |
| Soil Description | Greyish brown sandy slightly gravelly silty CLAY. | | | Depth | 2.00 |
| Specimen Reference | 4 | Specimen Depth | 2.05 m | Sample Type | UT |
| Specimen Description | Firm greyish brown sandy slightly gravelly silty CLAY. | | | KeyLAB ID | Caus2021070629 |
| Test Method | BS1377 : Part 7 : 1990, clause 8, single specimen | | | Date of test | 23/07/2021 |

| | | | |
|---|---|---|---|
| Test Number | | 1 | |
| Length | | 209.5 | mm |
| Diameter | | 104.5 | mm |
| Bulk Density | | 1.99 | Mg/m3 |
| Moisture Content | | 22.4 | % |
| Dry Density | | 1.63 | Mg/m3 |
| Rate of Strain | | 2.0 | %/min |
| Cell Pressure | | 40 | kPa |
| At failure | Axial Strain | 19.4 | % |
| | Deviator Stress, ( σ1 - σ3 )f | 110 | kPa |
| | Undrained Shear Strength, cu | 55 | kPa ½( σ1 - σ3 )f |
| | Mode of Failure | Plastic | |

**Deviator Stress v Axial Strain**




**Mohr Circles**




Deviator stress corrected for area change and membrane effects

Mohr circles and their interpretation is not covered by BS1377.
This is provided for information only.

**Remarks**

| Approved | Printed |
|---|---|
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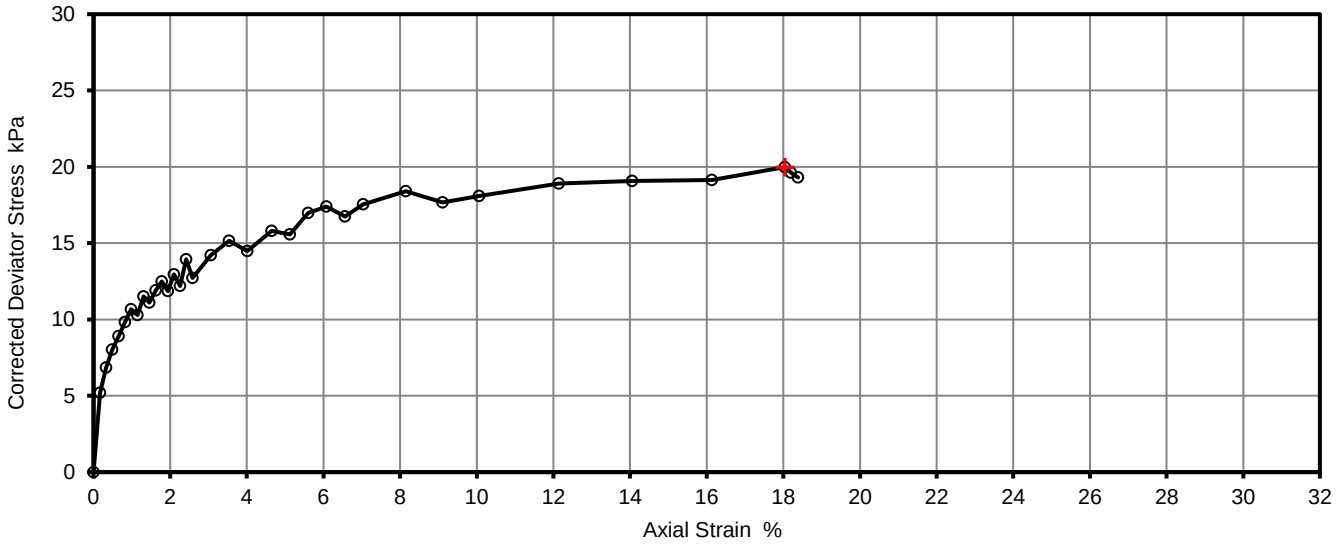
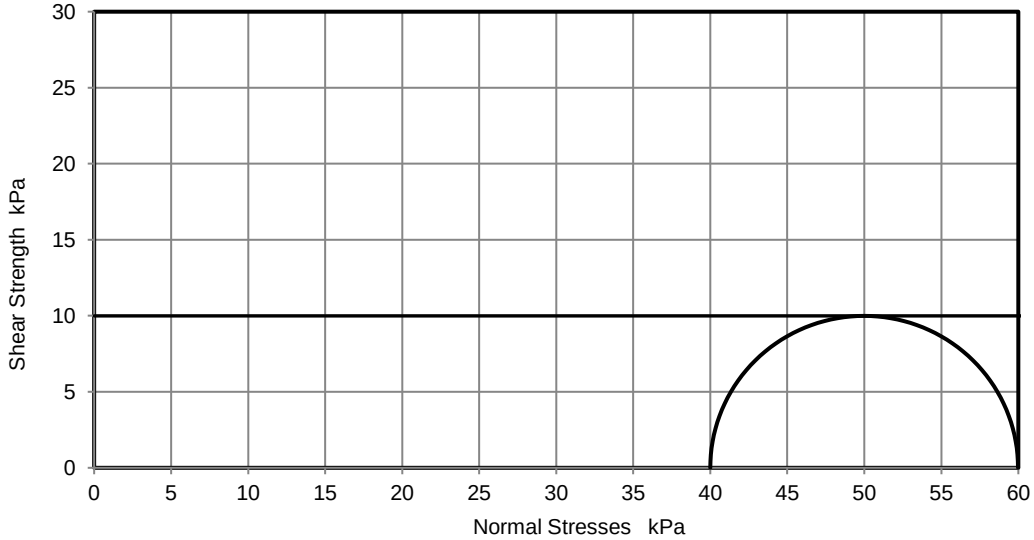
| | | | | | |
|---|---|---|---|---|---|
| CAUSEWAY GEOTECH | **Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen** | | | Job Ref | 21-0553 |
| | | | | Borehole/Pit No. | BH06 |
| Site Name | Riverine Community Park, Lifford | | | Sample No. | 19 |
| Soil Description | Brown very sandy silty CLAY. | | | Depth | 2.00 |
| Specimen Reference | 4 | Specimen Depth | 2.05 m | Sample Type | U |
| Specimen Description | Very soft brown very sandy silty CLAY. | | | KeyLAB ID | Caus2021070644 |
| Test Method | BS1377 : Part 7 : 1990, clause 8, single specimen | | | Date of test | 23/07/2021 |

| | | | |
|---|---|---|---|
| Test Number | | 1 | |
| Length | | 209.0 | mm |
| Diameter | | 104.9 | mm |
| Bulk Density | | 1.90 | Mg/m3 |
| Moisture Content | | 42.8 | % |
| Dry Density | | 1.33 | Mg/m3 |
| Rate of Strain | | 2.0 | %/min |
| Cell Pressure | | 40 | kPa |
| At failure | Axial Strain | 18.0 | % |
| | Deviator Stress, ( σ1 - σ3 )f | 20 | kPa |
| | Undrained Shear Strength, cu | 10 | kPa ½( σ1 - σ3 )f |
| | Mode of Failure | Plastic | |

**Deviator Stress v Axial Strain**




**Mohr Circles**




Deviator stress corrected for area change and membrane effects

Mohr circles and their interpretation is not covered by BS1377.
This is provided for information only.

**Remarks**

| Approved | Printed |
|---|---|
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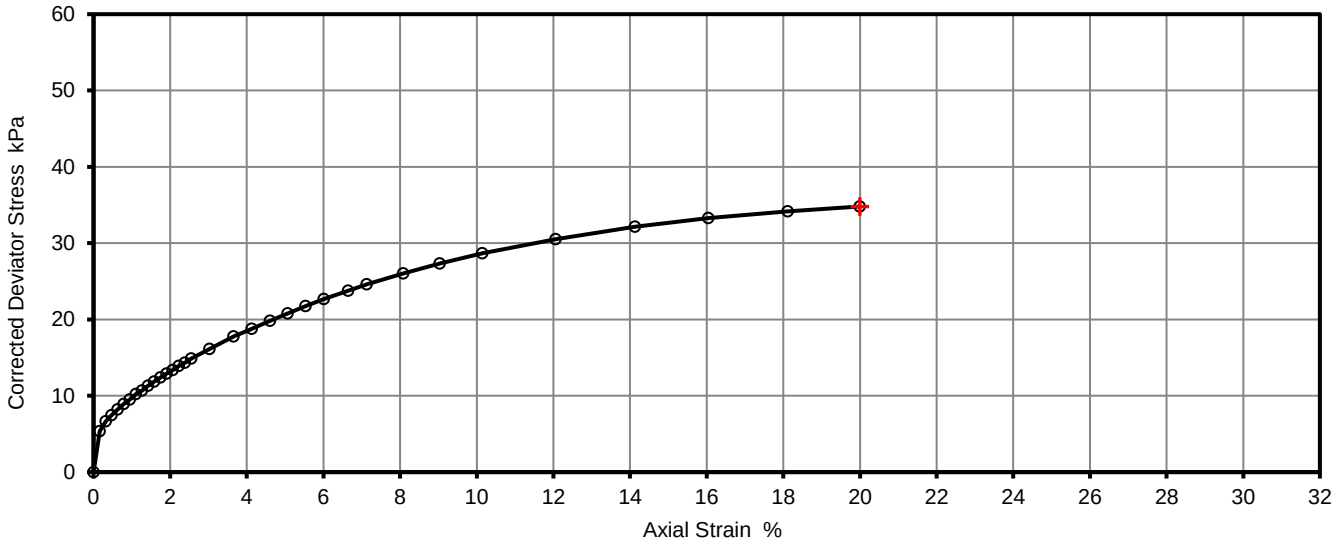
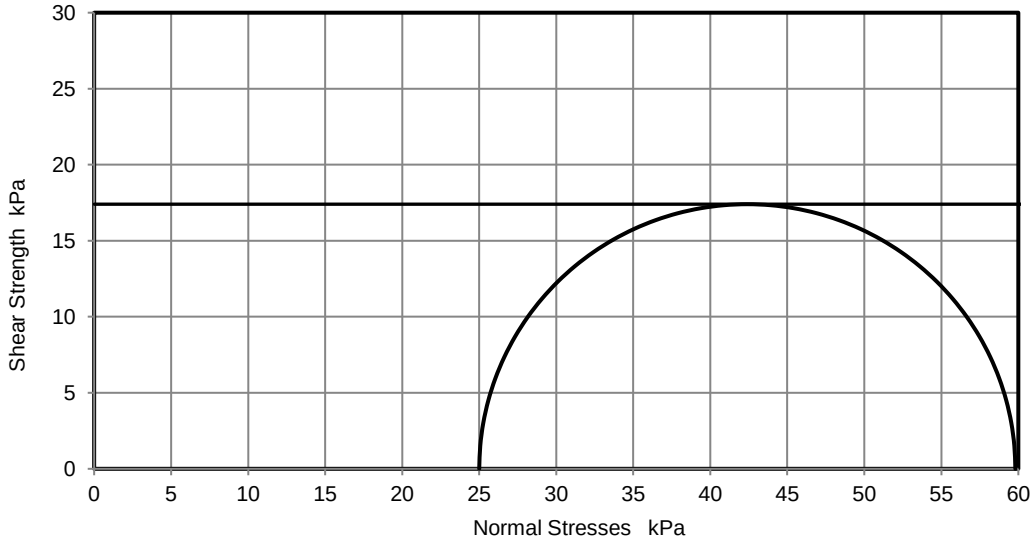
| | | | | | |
|---|---|---|---|---|---|
| CAUSEWAY GEOTECH | **Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen** | | | Job Ref | 21-0553 |
| | | | | Borehole/Pit No. | BH08 |
| Site Name | Riverine Community Park, Lifford | | | Sample No. | 9 |
| Soil Description | Brown sandy clayey SILT. | | | Depth | 1.20 |
| Specimen Reference | 4 | Specimen Depth | 1.25 m | Sample Type | UT |
| Specimen Description | Very soft brown sandy clayey SILT. | | | KeyLAB ID | Caus2021070664 |
| Test Method | BS1377 : Part 7 : 1990, clause 8, single specimen | | | Date of test | 23/07/2021 |

| | | | |
|---|---|---|---|
| Test Number | | 1 | |
| Length | | 209.1 | mm |
| Diameter | | 104.6 | mm |
| Bulk Density | | 1.70 | Mg/m3 |
| Moisture Content | | 53.0 | % |
| Dry Density | | 1.11 | Mg/m3 |
| Rate of Strain | | 2.0 | %/min |
| Cell Pressure | | 25 | kPa |
| At failure | Axial Strain | 20.0 | % |
| | Deviator Stress, ( σ1 - σ3 )f | 35 | kPa |
| | Undrained Shear Strength, cu | 17 | kPa ½( σ1 - σ3 )f |
| | Mode of Failure | | |

**Deviator Stress v Axial Strain**




**Mohr Circles**




Deviator stress corrected for area change and membrane effects

Mohr circles and their interpretation is not covered by BS1377.
This is provided for information only.

**Remarks**

No failure defined. Testing terminated at 20% axial strain.

Approved: Stephen.Watson

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| Direct Shear Test BS EN ISO 17892-10:2018 | | | | | |
|---|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | | |
| Location Number | BH02 | Sample Reference | | B6 | |
| Depth (m) | 5.00 | Sample Submerged? | | Yes | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | | 2.65 | Assumed |
| Description | Brown sandy silty subangular fine to coarse GRAVEL. | | | | |
| Sample Preparation | Sample is recompacted using material passing 2mm test sieve | | | | |

| Stage | 1 | 2 | 3 |
|---|---|---|---|
| **Initial Conditions** | | | |
| Height (mm) | 20.0 | 20.0 | 20.0 |
| Diameter (mm) | 60.0 | 60.0 | 60.0 |
| Water Content (%) | 12.0 | 12.0 | 12.0 |
| Bulk Density (Mg/m$^3$) | 1.74 | 1.75 | 1.79 |
| Dry Density (Mg/m$^3$) | 1.56 | 1.57 | 1.60 |
| Voids Ratio | 0.703 | 0.689 | 0.654 |
| **Consolidation** | | | |
| Normal Pressure (kPa) | 50 | 100 | 200 |
| Vertical Displacement (mm) | 0.268 | 0.195 | 0.705 |
| **Shearing** | | | |
| Rate of Strain (mm/min) | 0.600 | 0.600 | 0.600 |
| Peak Shear Stress (kPa) | 48.9 | 95.0 | 182.5 |
| Hoz Displacement (mm) | 10.2 | 10.2 | 10.2 |
| Hoz Displacement at Peak Shear Stress (mm) | 2.403 | 2.223 | 3.057 |
| **Final Conditions** | | | |
| Water Content (%) | 21.0 | 20.0 | 20.0 |
| Dry Density (Mg/m$^3$) | 1.56 | 1.56 | 1.71 |
| Voids Ratio | 0.698 | 0.679 | 0.591 |

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|---|---|
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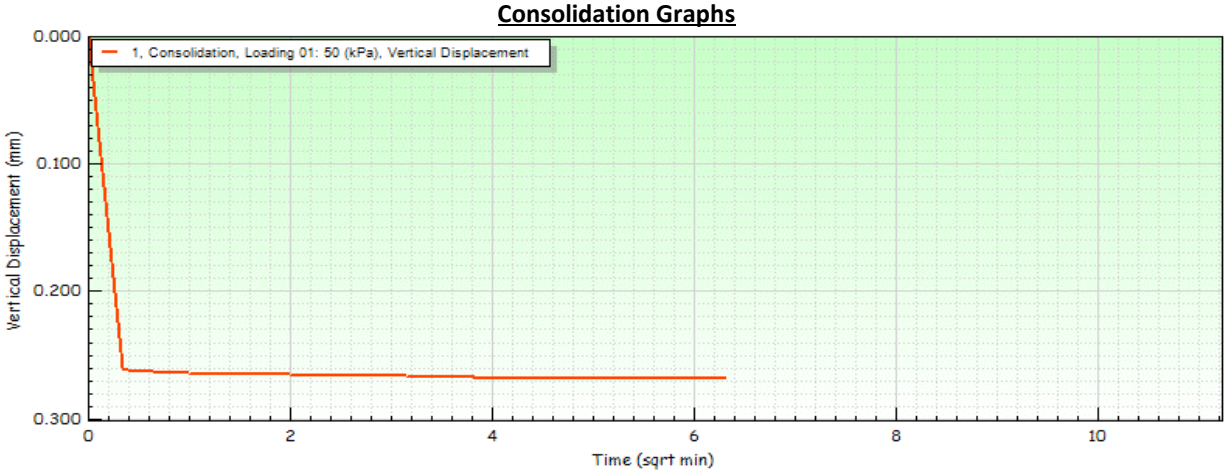
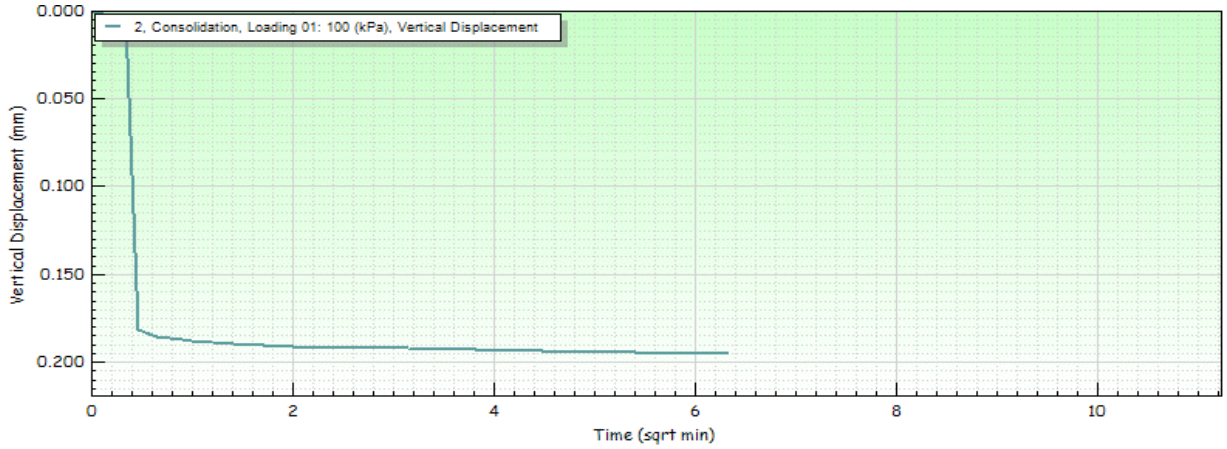
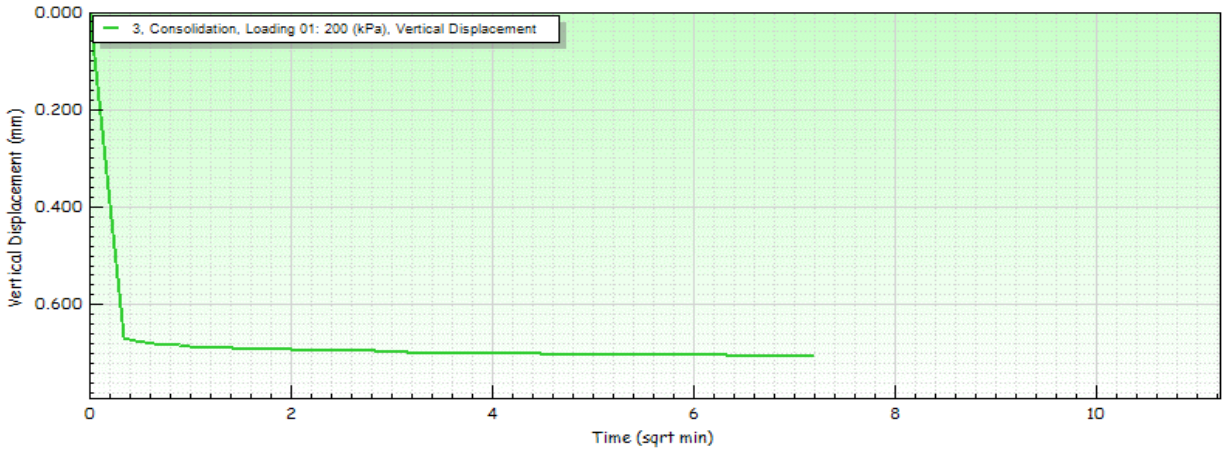
| Direct Shear Test BS EN ISO 17892-10:2018 | | | | |
|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | |
| Location Number | BH02 | Sample Reference | B6 | |
| Depth (m) | 5.00 | Sample Submerged? | Yes | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | 2.65 | Assumed |

**Consolidation Graphs**

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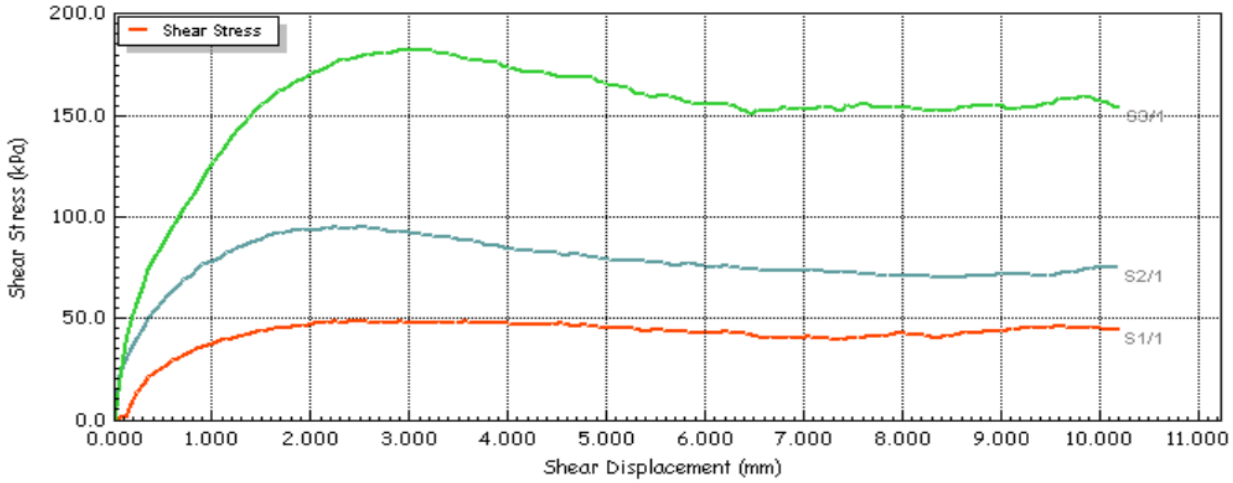
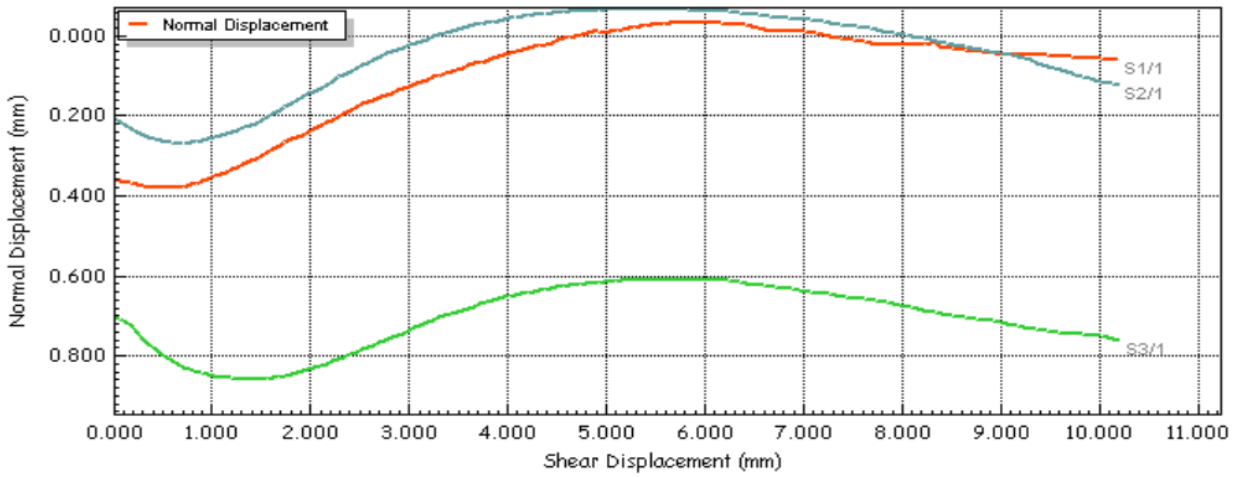
| Direct Shear Test BS EN ISO 17892-10:2018 | | | | |
|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | |
| Location Number | BH02 | Sample Reference | B6 | |
| Depth (m) | 5.00 | Sample Submerged? | Yes | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | 2.65 | Assumed |

**Shear Stage**

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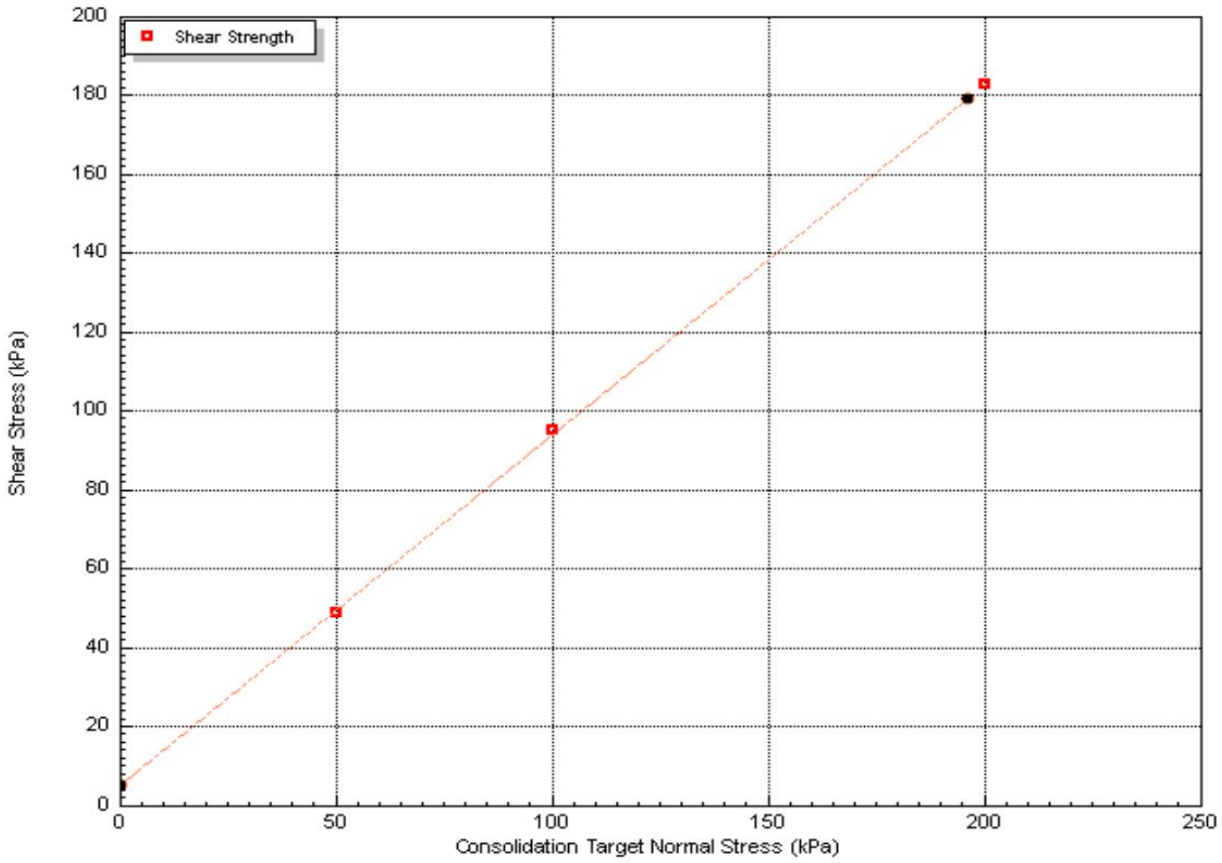
| Direct Shear Test BS EN ISO 17892-10:2018 | | | | |
|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | |
| Location Number | BH02 | Sample Reference | B6 | |
| Depth (m) | 5.00 | Sample Submerged? | 4 | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | 2.65 | Assumed |

| Stage | 1 | 2 | 3 |
|---|---|---|---|
| **Envelope Failure Results** | | | |
| Apparent Cohesion (kPa) | 5 | | |
| Angle of Shearing Resistance (°) | 41.5 | | |

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| Direct Shear Test BS EN ISO 17892-10:2018 | | | | | |
|---|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | | |
| Location Number | BH02 | Sample Reference | | B17 | |
| Depth (m) | 9.00 | Sample Submerged? | | Yes | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | | 2.65 | Assumed |
| Description | Brown sandy silty subangular fine to coarse GRAVEL. | | | | |
| Sample Preparation | Sample is recompacted using material passing 2mm test sieve | | | | |

| Stage | 1 | 2 | 3 |
|---|---|---|---|
| **Initial Conditions** | | | |
| Height (mm) | 20.0 | 20.0 | 20.0 |
| Diameter (mm) | 60.0 | 60.0 | 60.0 |
| Water Content (%) | 14.0 | 14.0 | 14.0 |
| Bulk Density (Mg/m$^3$) | 1.73 | 1.73 | 1.77 |
| Dry Density (Mg/m$^3$) | 1.51 | 1.51 | 1.55 |
| Voids Ratio | 0.755 | 0.752 | 0.715 |
| **Consolidation** | | | |
| Normal Pressure (kPa) | 90 | 180 | 360 |
| Vertical Displacement (mm) | 0.485 | 0.688 | 0.606 |
| **Shearing** | | | |
| Rate of Strain (mm/min) | 0.600 | 0.600 | 0.600 |
| Peak Shear Stress (kPa) | 74.5 | 178.3 | 283.2 |
| Hoz Displacement (mm) | 10.2 | 10.2 | 10.2 |
| Hoz Displacement at Peak Shear Stress (mm) | 1.918 | 2.223 | 2.763 |
| **Final Conditions** | | | |
| Water Content (%) | 23.0 | 22.0 | 22.0 |
| Dry Density (Mg/m$^3$) | 1.57 | 1.62 | 1.66 |
| Voids Ratio | 0.722 | 0.698 | 0.639 |

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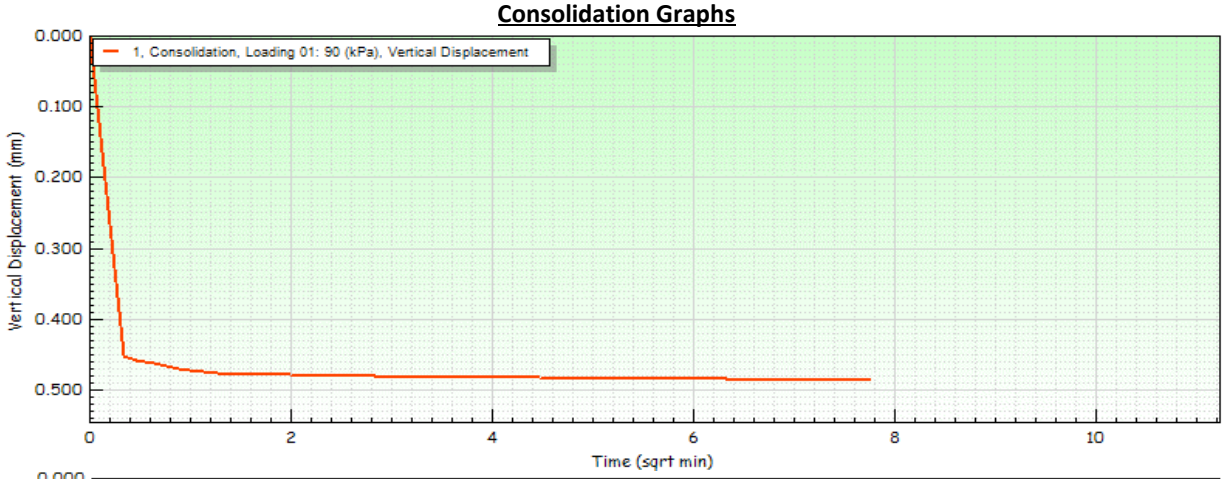
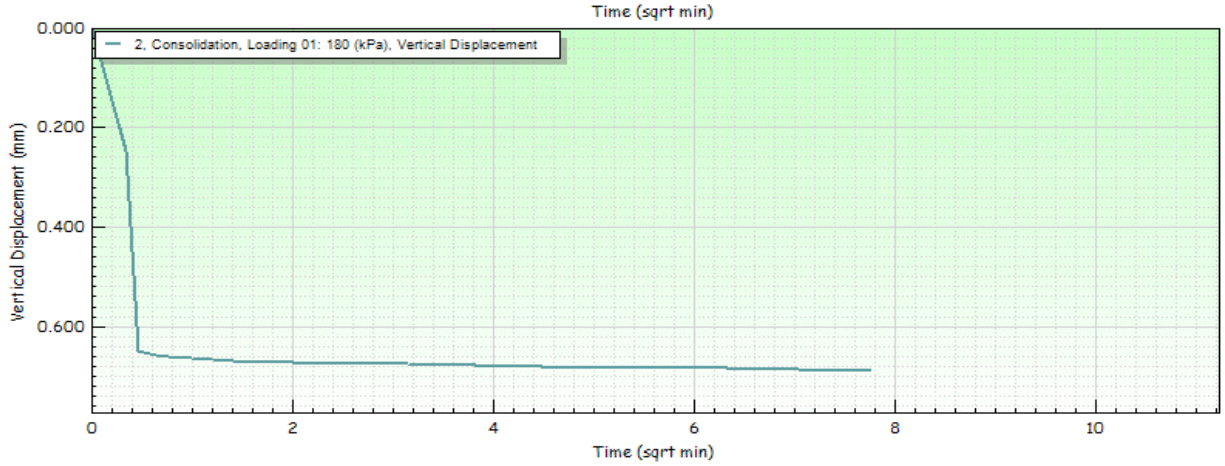
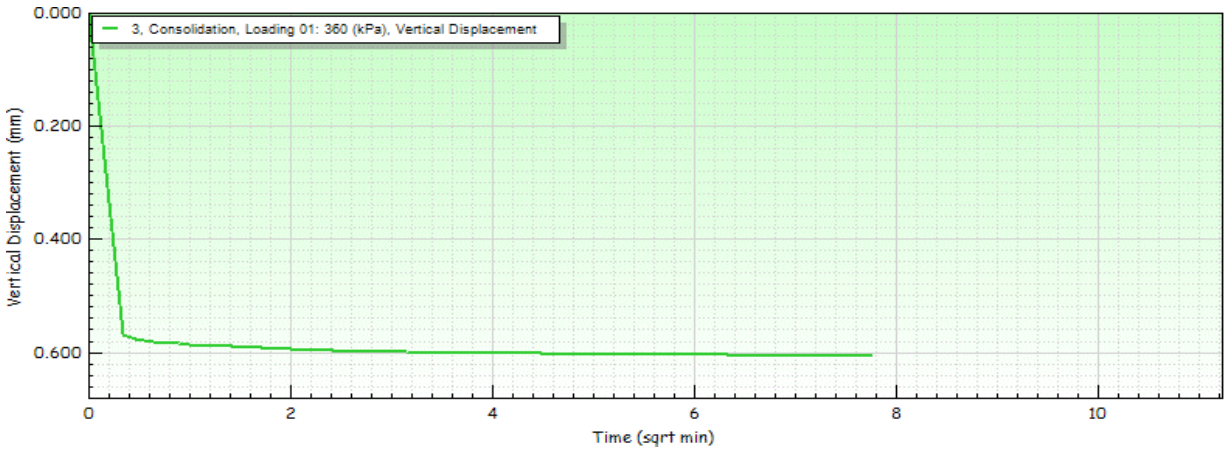
| Direct Shear Test BS EN ISO 17892-10:2018 | | | | |
|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | |
| Location Number | BH02 | Sample Reference | B17 | |
| Depth (m) | 9.00 | Sample Submerged? | Yes | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | 2.65 | Assumed |

**Consolidation Graphs**




| | Tested | Approved |
|---|---|---|
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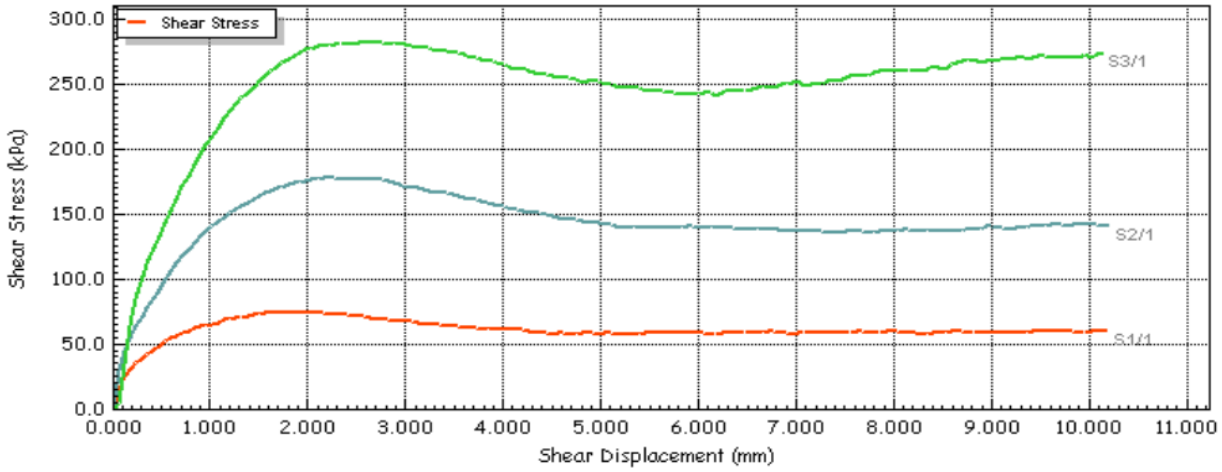
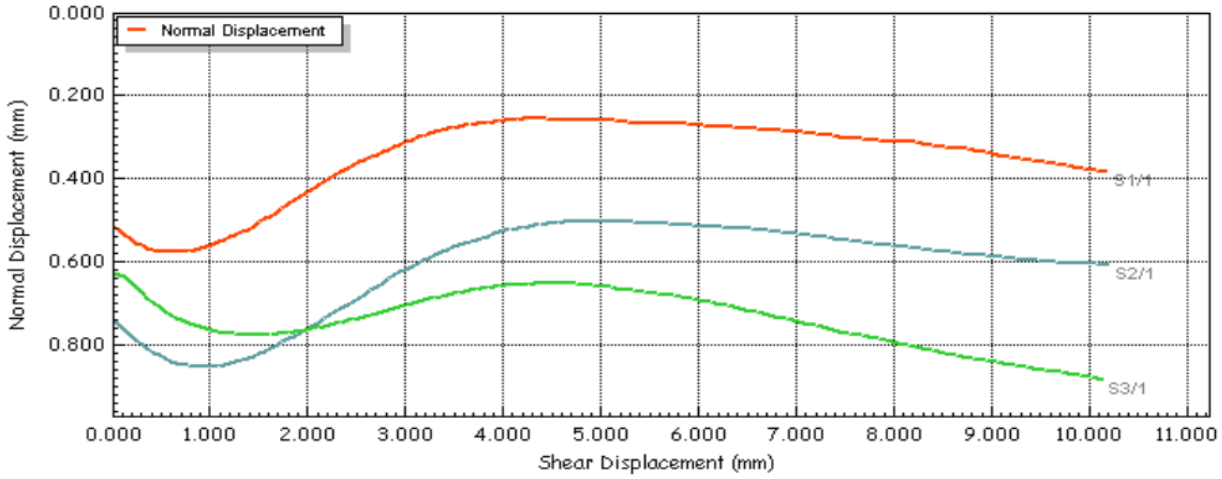
| Direct Shear Test BS EN ISO 17892-10:2018 | | | | |
|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | |
| Location Number | BH02 | Sample Reference | B17 | |
| Depth (m) | 9.00 | Sample Submerged? | Yes | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | 2.65 | Assumed |

**Shear Stage**

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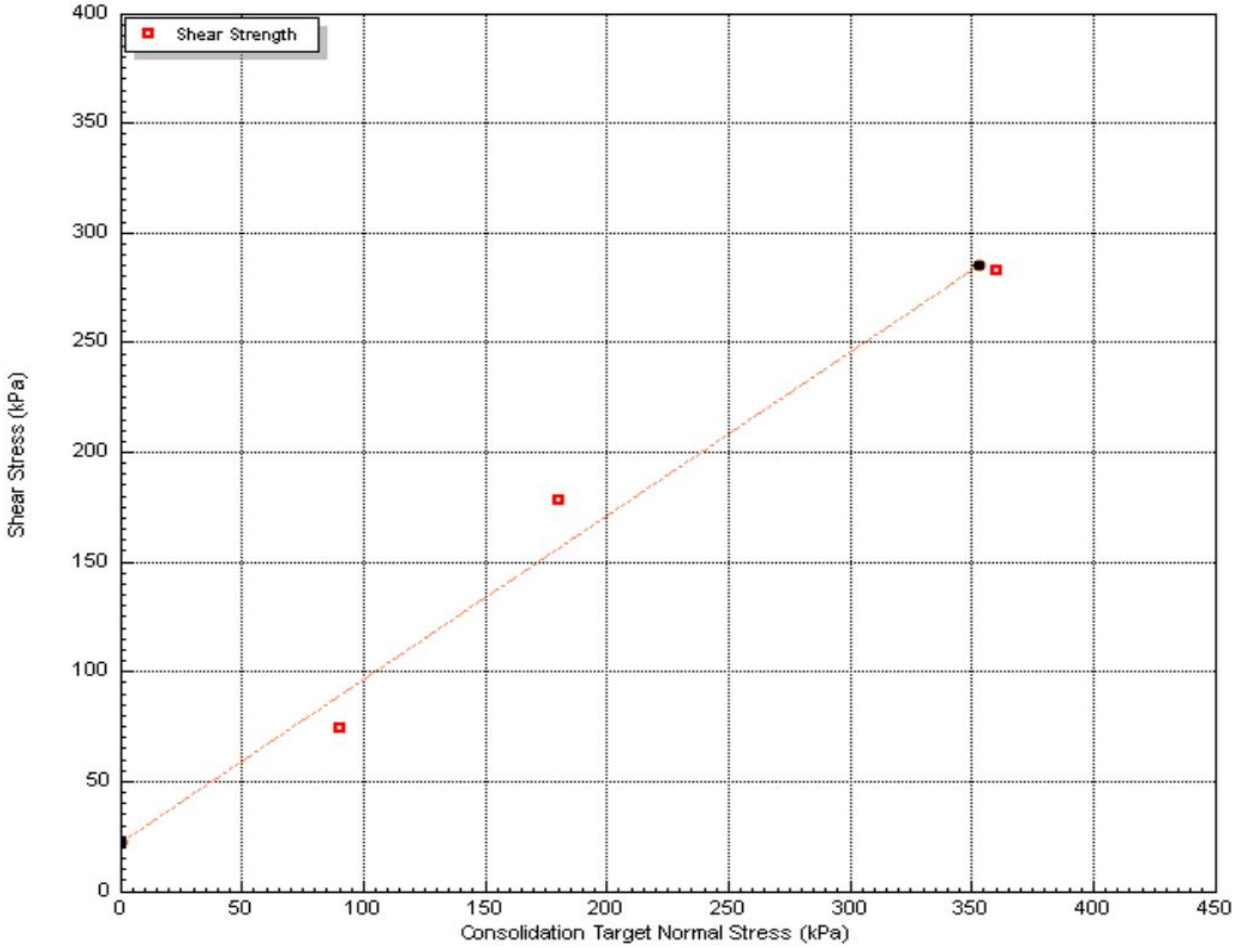
| Direct Shear Test BS EN ISO 17892-10:2018 | | | | |
|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | |
| Location Number | BH02 | Sample Reference | B17 | |
| Depth (m) | 9.00 | Sample Submerged? | 4 | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | 2.65 | Assumed |

| Stage | 1 | 2 | 3 |
|---|---|---|---|
| **Envelope Failure Results** | | | |
| Apparent Cohesion (kPa) | 22 | | |
| Angle of Shearing Resistance (°) | 36.5 | | |

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| Direct Shear Test BS EN ISO 17892-10:2018 | | | | | |
|---|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | | |
| Location Number | BH05 | Sample Reference | | B7 | |
| Depth (m) | 6.00 | Sample Submerged? | | Yes | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | | 2.65 | Assumed |
| Description | Brown sandy subangular fine to coarse GRAVEL. | | | | |
| Sample Preparation | Sample is recompacted using material passing 2mm test sieve | | | | |

| Stage | 1 | 2 | 3 |
|---|---|---|---|
| **Initial Conditions** | | | |
| Height (mm) | 20.0 | 20.0 | 20.0 |
| Diameter (mm) | 60.0 | 60.0 | 60.0 |
| Water Content (%) | 7.0 | 7.0 | 7.0 |
| Bulk Density (Mg/m$^3$) | 1.63 | 1.61 | 1.59 |
| Dry Density (Mg/m$^3$) | 1.52 | 1.50 | 1.48 |
| Voids Ratio | 0.744 | 0.765 | 0.785 |
| **Consolidation** | | | |
| Normal Pressure (kPa) | 60 | 120 | 240 |
| Vertical Displacement (mm) | 0.443 | 0.406 | 0.570 |
| **Shearing** | | | |
| Rate of Strain (mm/min) | 0.600 | 0.600 | 0.600 |
| Peak Shear Stress (kPa) | 71.9 | 103.5 | 214.2 |
| Hoz Displacement (mm) | 10.2 | 10.2 | 10.2 |
| Hoz Displacement at Peak Shear Stress (mm) | 3.063 | 2.823 | 4.138 |
| **Final Conditions** | | | |
| Water Content (%) | 20.0 | 22.0 | 22.0 |
| Dry Density (Mg/m$^3$) | 1.52 | 1.52 | 1.57 |
| Voids Ratio | 0.729 | 0.722 | 0.694 |

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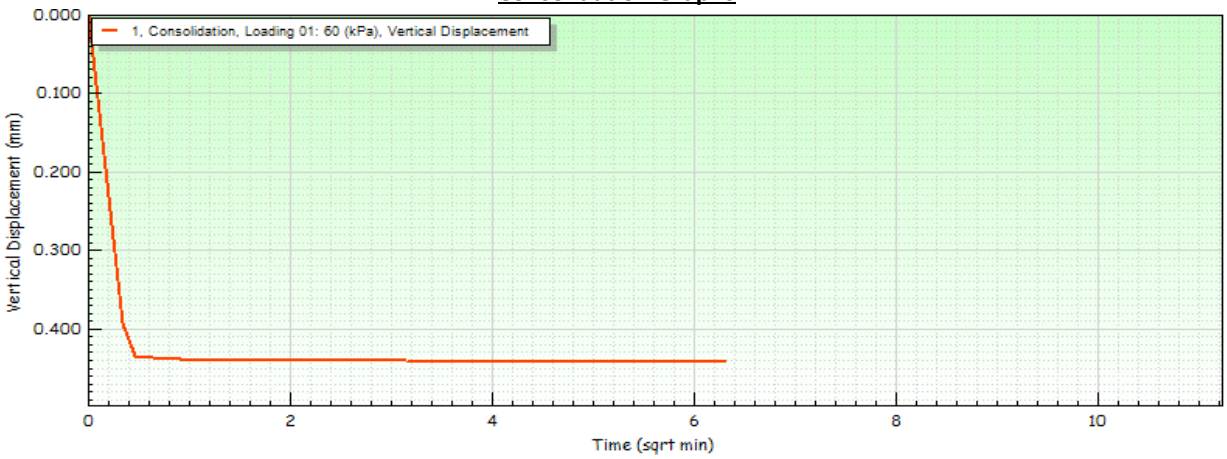
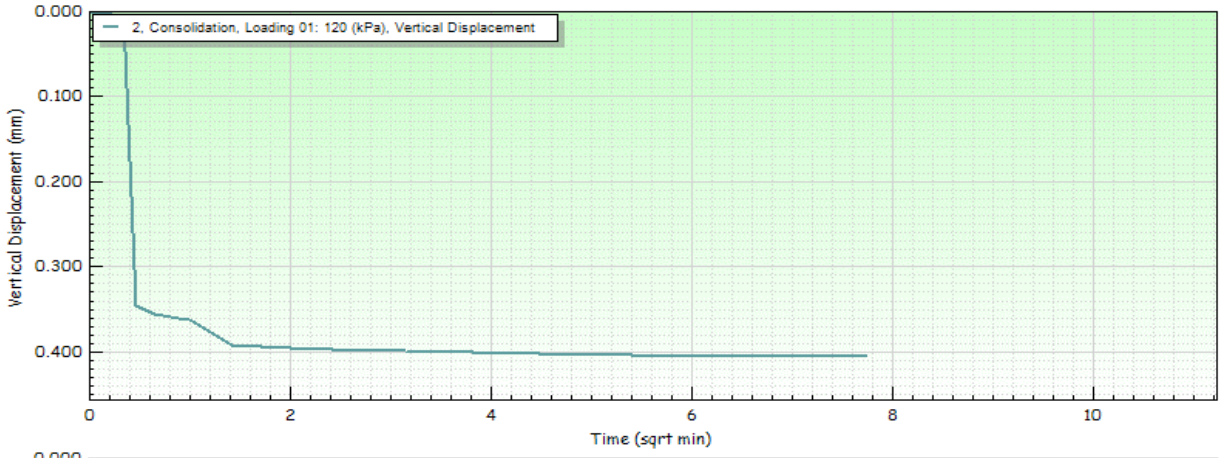
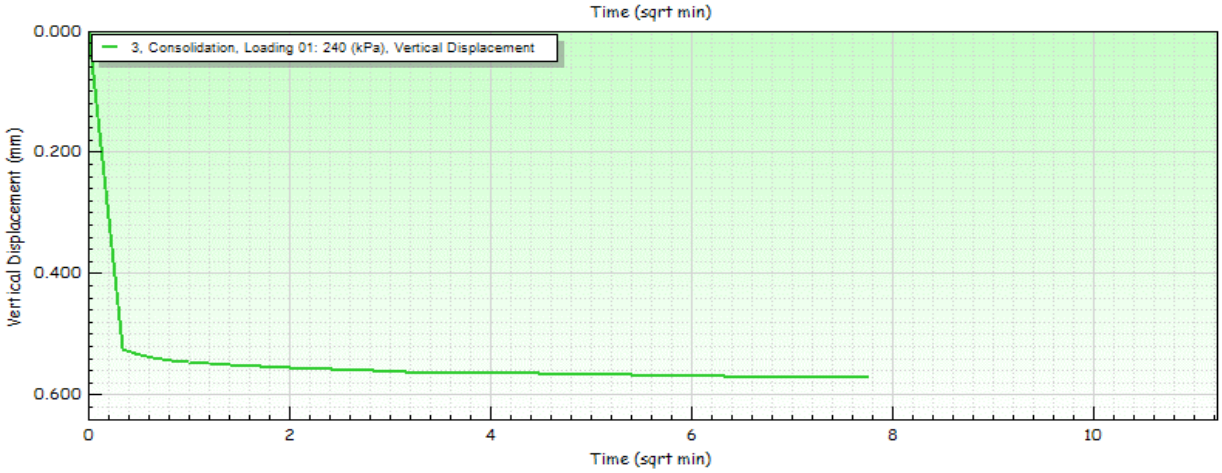
|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | |
| Location Number | BH05 | Sample Reference | B7 | |
| Depth (m) | 6.00 | Sample Submerged? | Yes | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | 2.65 | Assumed |

**Consolidation Graphs**

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|---|---|---|
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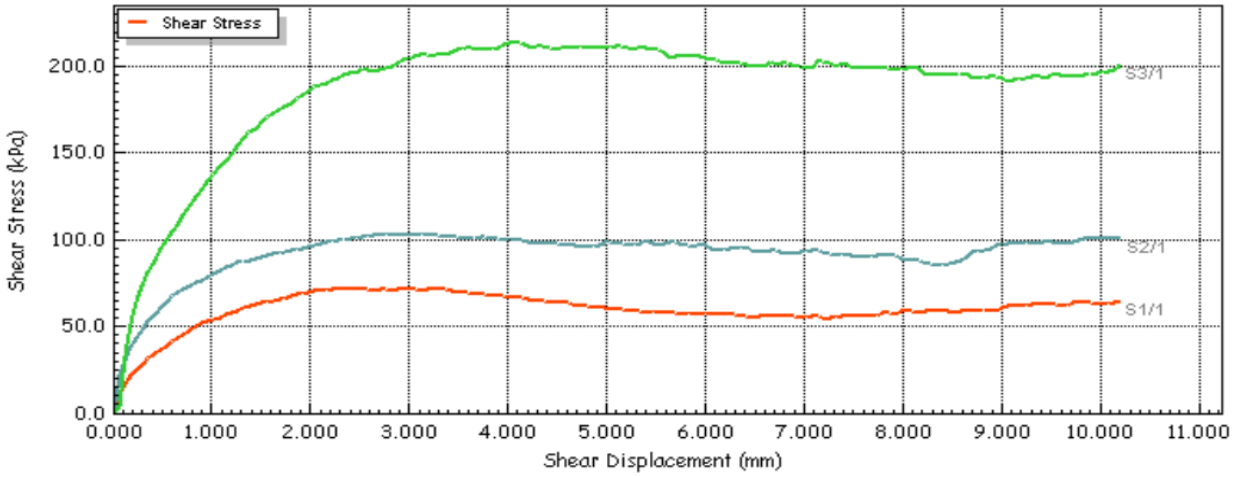
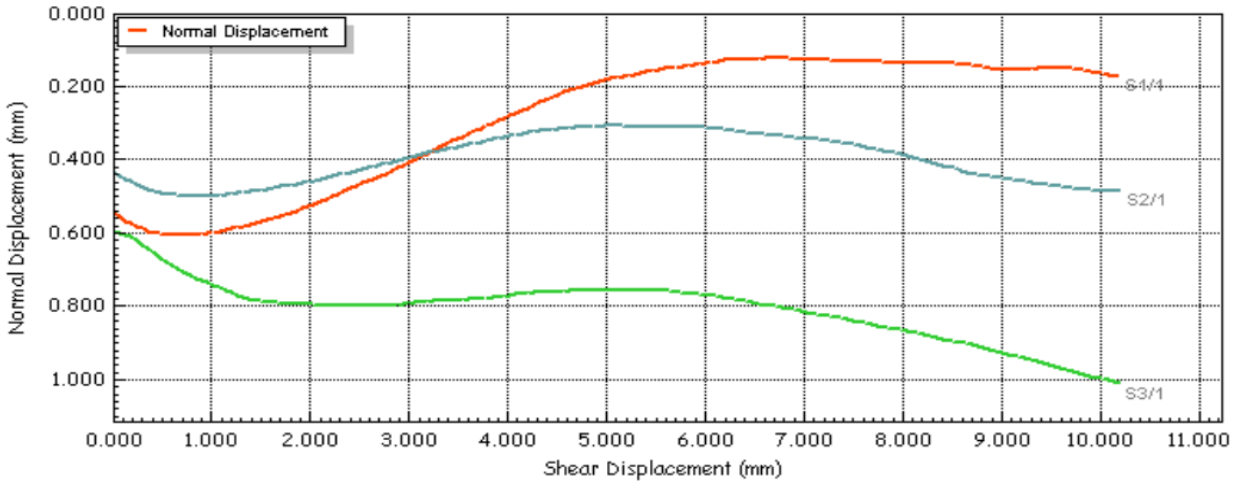
| Direct Shear Test BS EN ISO 17892-10:2018 | | | | |
|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | |
| Location Number | BH05 | Sample Reference | B7 | |
| Depth (m) | 6.00 | Sample Submerged? | Yes | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | 2.65 | Assumed |

**Shear Stage**

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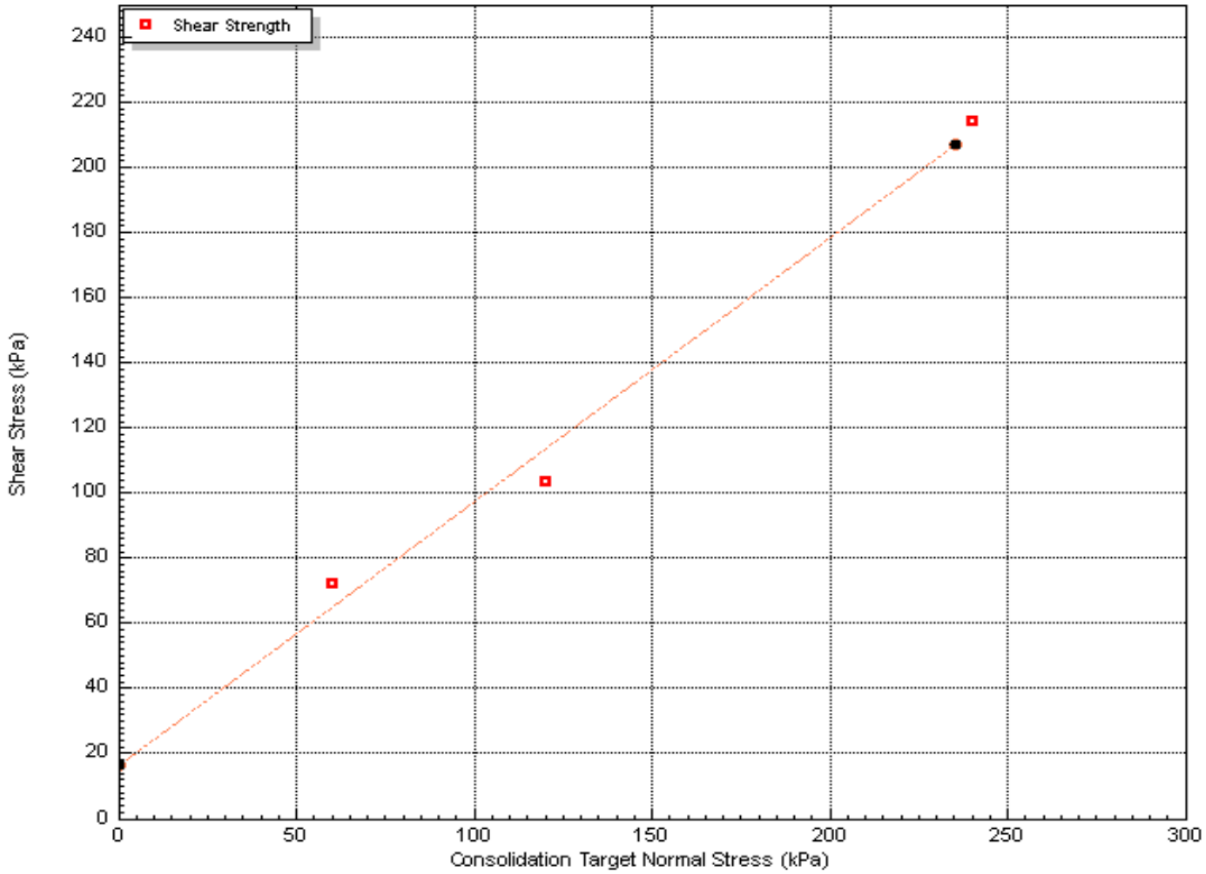
| Direct Shear Test BS EN ISO 17892-10:2018 | | | | |
|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | |
| Location Number | BH05 | Sample Reference | B7 | |
| Depth (m) | 6.00 | Sample Submerged? | 4 | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | 2.65 | Assumed |

| Stage | 1 | 2 | 3 |
|---|---|---|---|
| **Envelope Failure Results** | | | |
| Apparent Cohesion (kPa) | 17 | | |
| Angle of Shearing Resistance (°) | 39.0 | | |

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|---|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | | |
| Location Number | BH05 | Sample Reference | | B20 | |
| Depth (m) | 12.00 | Sample Submerged? | | Yes | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | | 2.65 | Assumed |
| Description | Brown sandy slightly silty subangular fine to coarse GRAVEL. | | | | |
| Sample Preparation | Sample is recompacted using material passing 2mm test sieve | | | | |

| Stage | 1 | 2 | 3 |
|---|---|---|---|
| **Initial Conditions** | | | |
| Height (mm) | 20.0 | 20.0 | 20.0 |
| Diameter (mm) | 60.0 | 60.0 | 60.0 |
| Water Content (%) | 8.8 | 8.8 | 8.8 |
| Bulk Density (Mg/m$^3$) | 1.91 | 1.95 | 1.94 |
| Dry Density (Mg/m$^3$) | 1.75 | 1.79 | 1.78 |
| Voids Ratio | 0.512 | 0.480 | 0.485 |
| **Consolidation** | | | |
| Normal Pressure (kPa) | 120 | 240 | 480 |
| Vertical Displacement (mm) | 0.665 | 0.386 | 0.539 |
| **Shearing** | | | |
| Rate of Strain (mm/min) | 0.600 | 0.600 | 0.600 |
| Peak Shear Stress (kPa) | 117.9 | 188.0 | 336.6 |
| Hoz Displacement (mm) | 10.2 | 10.2 | 10.2 |
| Hoz Displacement at Peak Shear Stress (mm) | 8.703 | 1.737 | 2.937 |
| **Final Conditions** | | | |
| Water Content (%) | 16.0 | 14.0 | 15.0 |
| Dry Density (Mg/m$^3$) | 1.83 | 1.84 | 1.88 |
| Voids Ratio | 0.466 | 0.448 | 0.420 |

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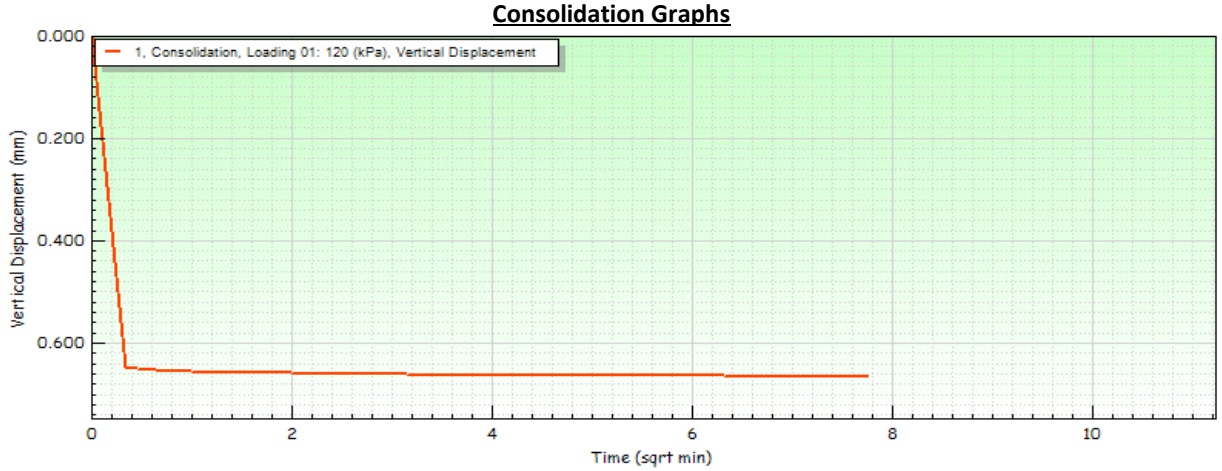
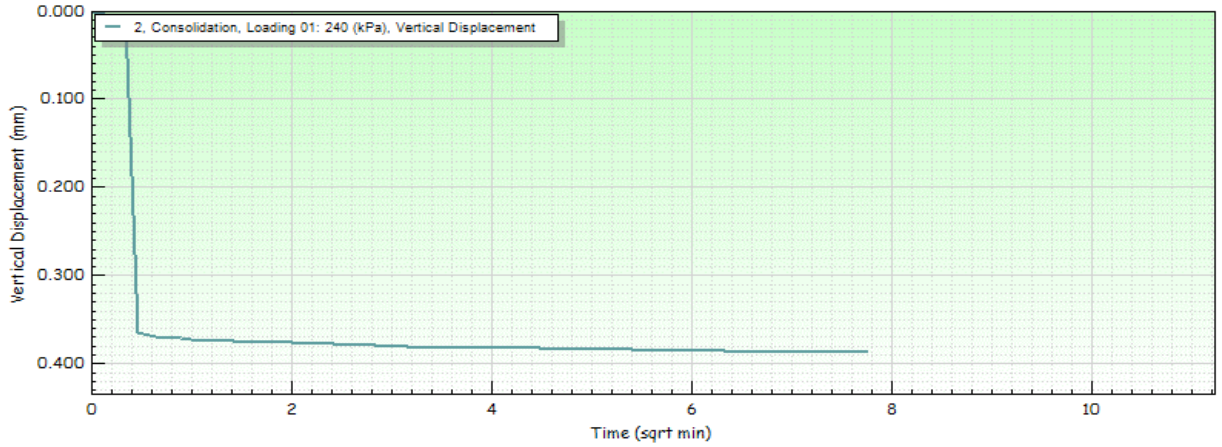
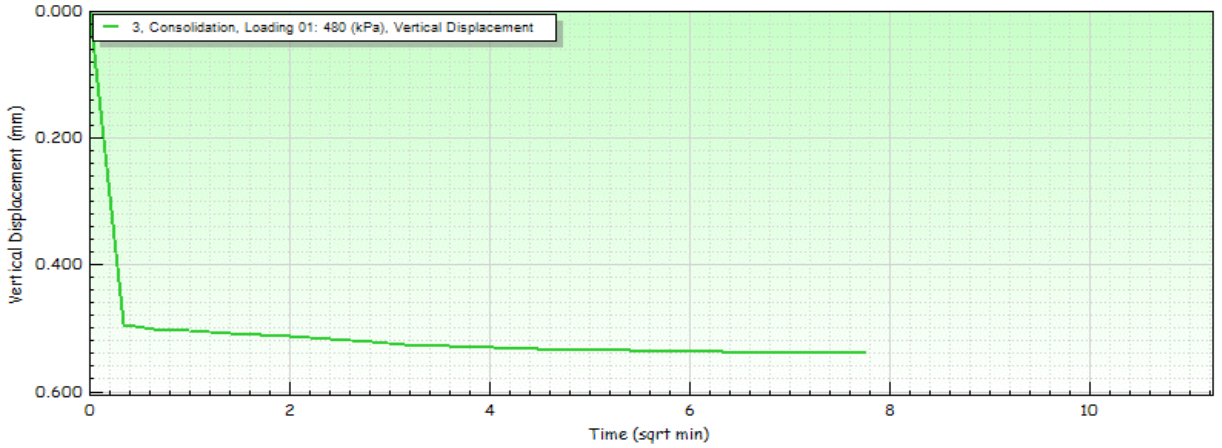
|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | |
| Location Number | BH05 | Sample Reference | B20 | |
| Depth (m) | 12.00 | Sample Submerged? | Yes | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | 2.65 | Assumed |

**Consolidation Graphs**

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|---|---|---|
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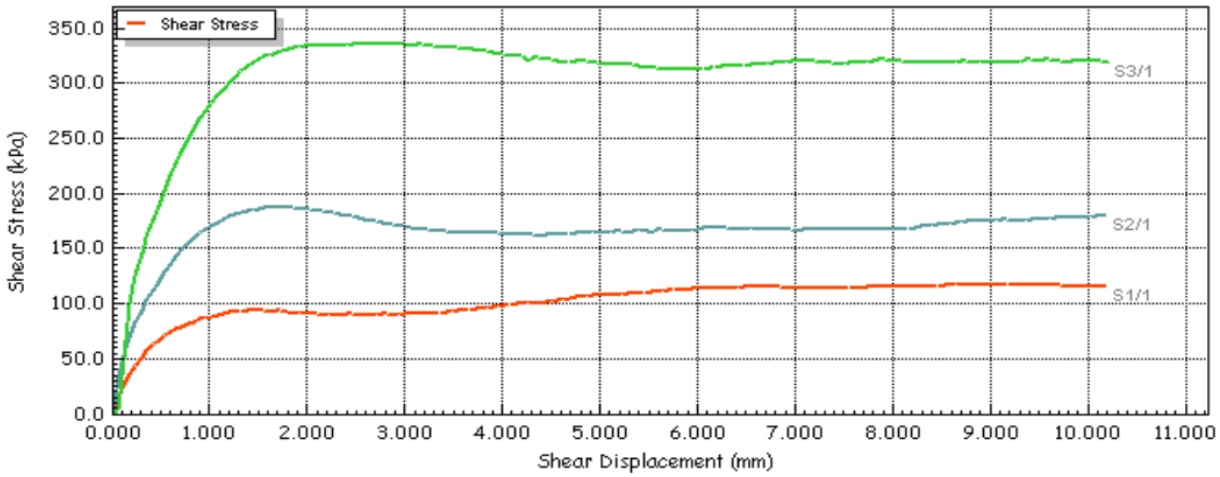
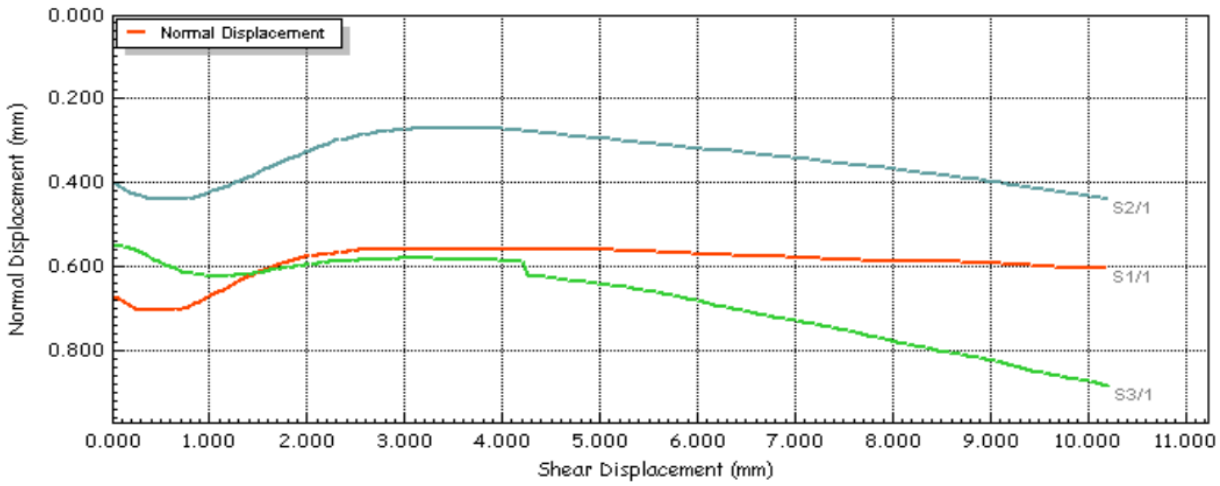
| Direct Shear Test BS EN ISO 17892-10:2018 | | | | | |
|---|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | | |
| Location Number | BH05 | Sample Reference | | B20 | |
| Depth (m) | 12.00 | Sample Submerged? | | Yes | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | | 2.65 | Assumed |

**Shear Stage**




| | Tested | Approved |
|---|---|---|
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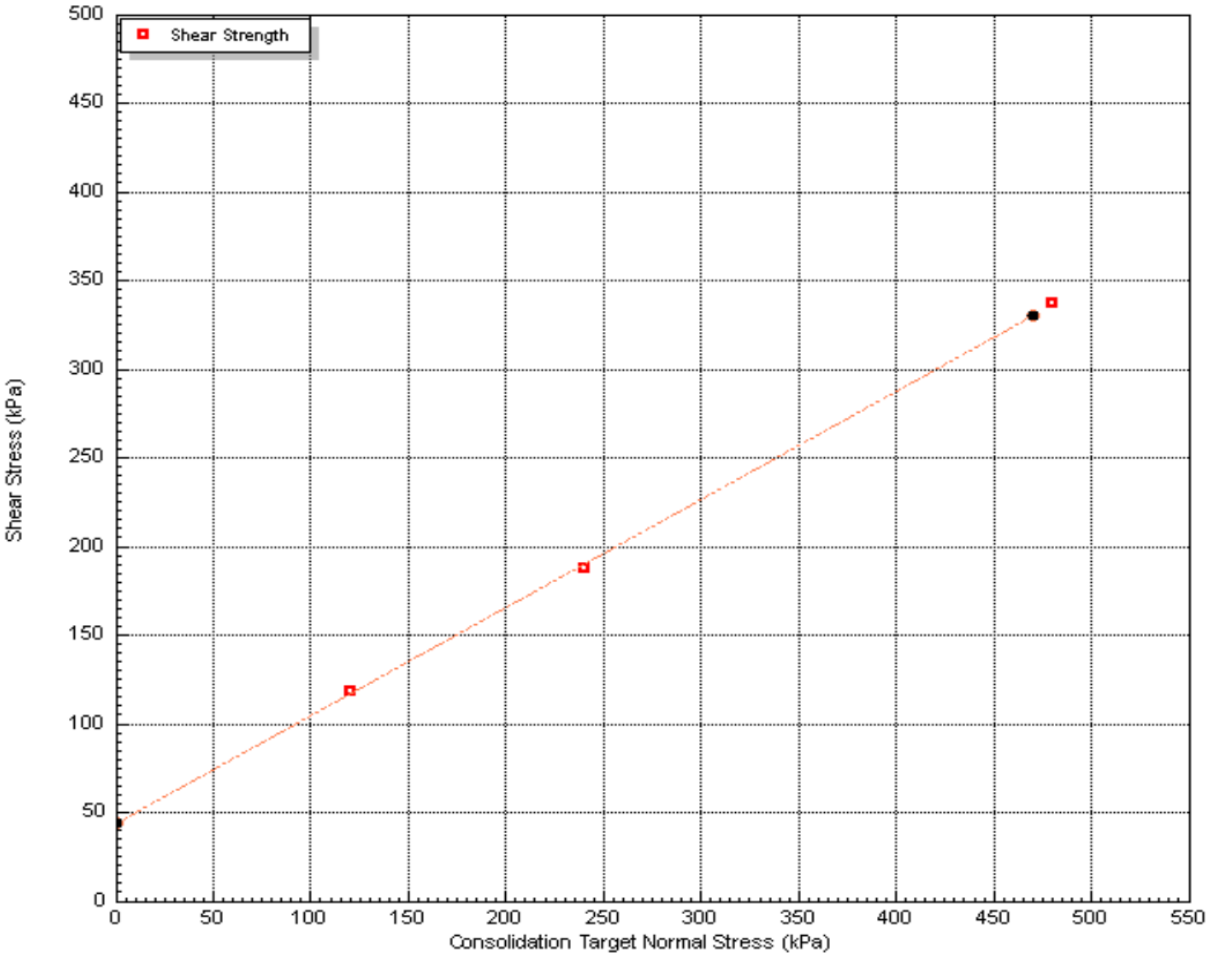
| Direct Shear Test BS EN ISO 17892-10:2018 | | | | |
|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | |
| Location Number | BH05 | Sample Reference | B20 | |
| Depth (m) | 12.00 | Sample Submerged? | 4 | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | 2.65 | Assumed |

| Stage | 1 | 2 | 3 |
|---|---|---|---|
| **Envelope Failure Results** | | | |
| Apparent Cohesion (kPa) | 44 | | |
| Angle of Shearing Resistance (°) | 31.5 | | |

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| Direct Shear Test BS EN ISO 17892-10:2018 | | | | | |
|---|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | | |
| Location Number | BH06 | Sample Reference | | B5 | |
| Depth (m) | 4.00 | Sample Submerged? | | Yes | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | | 2.65 | Assumed |
| Description | Greyish brown sandy subangular fine to coarse GRAVEL | | | | |
| Sample Preparation | Sample is recompacted using material passing 2mm test sieve | | | | |

| Stage | 1 | 2 | 3 |
|---|---|---|---|
| **Initial Conditions** | | | |
| Height (mm) | 20.0 | 20.0 | 20.0 |
| Diameter (mm) | 60.0 | 60.0 | 60.0 |
| Water Content (%) | 5.8 | 5.8 | 5.8 |
| Bulk Density (Mg/m$^3$) | 1.76 | 1.74 | 1.76 |
| Dry Density (Mg/m$^3$) | 1.66 | 1.64 | 1.66 |
| Voids Ratio | 0.595 | 0.614 | 0.593 |
| **Consolidation** | | | |
| Normal Pressure (kPa) | 40 | 80 | 160 |
| Vertical Displacement (mm) | 0.382 | 0.280 | 0.397 |
| **Shearing** | | | |
| Rate of Strain (mm/min) | 0.600 | 0.600 | 0.600 |
| Peak Shear Stress (kPa) | 48.7 | 69.1 | 144.2 |
| Hoz Displacement (mm) | 10.2 | 10.2 | 10.2 |
| Hoz Displacement at Peak Shear Stress (mm) | 1.983 | 2.037 | 2.823 |
| **Final Conditions** | | | |
| Water Content (%) | 19.0 | 19.0 | 19.0 |
| Dry Density (Mg/m$^3$) | 1.67 | 1.65 | 1.71 |
| Voids Ratio | 0.597 | 0.592 | 0.561 |

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| Tested | Approved |
|---|---|
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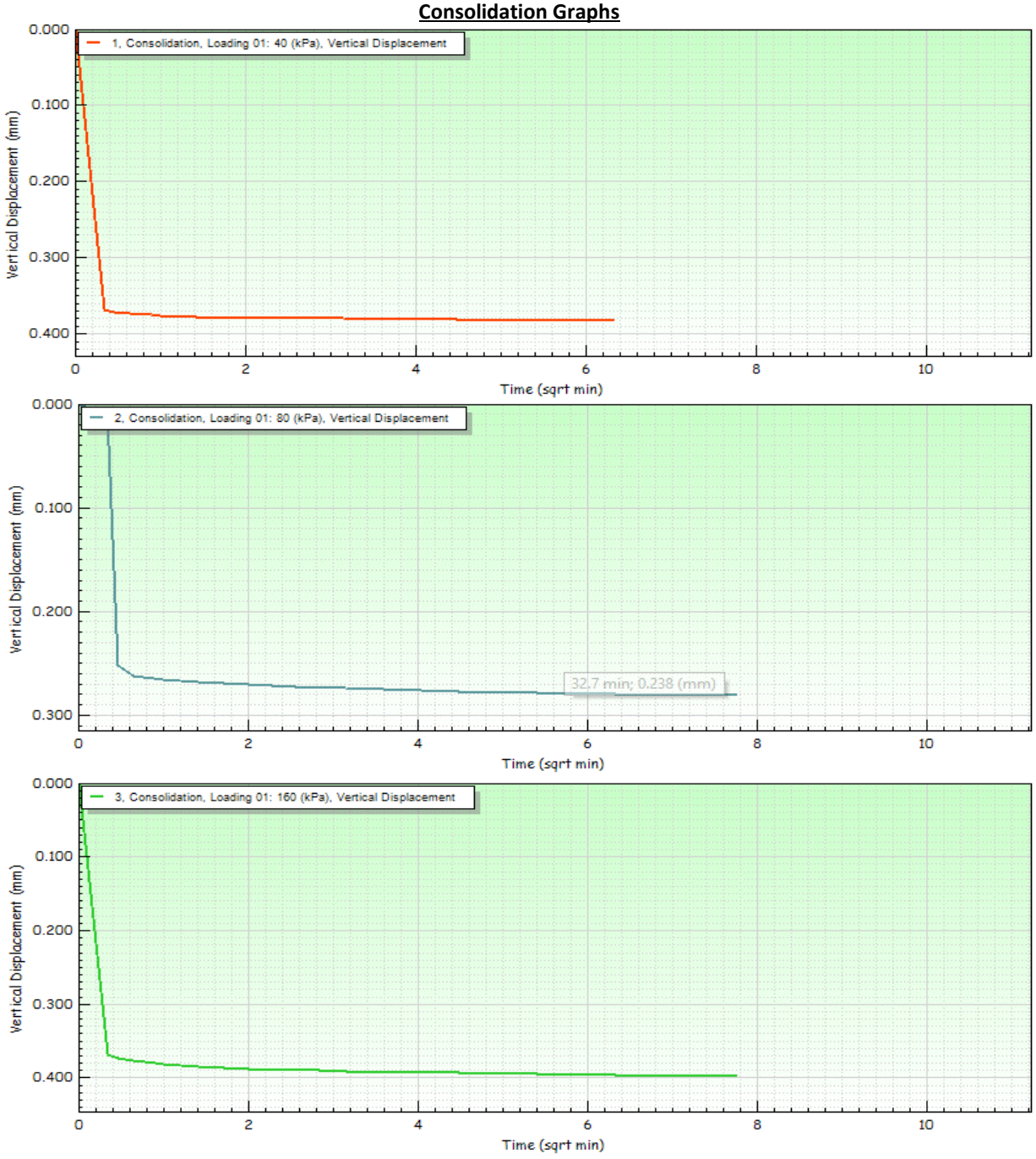
| Direct Shear Test BS EN ISO 17892-10:2018 | | | | |
|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | |
| Location Number | BH06 | Sample Reference | B5 | |
| Depth (m) | 4.00 | Sample Submerged? | Yes | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | 2.65 | Assumed |

**Consolidation Graphs**

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| 10122 | Aaron Nutt | Joseph Nicholl |

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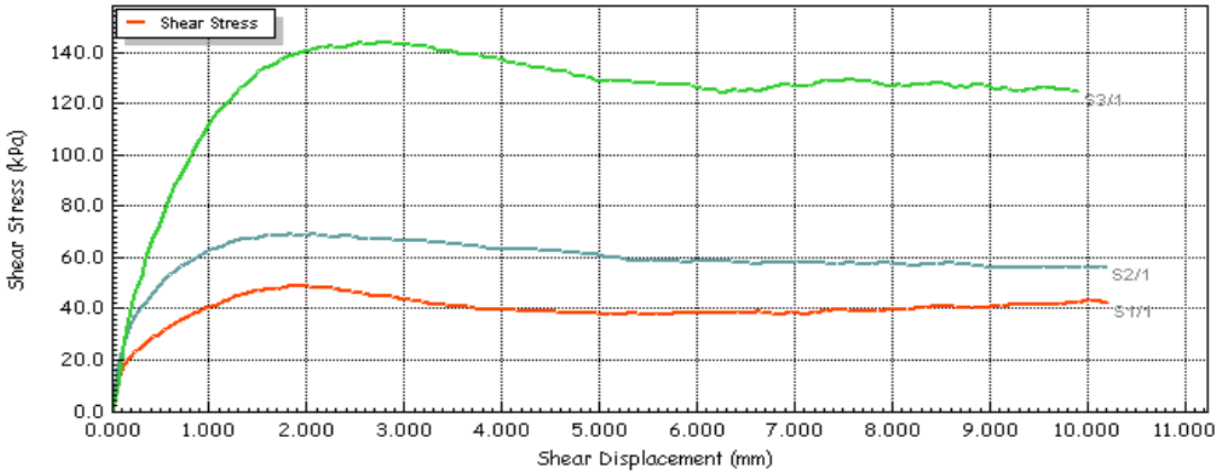
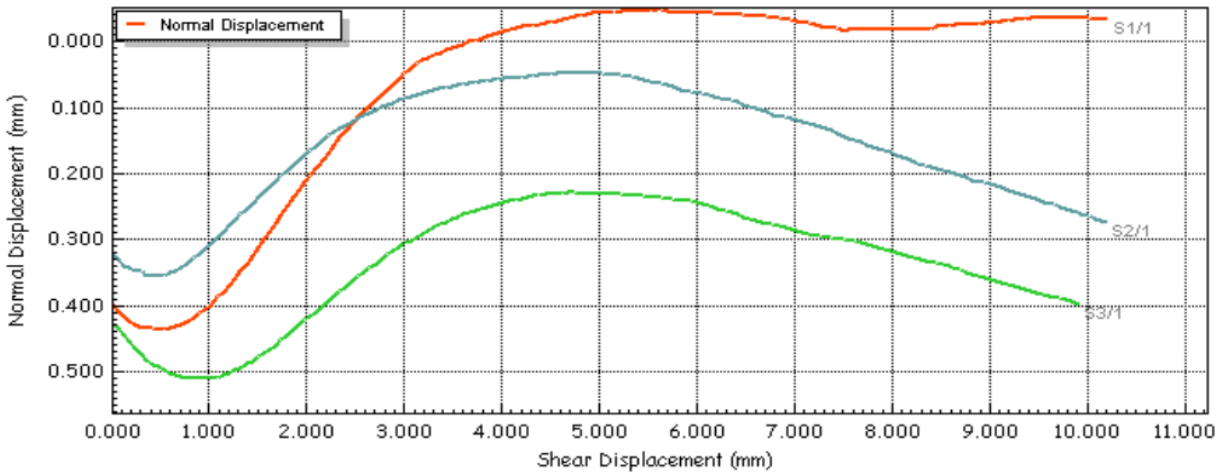
| Direct Shear Test BS EN ISO 17892-10:2018 | | | | |
|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | |
| Location Number | BH06 | Sample Reference | B5 | |
| Depth (m) | 4.00 | Sample Submerged? | Yes | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | 2.65 | Assumed |

**Shear Stage**

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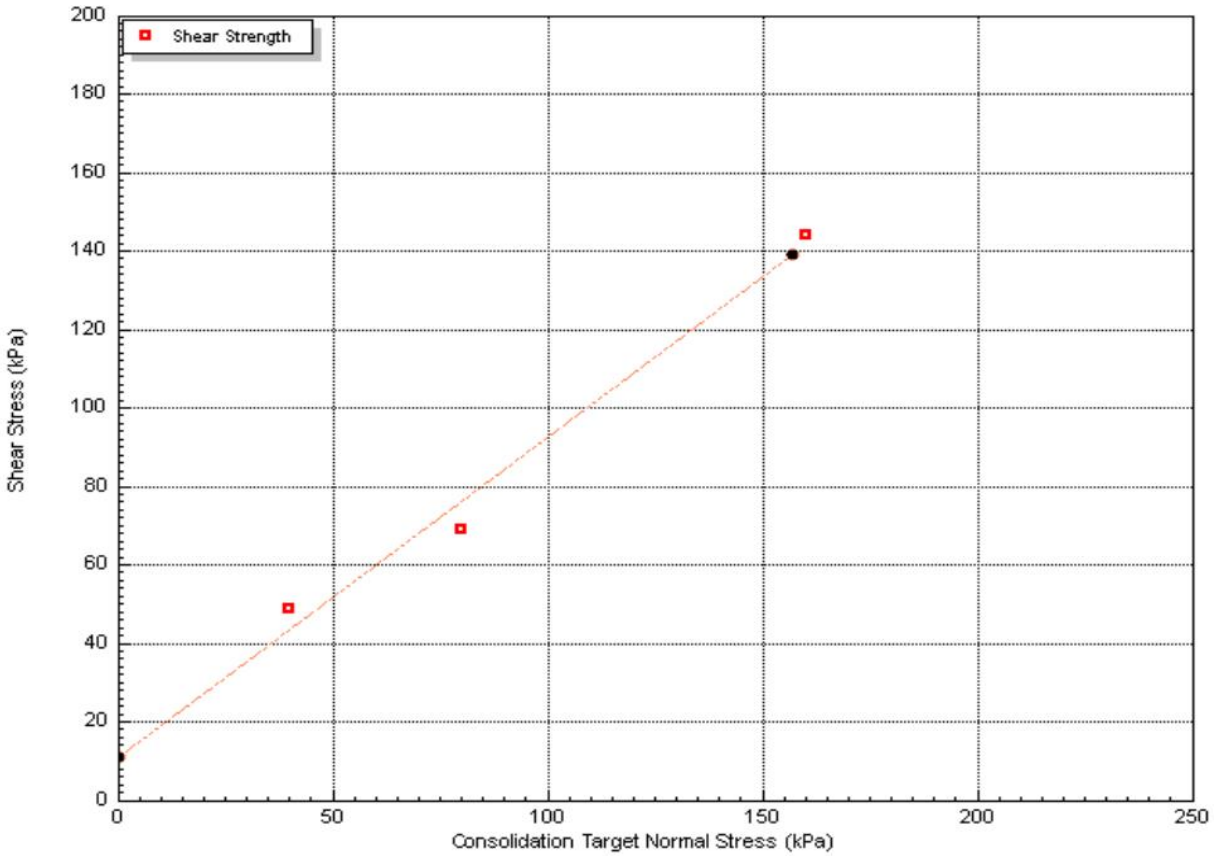
| Direct Shear Test BS EN ISO 17892-10:2018 | | | | |
|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | |
| Location Number | BH06 | Sample Reference | B5 | |
| Depth (m) | 4.00 | Sample Submerged? | 4 | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | 2.65 | Assumed |

| Stage | 1 | 2 | 3 |
|---|---|---|---|
| **Envelope Failure Results** | | | |
| Apparent Cohesion (kPa) | 11 | | |
| Angle of Shearing Resistance (°) | 39.0 | | |

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| Direct Shear Test BS EN ISO 17892-10:2018 | | | | | |
|---|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | | |
| Location Number | BH06 | Sample Reference | | B9 | |
| Depth (m) | 9.00 | Sample Submerged? | | Yes | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | | 2.65 | Assumed |
| Description | Greyish brown slightly silty fine to coarse SAND. | | | | |
| Sample Preparation | Sample is recompacted using material passing 2mm test sieve | | | | |

| Stage | 1 | 2 | 3 |
|---|---|---|---|
| **Initial Conditions** | | | |
| Height (mm) | 20.0 | 20.0 | 20.0 |
| Diameter (mm) | 60.0 | 60.0 | 60.0 |
| Water Content (%) | 17.0 | 17.0 | 17.0 |
| Bulk Density (Mg/m$^3$) | 1.90 | 1.94 | 1.94 |
| Dry Density (Mg/m$^3$) | 1.63 | 1.66 | 1.66 |
| Voids Ratio | 0.630 | 0.599 | 0.598 |
| **Consolidation** | | | |
| Normal Pressure (kPa) | 90 | 180 | 360 |
| Vertical Displacement (mm) | 0.557 | 0.483 | 0.529 |
| **Shearing** | | | |
| Rate of Strain (mm/min) | 0.600 | 0.600 | 0.600 |
| Peak Shear Stress (kPa) | 81.9 | 81.6 | 296.0 |
| Hoz Displacement (mm) | 9.4 | 9.4 | 9.4 |
| Hoz Displacement at Peak Shear Stress (mm) | 1.983 | 1.703 | 2.637 |
| **Final Conditions** | | | |
| Water Content (%) | 19.0 | 18.0 | 18.0 |
| Dry Density (Mg/m$^3$) | 1.71 | 1.75 | 1.74 |
| Voids Ratio | 0.600 | 0.567 | 0.550 |

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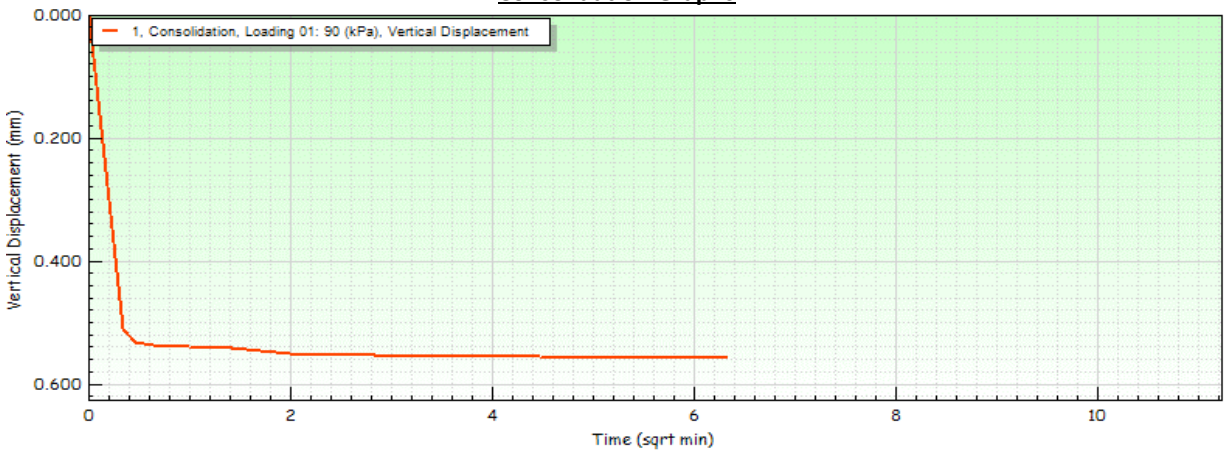
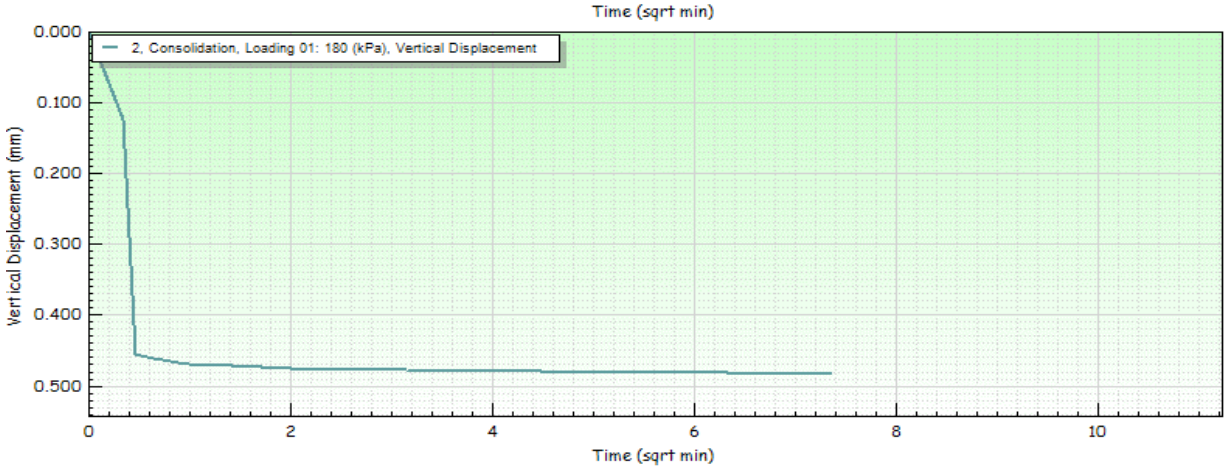
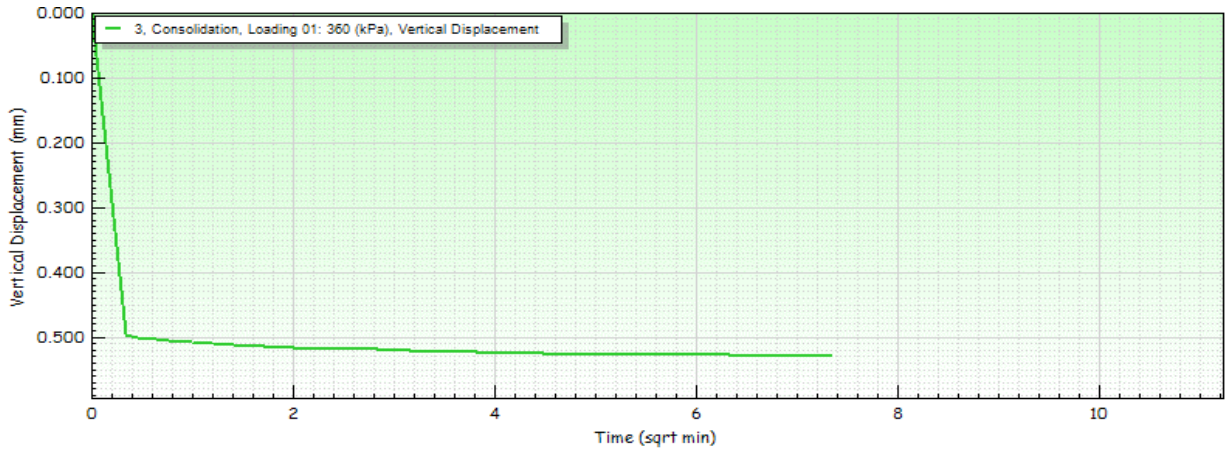
| Direct Shear Test BS EN ISO 17892-10:2018 | | | | |
|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | |
| Location Number | BH06 | Sample Reference | B9 | |
| Depth (m) | 9.00 | Sample Submerged? | Yes | ~~No~~ |
| Sample Type | B | Particle Density ($Mg/m^3$) | 2.65 | Assumed |

**Consolidation Graphs**

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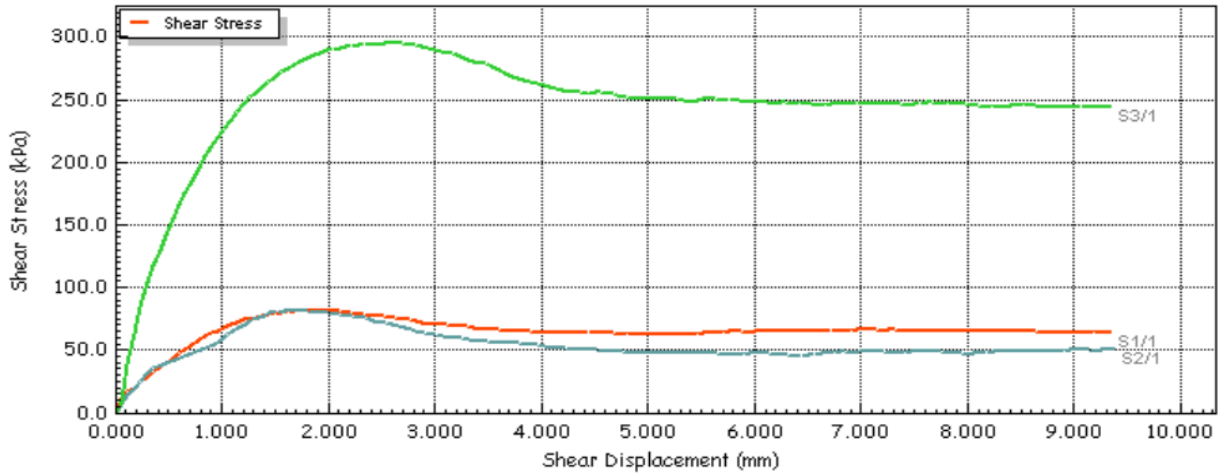
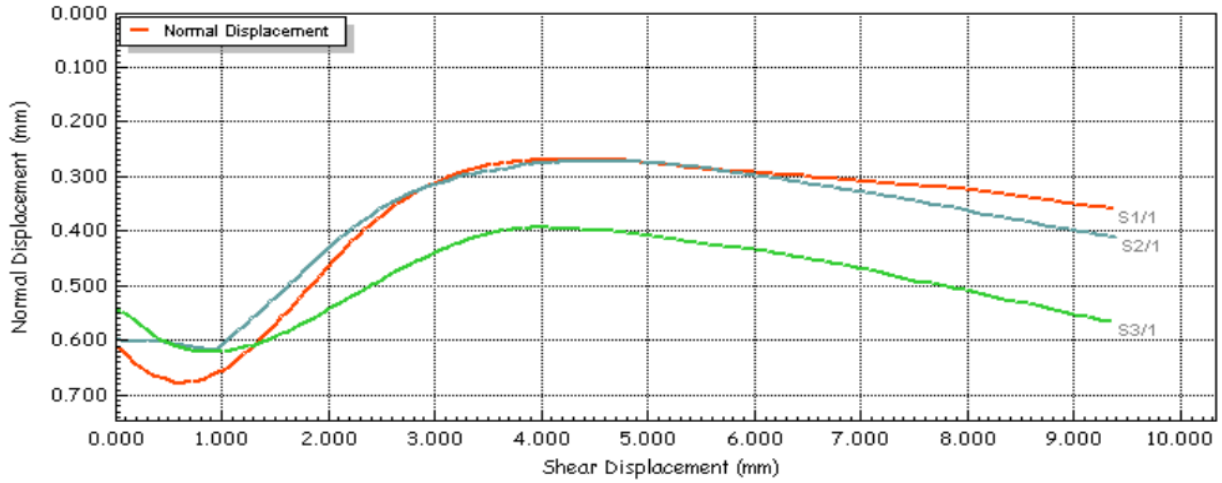
| Direct Shear Test BS EN ISO 17892-10:2018 | | | | |
|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | |
| Location Number | BH06 | Sample Reference | B9 | |
| Depth (m) | 9.00 | Sample Submerged? | Yes | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | 2.65 | Assumed |

**Shear Stage**




| | Tested | Approved |
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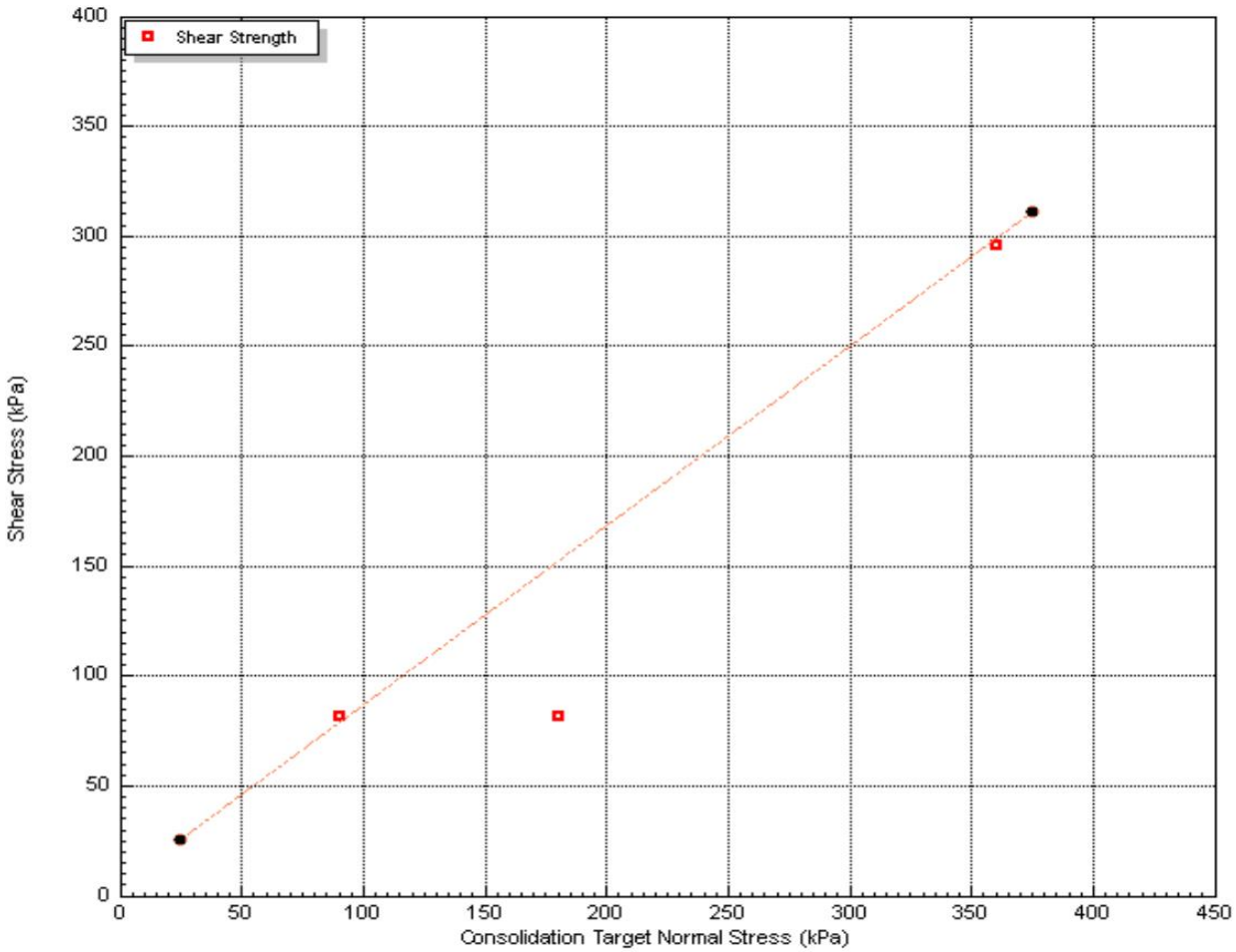
| Direct Shear Test BS EN ISO 17892-10:2018 | | | | |
|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | |
| Location Number | BH06 | Sample Reference | B9 | |
| Depth (m) | 9.00 | Sample Submerged? | 4 | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | 2.65 | Assumed |

| Stage | 1 | 2 | 3 |
|---|---|---|---|
| **Envelope Failure Results** | | | |
| Apparent Cohesion (kPa) | 5 | | |
| Angle of Shearing Resistance (°) | 39.2 | | |

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| Direct Shear Test BS EN ISO 17892-10:2018 | | | | | |
|---|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | | |
| Location Number | BH07 | Sample Reference | | B10 | |
| Depth (m) | 5.00 | Sample Submerged? | | Yes | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | | 2.65 | Assumed |
| Description | Grey slightly sandy subangular fine to coarse GRAVEL. | | | | |
| Sample Preparation | Sample is recompacted using material passing 2mm test sieve | | | | |

| Stage | 1 | 2 | 3 |
|---|---|---|---|
| **Initial Conditions** | | | |
| Height (mm) | 20.0 | 20.0 | 20.0 |
| Diameter (mm) | 60.0 | 60.0 | 60.0 |
| Water Content (%) | 8.4 | 8.2 | 8.2 |
| Bulk Density (Mg/m$^3$) | 1.69 | 1.66 | 1.66 |
| Dry Density (Mg/m$^3$) | 1.56 | 1.53 | 1.53 |
| Voids Ratio | 0.697 | 0.732 | 0.731 |
| **Consolidation** | | | |
| Normal Pressure (kPa) | 50 | 100 | 200 |
| Vertical Displacement (mm) | 0.249 | 0.149 | 0.474 |
| **Shearing** | | | |
| Rate of Strain (mm/min) | 0.600 | 0.600 | 0.600 |
| Peak Shear Stress (kPa) | 53.5 | 85.6 | 177.6 |
| Hoz Displacement (mm) | 10.2 | 10.2 | 10.2 |
| Hoz Displacement at Peak Shear Stress (mm) | 2.457 | 3.003 | 4.023 |
| **Final Conditions** | | | |
| Water Content (%) | 21.0 | 22.0 | 22.0 |
| Dry Density (Mg/m$^3$) | 1.52 | 1.51 | 1.62 |
| Voids Ratio | 0.715 | 0.730 | 0.658 |

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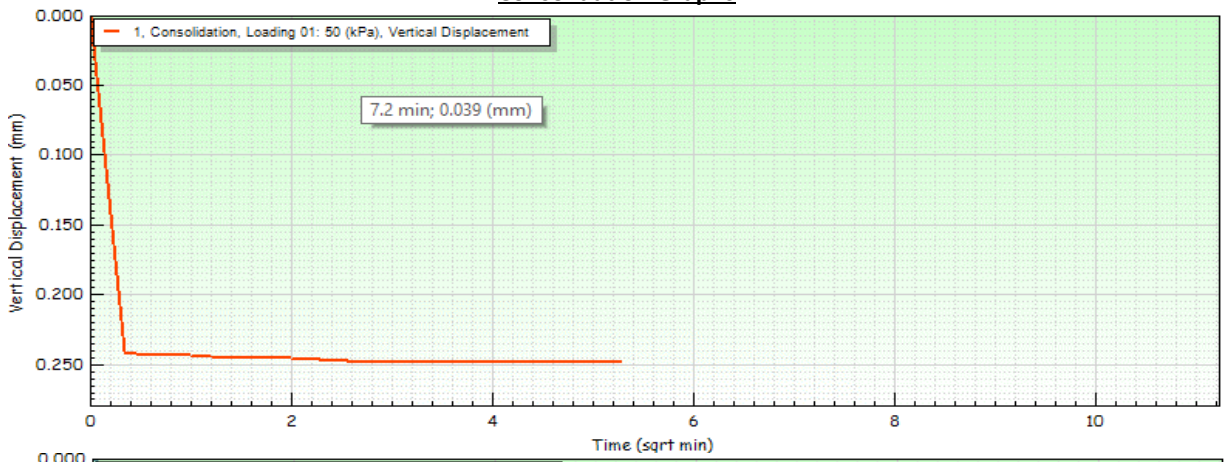
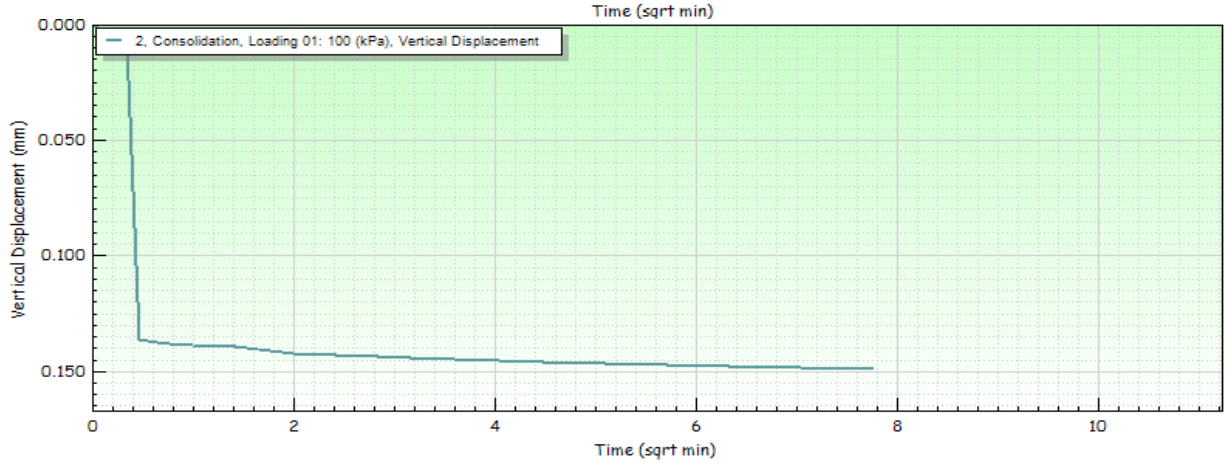
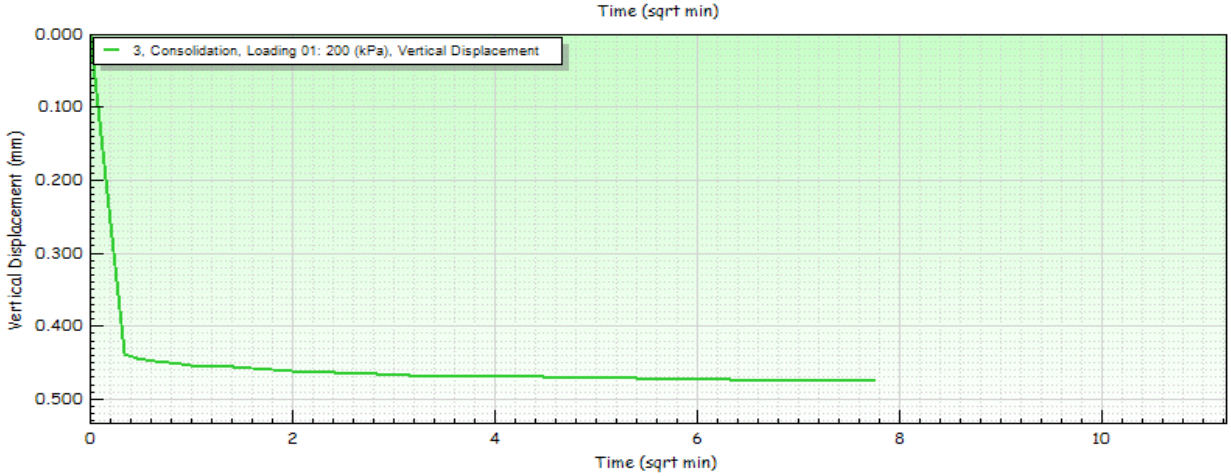
| Direct Shear Test BS EN ISO 17892-10:2018 | | | | |
|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | |
| Location Number | BH07 | Sample Reference | B10 | |
| Depth (m) | 5.00 | Sample Submerged? | Yes | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | 2.65 | Assumed |

**Consolidation Graphs**

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|---|---|---|
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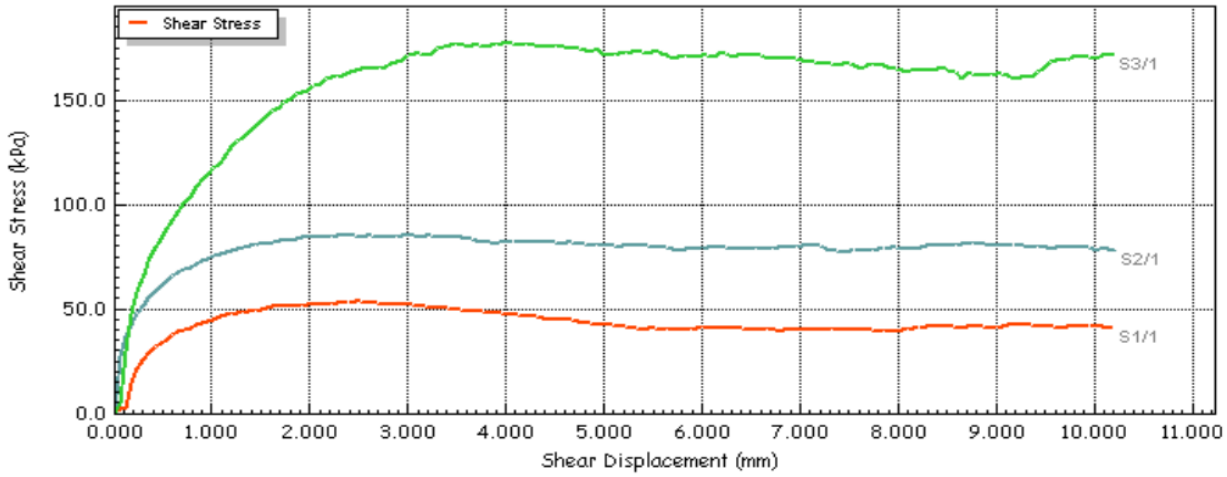
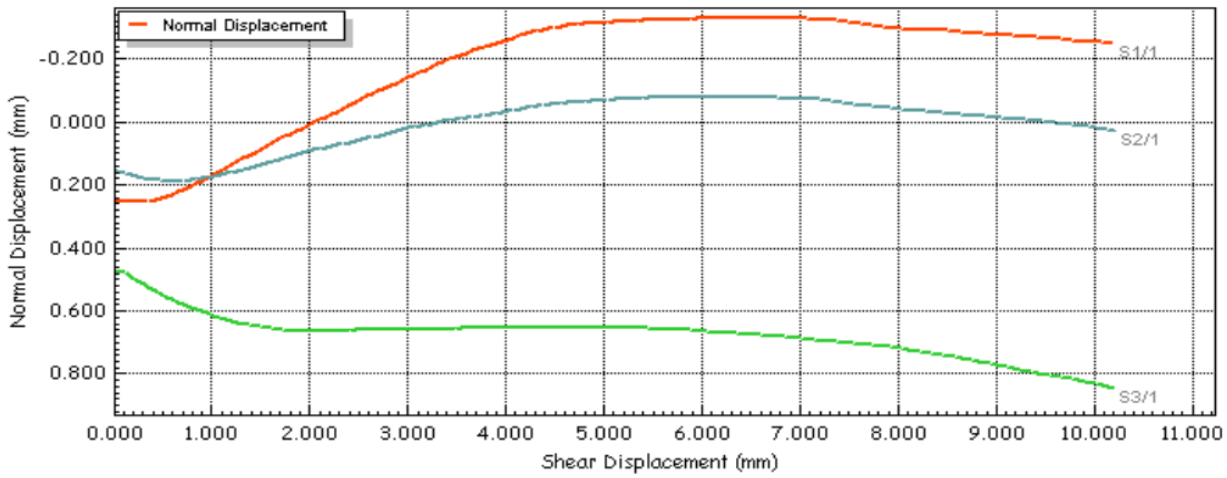
Lab Sheet Reference : LAB25R - Version 3

| Direct Shear Test BS EN ISO 17892-10:2018 | | | | |
|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | |
| Location Number | BH07 | Sample Reference | B10 | |
| Depth (m) | 5.00 | Sample Submerged? | Yes | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | 2.65 | Assumed |

**Shear Stage**

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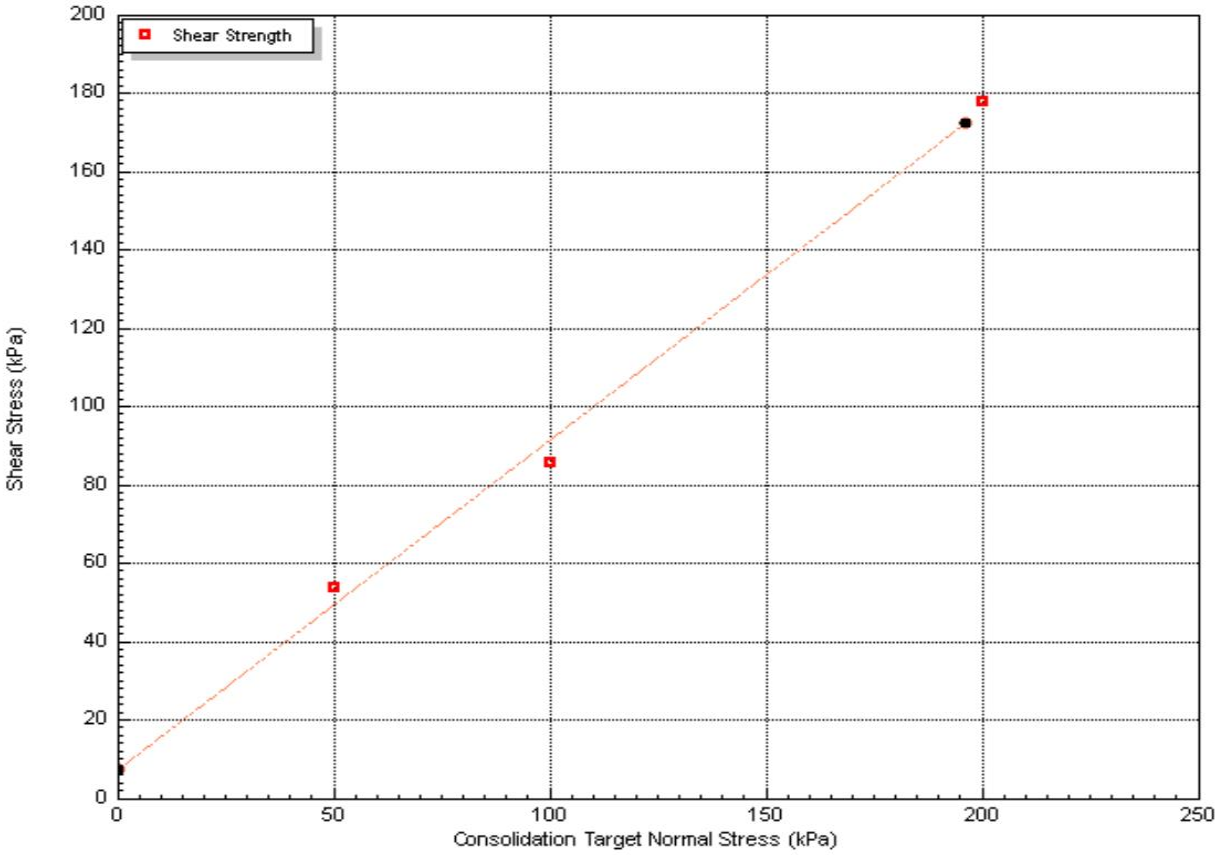
| Direct Shear Test BS EN ISO 17892-10:2018 | | | | |
|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | |
| Location Number | BH07 | Sample Reference | B10 | |
| Depth (m) | 5.00 | Sample Submerged? | 4 | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | 2.65 | Assumed |

| Stage | 1 | 2 | 3 |
|---|---|---|---|
| **Envelope Failure Results** | | | |
| Apparent Cohesion (kPa) | 8 | | |
| Angle of Shearing Resistance (°) | 40.0 | | |

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| Direct Shear Test BS EN ISO 17892-10:2018 | | | | | |
|---|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | | |
| Location Number | BH07 | Sample Reference | | B14 | |
| Depth (m) | 10.50 | Sample Submerged? | | Yes | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | | 2.65 | Assumed |
| Description | Grey subangular fine to coarse GRAVEL. | | | | |
| Sample Preparation | Sample is recompacted using material passing 2mm test sieve | | | | |

| Stage | 1 | 2 | 3 |
|---|---|---|---|
| **Initial Conditions** | | | |
| Height (mm) | 20.0 | 20.0 | 20.0 |
| Diameter (mm) | 60.0 | 60.0 | 60.0 |
| Water Content (%) | 12.0 | 12.0 | 12.0 |
| Bulk Density (Mg/m$^3$) | 2.24 | 2.26 | 2.27 |
| Dry Density (Mg/m$^3$) | 2.00 | 2.03 | 2.03 |
| Voids Ratio | 0.323 | 0.307 | 0.304 |
| **Consolidation** | | | |
| Normal Pressure (kPa) | 100 | 200 | 400 |
| Vertical Displacement (mm) | 0.373 | 0.483 | 0.633 |
| **Shearing** | | | |
| Rate of Strain (mm/min) | 0.600 | 0.600 | 0.600 |
| Peak Shear Stress (kPa) | 114.3 | 211.6 | 447.6 |
| Hoz Displacement (mm) | 10.2 | 10.2 | 10.2 |
| Hoz Displacement at Peak Shear Stress (mm) | 1.978 | 2.403 | 2.823 |
| **Final Conditions** | | | |
| Water Content (%) | 14.0 | 13.0 | 14.0 |
| Dry Density (Mg/m$^3$) | 1.99 | 2.06 | 2.12 |
| Voids Ratio | 0.335 | 0.308 | 0.277 |

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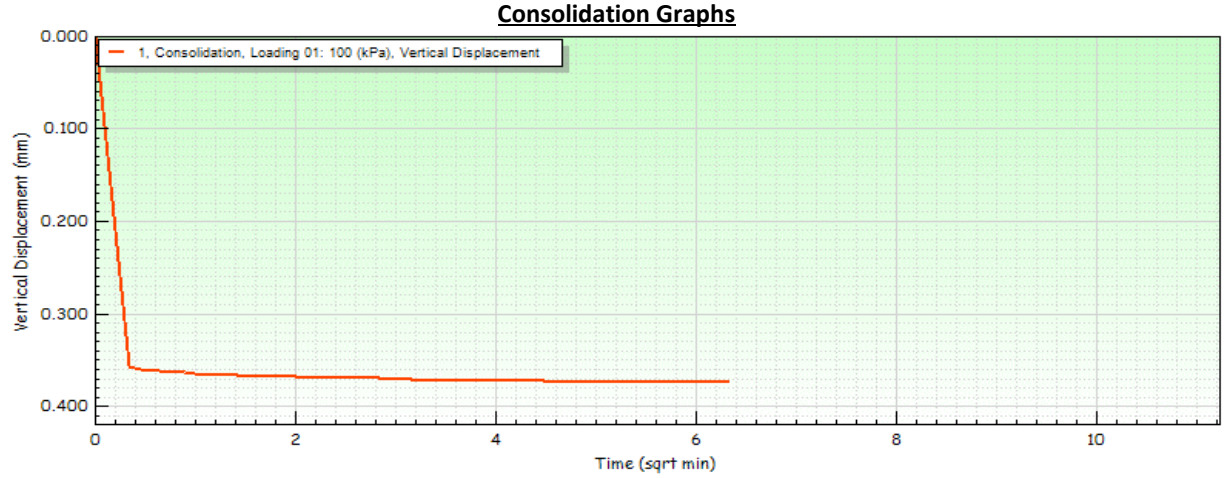
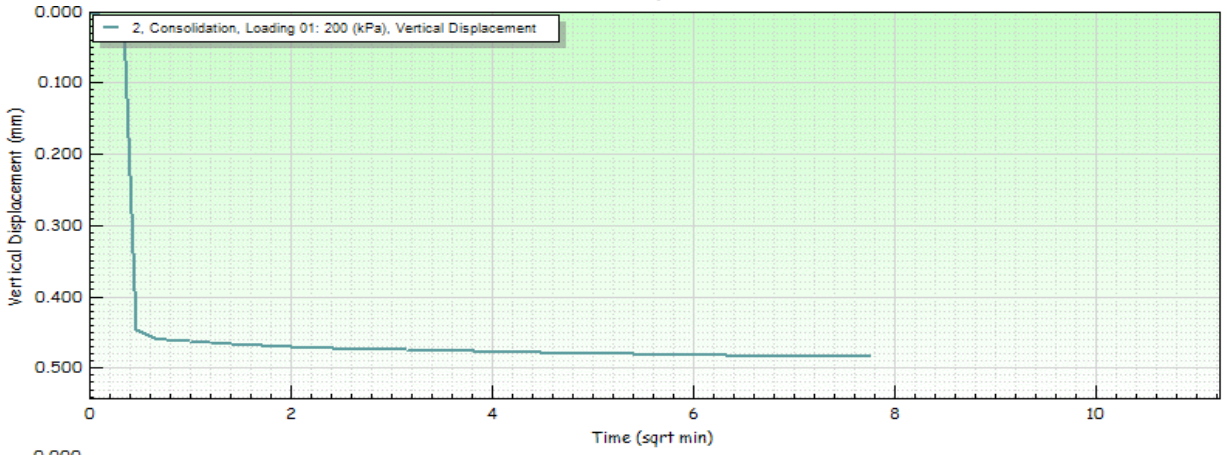
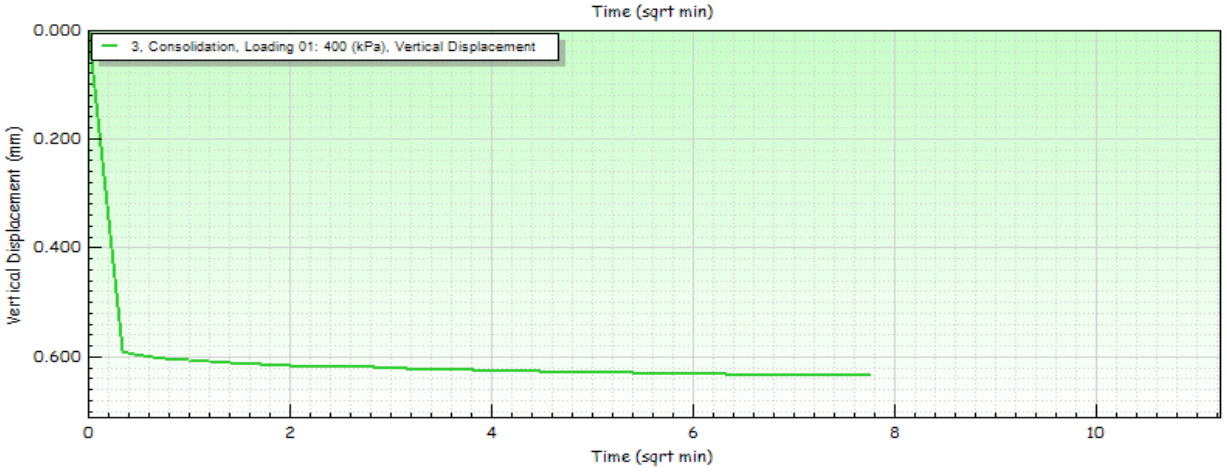
| Direct Shear Test BS EN ISO 17892-10:2018 | | | | |
|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | |
| Location Number | BH07 | Sample Reference | B14 | |
| Depth (m) | 10.50 | Sample Submerged? | Yes | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | 2.65 | Assumed |

**Consolidation Graphs**

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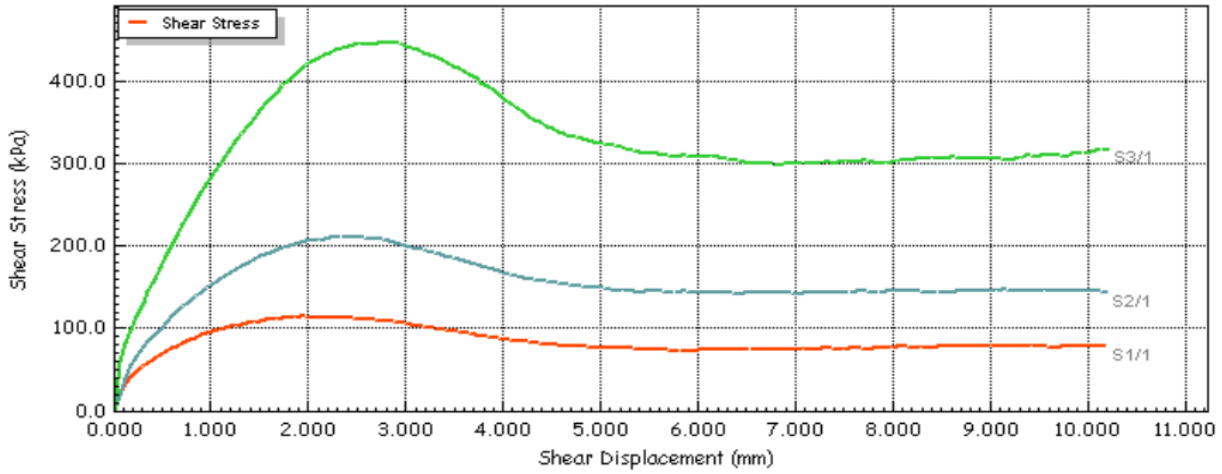
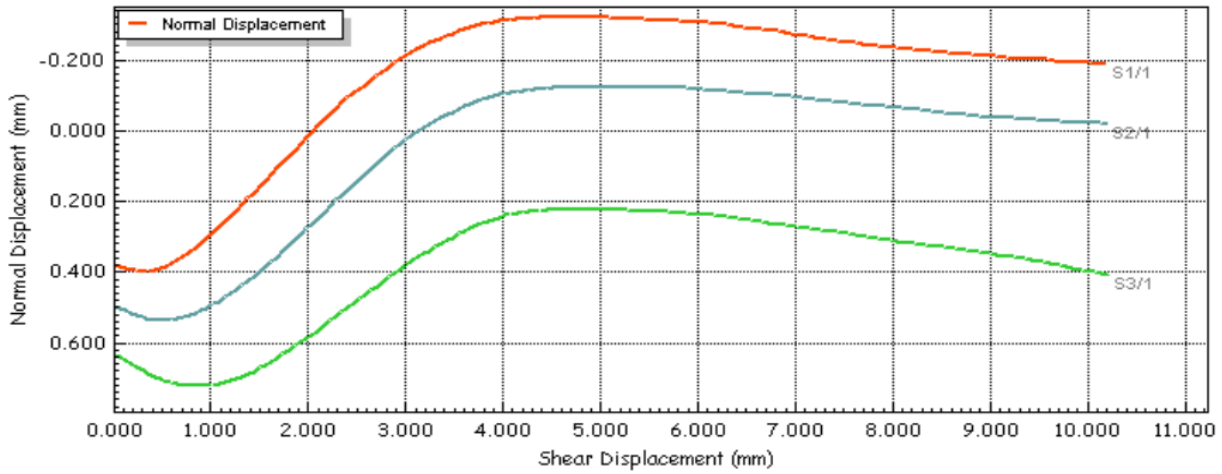
| Direct Shear Test BS EN ISO 17892-10:2018 | | | | | |
|---|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | | |
| Location Number | BH07 | Sample Reference | | B14 | |
| Depth (m) | 10.50 | Sample Submerged? | | Yes | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | | 2.65 | Assumed |

**Shear Stage**

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|---|---|---|
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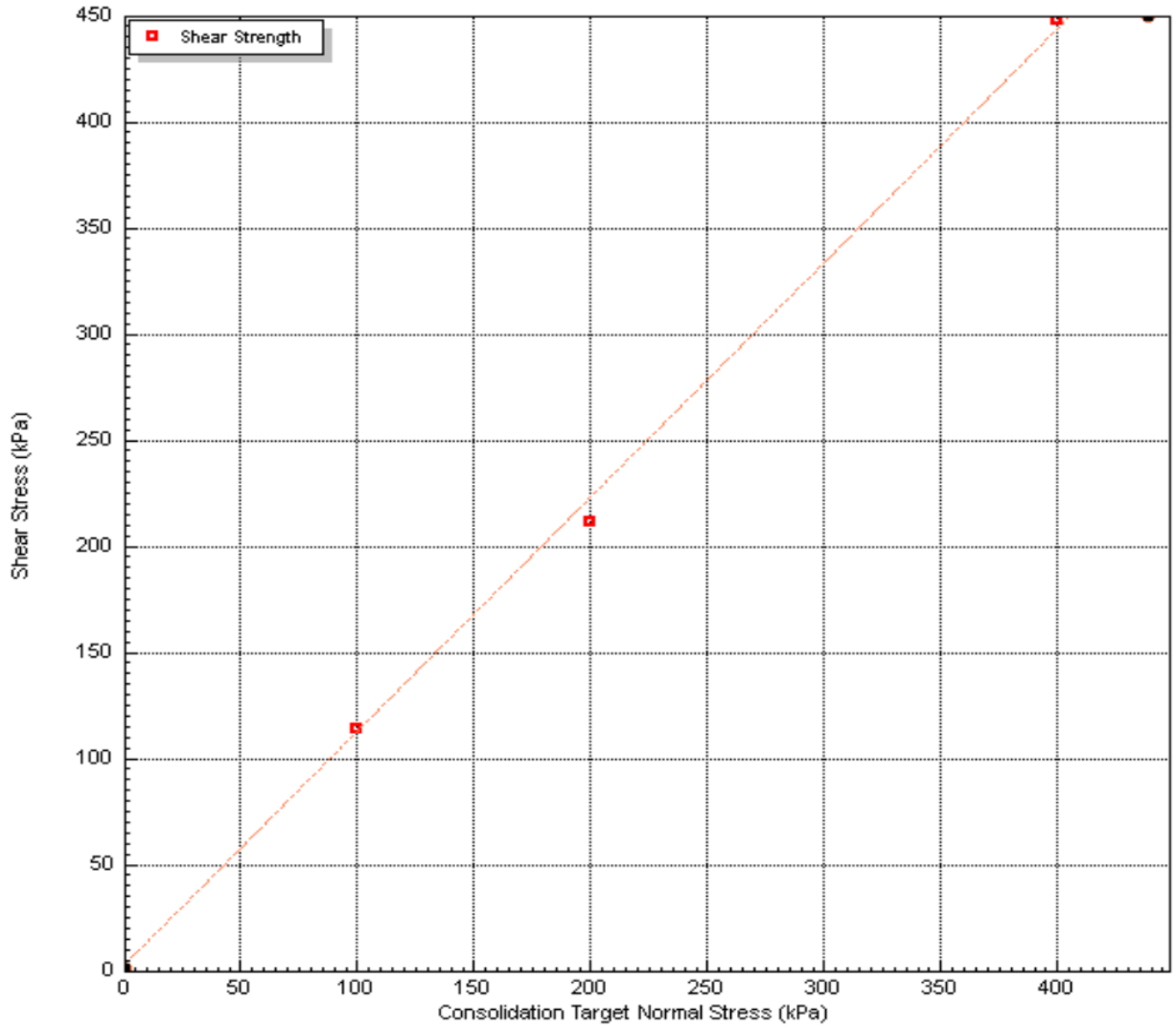
| Direct Shear Test BS EN ISO 17892-10:2018 | | | | |
|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | |
| Location Number | BH07 | Sample Reference | B14 | |
| Depth (m) | 10.50 | Sample Submerged? | 4 | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | 2.65 | Assumed |

| Stage | 1 | 2 | 3 |
|---|---|---|---|
| **Envelope Failure Results** | | | |
| Apparent Cohesion (kPa) | 2 | | |
| Angle of Shearing Resistance (°) | 48.0 | | |

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| Direct Shear Test BS EN ISO 17892-10:2018 | | | | | |
|---|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | | |
| Location Number | BH08 | Sample Reference | | B11 | |
| Depth (m) | 5.00 | Sample Submerged? | | Yes | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | | 2.65 | Assumed |
| Description | Greyish brown slightly gravelly fine to coarse SAND | | | | |
| Sample Preparation | Sample is recompacted using material passing 2mm test sieve | | | | |

| Stage | 1 | 2 | 3 |
|---|---|---|---|
| **Initial Conditions** | | | |
| Height (mm) | 20.0 | 20.0 | 20.0 |
| Diameter (mm) | 60.0 | 60.0 | 60.0 |
| Water Content (%) | 12.0 | 12.0 | 12.0 |
| Bulk Density (Mg/m$^3$) | 1.71 | 1.73 | 1.76 |
| Dry Density (Mg/m$^3$) | 1.53 | 1.55 | 1.58 |
| Voids Ratio | 0.735 | 0.714 | 0.681 |
| **Consolidation** | | | |
| Normal Pressure (kPa) | 50 | 100 | 200 |
| Vertical Displacement (mm) | 0.306 | 0.181 | 0.327 |
| **Shearing** | | | |
| Rate of Strain (mm/min) | 0.600 | 0.600 | 0.600 |
| Peak Shear Stress (kPa) | 47.2 | 93.7 | 182.4 |
| Hoz Displacement (mm) | 10.2 | 10.2 | 10.2 |
| Hoz Displacement at Peak Shear Stress (mm) | 2.337 | 2.223 | 2.877 |
| **Final Conditions** | | | |
| Water Content (%) | 22.0 | 20.0 | 20.0 |
| Dry Density (Mg/m$^3$) | 1.51 | 1.53 | 1.62 |
| Voids Ratio | 0.742 | 0.708 | 0.642 |

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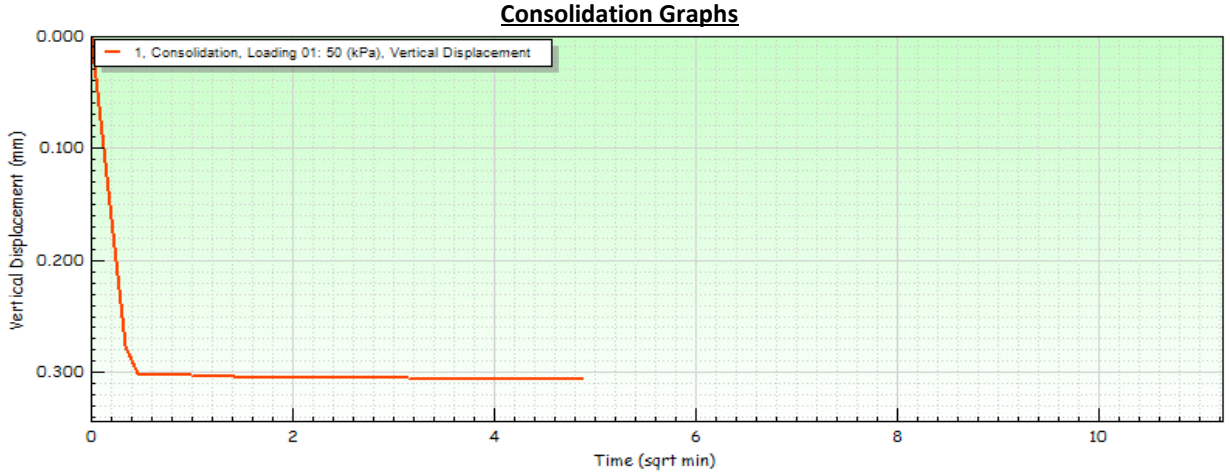
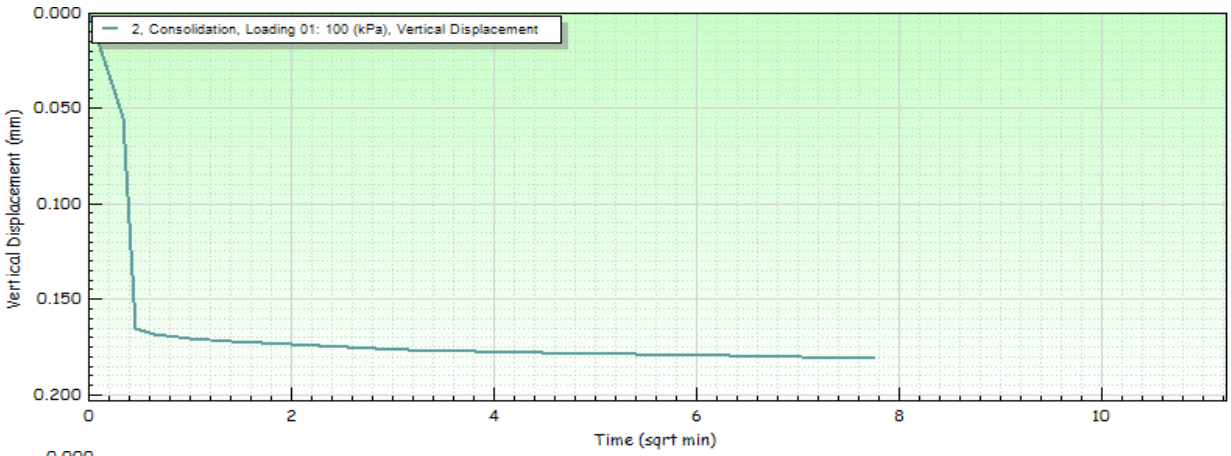
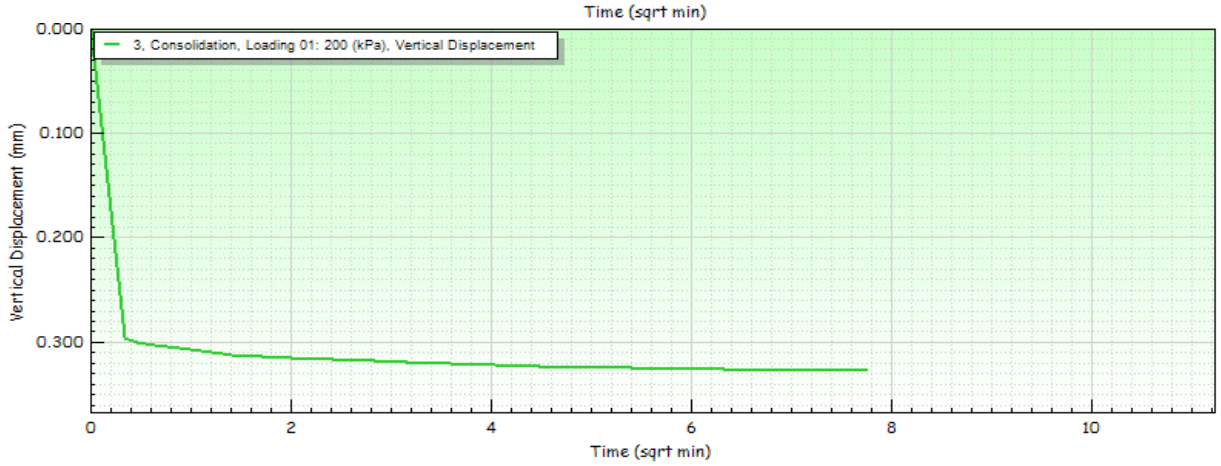
| Direct Shear Test BS EN ISO 17892-10:2018 | | | | |
|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | |
| Location Number | BH08 | Sample Reference | B11 | |
| Depth (m) | 5.00 | Sample Submerged? | Yes | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | 2.65 | Assumed |

**Consolidation Graphs**



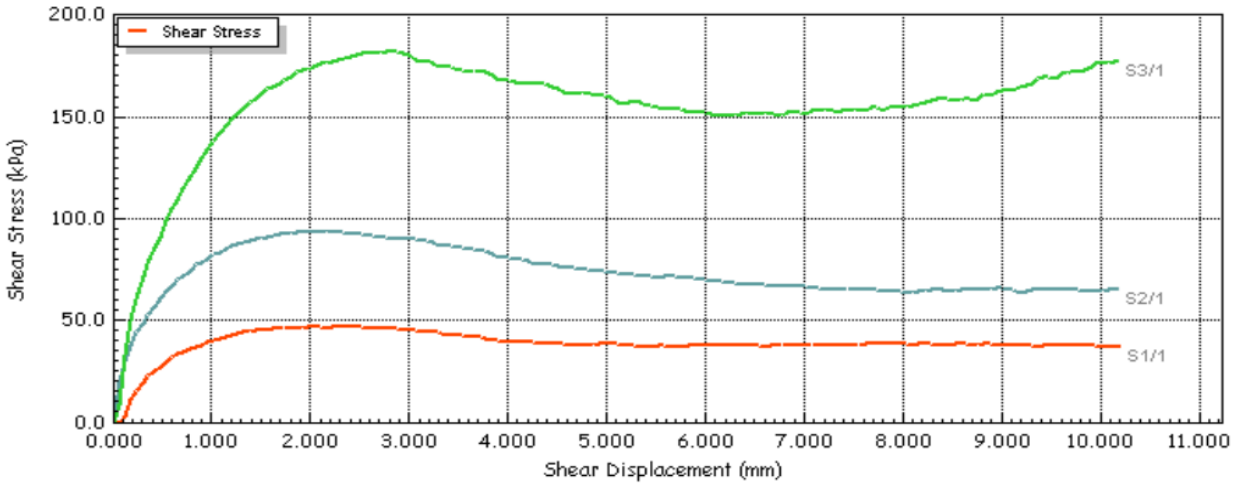



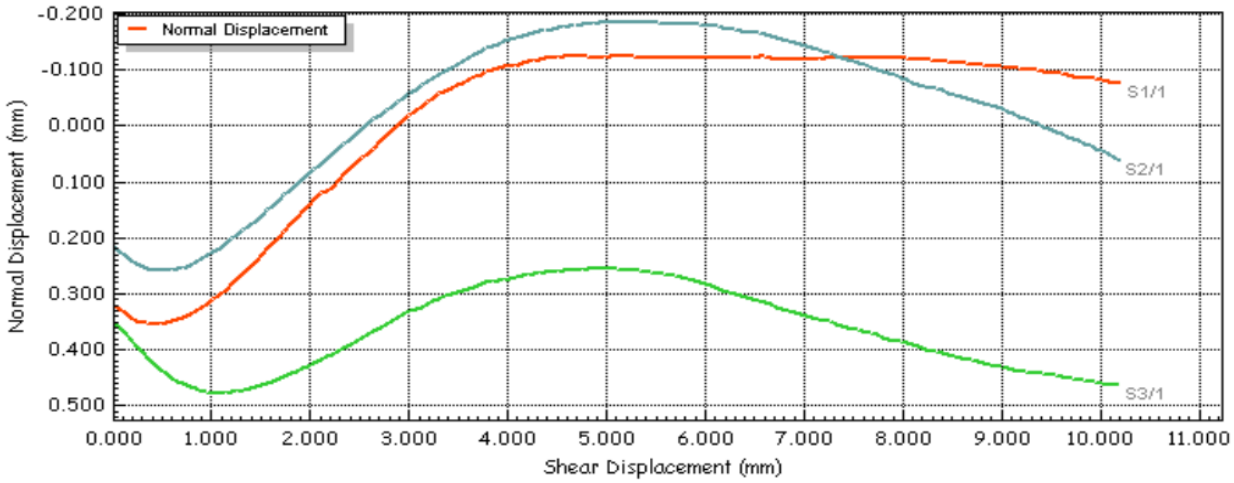

| | Tested | Approved |
|---|---|---|
| UKAS TESTING 10122 / CAUSEWAY GEOTECH | Aaron Nutt | Joseph Nicholl |

Lab Sheet Reference : LAB25R - Version 3

| Direct Shear Test BS EN ISO 17892-10:2018 | | | | |
|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | |
| Location Number | BH08 | Sample Reference | B11 | |
| Depth (m) | 5.00 | Sample Submerged? | Yes | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | 2.65 | Assumed |

**Shear Stage**

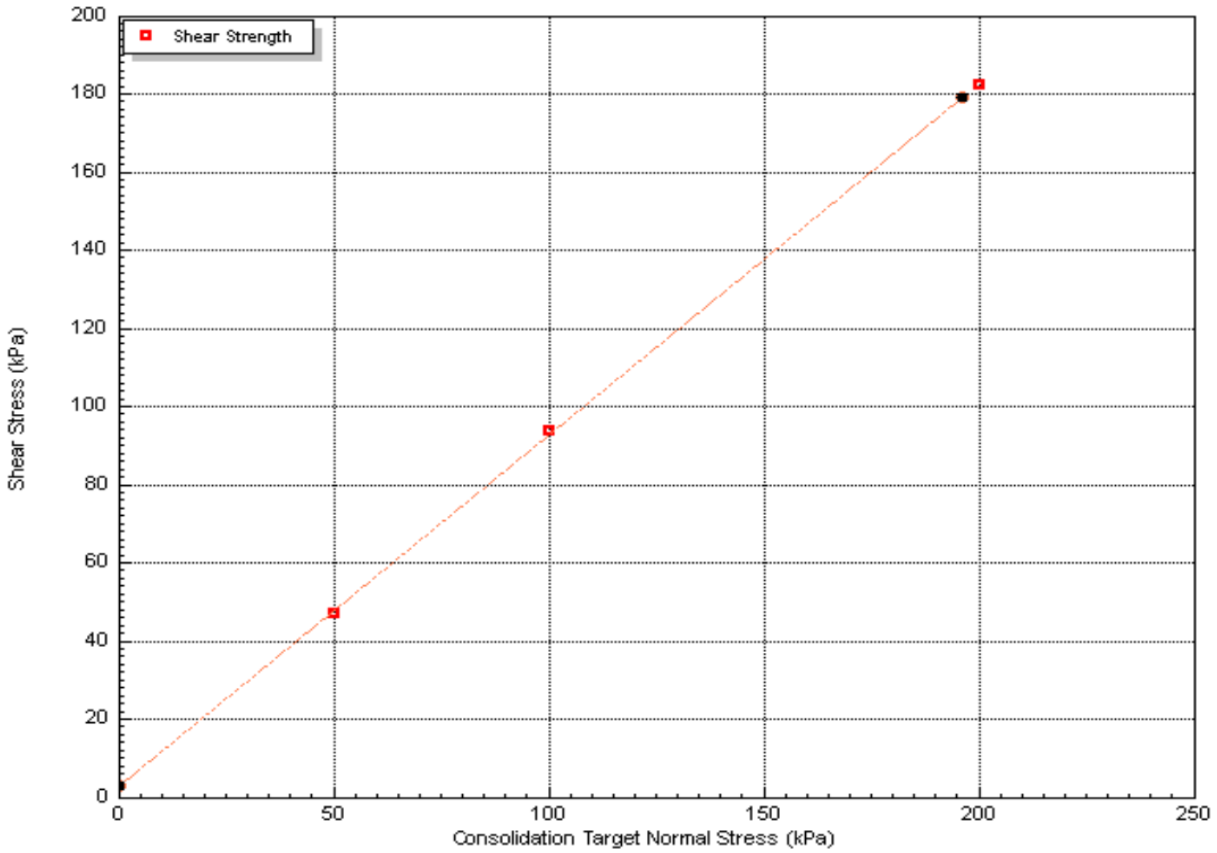



| | Tested | Approved |
|---|---|---|
| UKAS TESTING 10122 / CAUSEWAY GEOTECH | Aaron Nutt | Joseph Nicholl |

| Direct Shear Test BS EN ISO 17892-10:2018 | | | | |
|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | |
| Location Number | BH08 | Sample Reference | B11 | |
| Depth (m) | 5.00 | Sample Submerged? | 4 | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | 2.65 | Assumed |

| Stage | 1 | 2 | 3 |
|---|---|---|---|
| **Envelope Failure Results** | | | |
| Apparent Cohesion (kPa) | 3 | | |
| Angle of Shearing Resistance (°) | 42.0 | | |




| | Tested | Approved |
|---|---|---|
| UKAS TESTING 10122 / CAUSEWAY GEOTECH | Aaron Nutt | Joseph Nicholl |

Lab Sheet Reference : LAB25R - Version 3

| Direct Shear Test BS EN ISO 17892-10:2018 | | | | | |
|---|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | | |
| Location Number | BH08 | Sample Reference | | B16 | |
| Depth (m) | 12.00 | Sample Submerged? | | Yes | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | | 2.65 | Assumed |
| Description | Greyish brown subangular fine to coarse GRAVEL. | | | | |
| Sample Preparation | Sample is recompacted using material passing 2mm test sieve | | | | |

| Stage | 1 | 2 | 3 |
|---|---|---|---|
| **Initial Conditions** | | | |
| Height (mm) | 20.0 | 20.0 | 20.0 |
| Diameter (mm) | 60.0 | 60.0 | 60.0 |
| Water Content (%) | 8.0 | 7.9 | 7.9 |
| Bulk Density (Mg/m$^3$) | 1.84 | 1.82 | 1.88 |
| Dry Density (Mg/m$^3$) | 1.70 | 1.69 | 1.74 |
| Voids Ratio | 0.559 | 0.569 | 0.524 |
| **Consolidation** | | | |
| Normal Pressure (kPa) | 120 | 240 | 480 |
| Vertical Displacement (mm) | 0.563 | 0.457 | 0.796 |
| **Shearing** | | | |
| Rate of Strain (mm/min) | 0.600 | 0.600 | 0.600 |
| Peak Shear Stress (kPa) | 118.2 | 186.6 | 361.7 |
| Hoz Displacement (mm) | 10.2 | 10.2 | 10.2 |
| Hoz Displacement at Peak Shear Stress (mm) | 10.200 | 1.917 | 2.577 |
| **Final Conditions** | | | |
| Water Content (%) | 17.0 | 17.0 | 16.0 |
| Dry Density (Mg/m$^3$) | 1.78 | 1.77 | 1.90 |
| Voids Ratio | 0.514 | 0.514 | 0.435 |

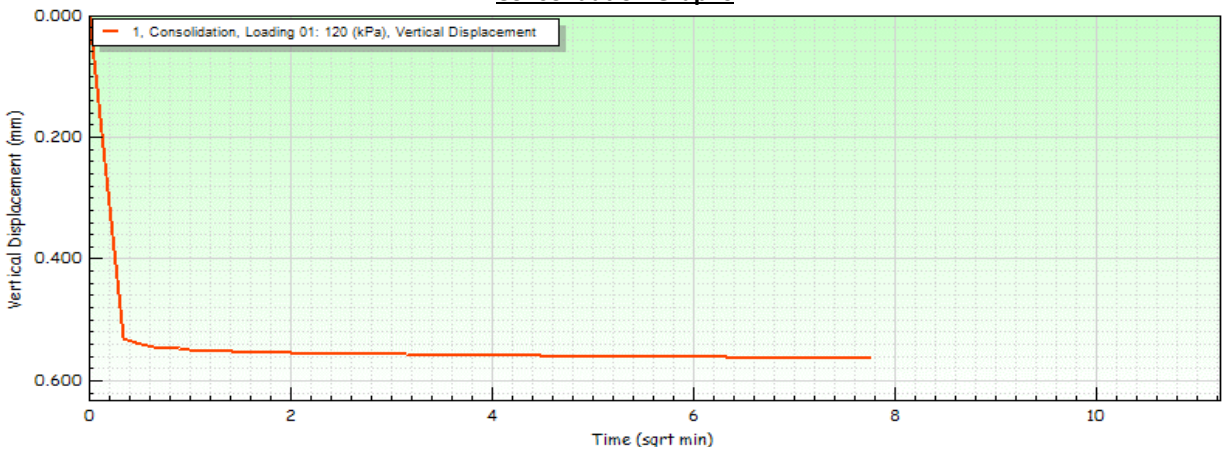
UKAS TESTING
10122

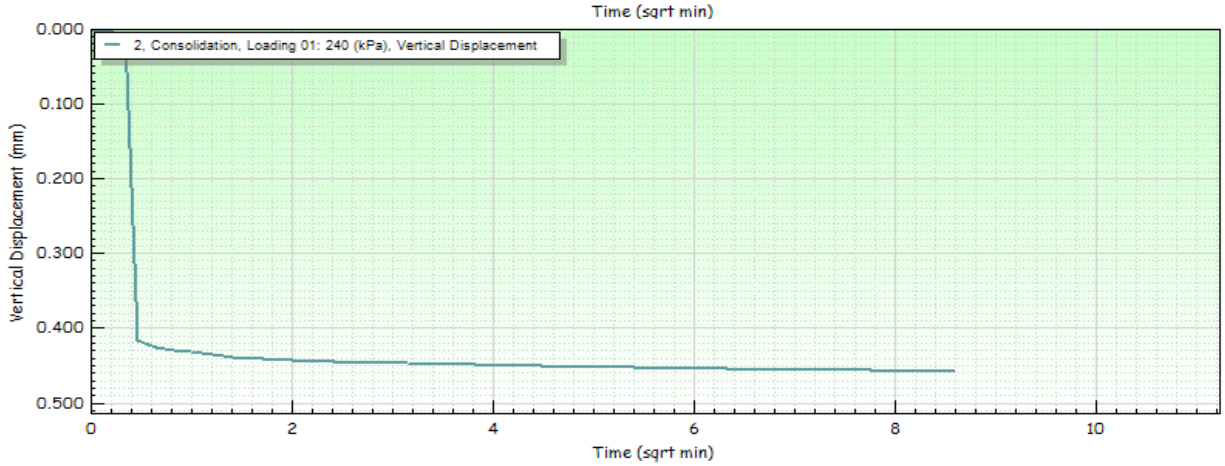
CAUSEWAY GEOTECH

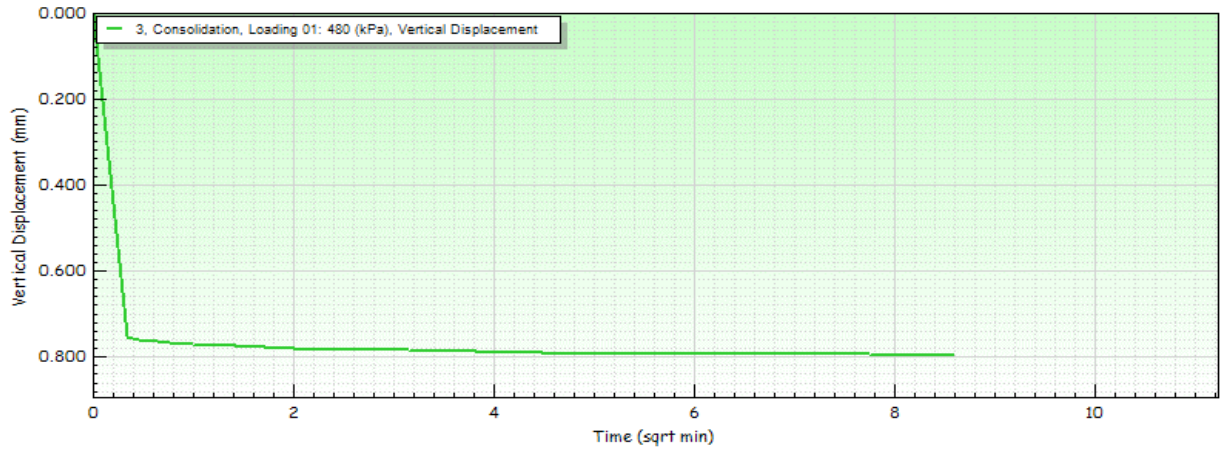
| Tested | Approved |
|---|---|
| Aaron Nutt | Joseph Nicholl |

| Direct Shear Test BS EN ISO 17892-10:2018 | | | | |
|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | |
| Location Number | BH08 | Sample Reference | B16 | |
| Depth (m) | 12.00 | Sample Submerged? | Yes | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | 2.65 | Assumed |

**Consolidation Graphs**



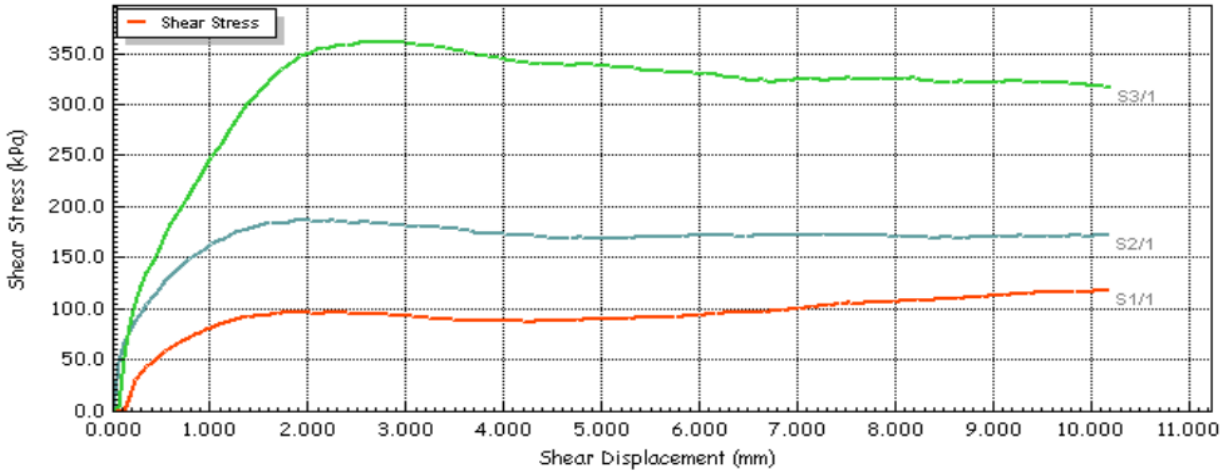



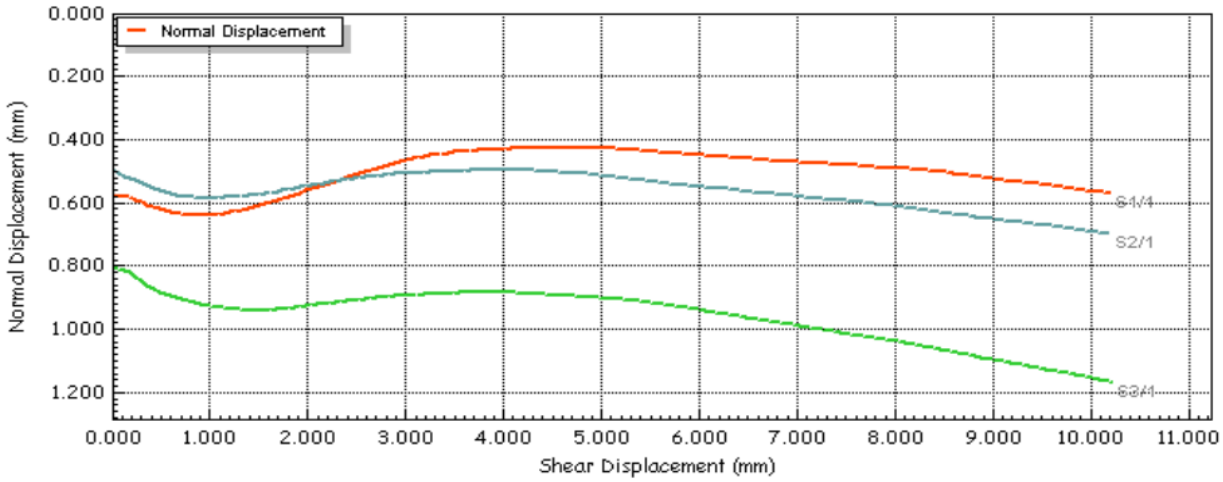

| | Tested | Approved |
|---|---|---|
| UKAS TESTING 10122 / CAUSEWAY GEOTECH | Aaron Nutt | Joseph Nicholl |

Lab Sheet Reference : LAB25R - Version 3

| Direct Shear Test BS EN ISO 17892-10:2018 | | | | | |
|---|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | | |
| Location Number | BH08 | Sample Reference | | B16 | |
| Depth (m) | 12.00 | Sample Submerged? | | Yes | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | | 2.65 | Assumed |

**Shear Stage**



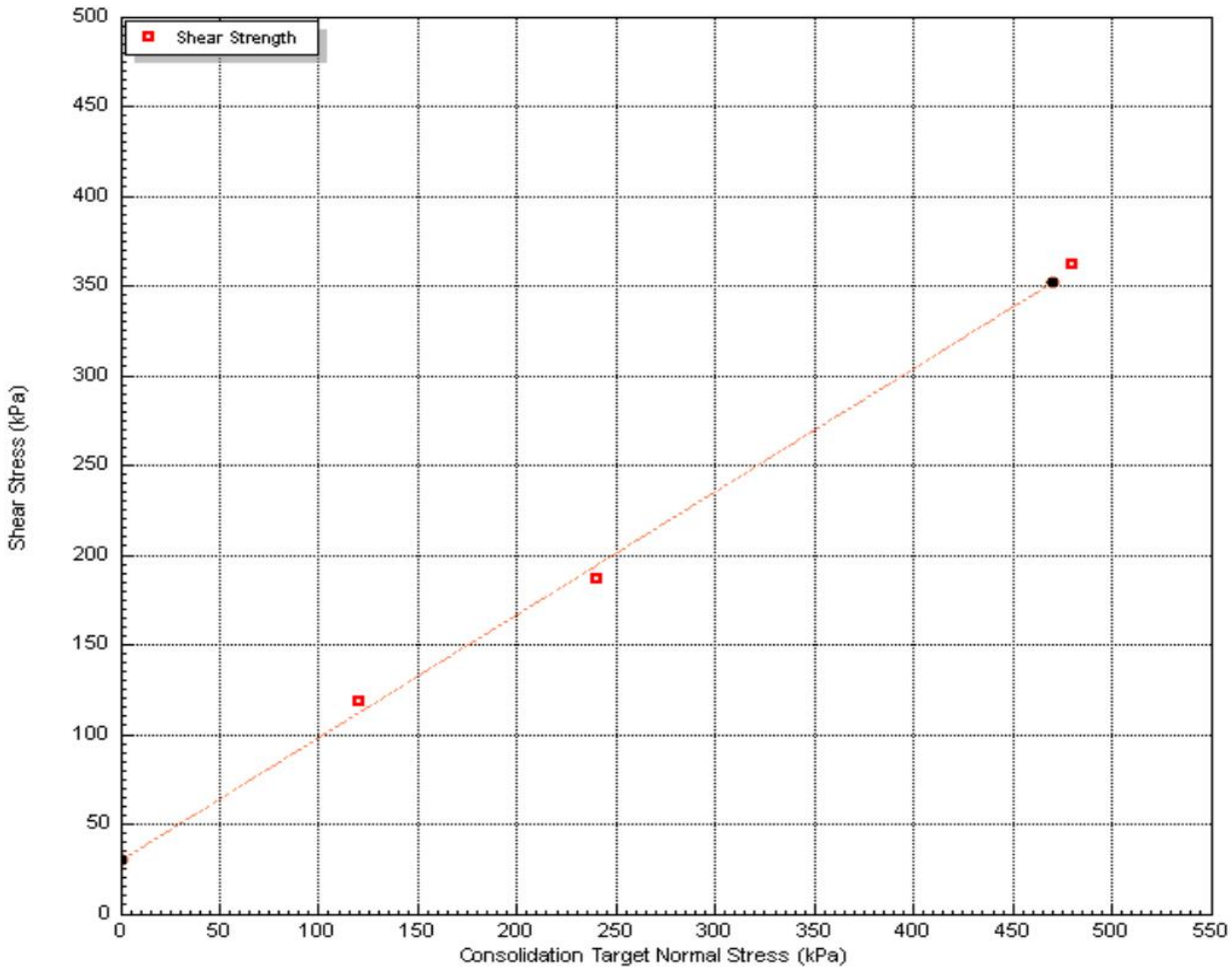




| | Tested | Approved |
|---|---|---|
| UKAS TESTING 10122 / CAUSEWAY GEOTECH | Aaron Nutt | Joseph Nicholl |

Lab Sheet Reference : LAB25R - Version 3

| Direct Shear Test BS EN ISO 17892-10:2018 | | | | |
|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | |
| Location Number | BH08 | Sample Reference | B16 | |
| Depth (m) | 12.00 | Sample Submerged? | 4 | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | 2.65 | Assumed |

| Stage | 1 | 2 | 3 |
|---|---|---|---|
| **Envelope Failure Results** | | | |
| Apparent Cohesion (kPa) | 31 | | |
| Angle of Shearing Resistance (°) | 34.5 | | |




| | Tested | Approved |
|---|---|---|
| UKAS TESTING 10122 / CAUSEWAY GEOTECH | Aaron Nutt | Joseph Nicholl |

Lab Sheet Reference : LAB25R - Version 3

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

# Final Report

| | |
|---|---|
| **Report No.:** | 21-25664-1 |
| **Initial Date of Issue:** | 30-Jul-2021 |
| **Client** | Causeway Geotech Ltd |
| **Client Address:** | 8 Drumahiskey Road<br>Balnamore<br>Ballymoney<br>County Antrim<br>BT53 7QL |
| **Contact(s):** | Carin Cornwall<br>Colm Hurley<br>Darren O'Mahony<br>Gabriella Horan<br>Joe Gervin<br>John Cameron<br>Lucy Newland<br>Martin Gardiner<br>Matthew Gilbert<br>Michelle Gaffney<br>Neil Haggan<br>Paul Dunlop<br>Sean Ross<br>Stephen Franey<br>Stephen Watson<br>Stuart Abraham<br>Thomas McAllist |
| **Project** | 21-0553 Riverine Community Park, Lifford |

| | | | |
|---|---|---|---|
| **Quotation No.:** | | **Date Received:** | 26-Jul-2021 |
| **Order No.:** | | **Date Instructed:** | 26-Jul-2021 |
| **No. of Samples:** | 25 | | |
| **Turnaround (Wkdays):** | 7 | **Results Due:** | 03-Aug-2021 |
| **Date Approved:** | 30-Jul-2021 | | |

**Approved By:**



**Details:** Glynn Harvey, Technical Manager

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

# Results - Soil

**Project: 21-0553 Riverine Community Park, Lifford**

| **Client: Causeway Geotech Ltd** | | | **Chemtest Job No.:** | | 21-25664 | 21-25664 | 21-25664 | 21-25664 | 21-25664 | 21-25664 | 21-25664 | 21-25664 | 21-25664 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Quotation No.: | | | **Chemtest Sample ID.:** | | 1247932 | 1247933 | 1247934 | 1247935 | 1247936 | 1247937 | 1247938 | 1247939 | 1247940 |
| Order No.: | | | Client Sample Ref.: | | 10 | 14 | 20 | 3 | 15 | 19 | 10 | 13 | 16 |
| | | | Sample Location: | | BH02 | BH02 | BH02 | BH03 | BH03 | BH03 | BH05 | BH05 | BH05 |
| | | | Sample Type: | | SOIL | SOIL | SOIL | SOIL | SOIL | SOIL | SOIL | SOIL | SOIL |
| | | | Top Depth (m): | | 1.0 | 5.0 | 10.5 | 0.5 | 4.0 | 9.0 | 1.0 | 4.0 | 7.5 |
| | | | Date Sampled: | | 23-Jul-2021 | 23-Jul-2021 | 23-Jul-2021 | 23-Jul-2021 | 23-Jul-2021 | 23-Jul-2021 | 23-Jul-2021 | 23-Jul-2021 | 23-Jul-2021 |
| **Determinand** | **Accred.** | **SOP** | **Units** | **LOD** | | | | | | | | | |
| Moisture | N | 2030 | % | 0.020 | 18 | 6.0 | 5.5 | | | | 16 | 4.4 | 16 |
| Soil Colour | N | 2040 | | N/A | Brown | Brown | Brown | | | | Brown | Black | Brown |
| Other Material | N | 2040 | | N/A | None | Stones | Stones | | | | Stones | Stones | Stones |
| Soil Texture | N | 2040 | | N/A | Sand | Gravel | Sand | | | | Clay | Sand | Sand |
| pH (2.5:1) | N | 2010 | | 4.0 | 8.0 | 8.1 | 8.5 | | | | 7.3 | 6.7 | 7.5 |
| Magnesium (Water Soluble) | N | 2120 | g/l | 0.010 | < 0.010 | | | | | | < 0.010 | | |
| Sulphate (2:1 Water Soluble) as SO4 | M | 2120 | g/l | 0.010 | < 0.010 | 0.14 | < 0.010 | | | | 0.11 | 0.23 | < 0.010 |
| Chloride (Water Soluble) | M | 2220 | g/l | 0.010 | < 0.010 | | | | | | < 0.010 | | |
| Nitrate (Water Soluble) | N | 2220 | g/l | 0.010 | < 0.010 | | | | | | 0.011 | | |

# Results - Soil

**Project: 21-0553 Riverine Community Park, Lifford**

| **Client: Causeway Geotech Ltd** | | | **Chemtest Job No.:** | | 21-25664 | 21-25664 | 21-25664 | 21-25664 | 21-25664 | 21-25664 | 21-25664 | 21-25664 | 21-25664 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Quotation No.: | | | **Chemtest Sample ID.:** | | 1247941 | 1247942 | 1247943 | 1247944 | 1247945 | 1247946 | 1247947 | 1247948 | 1247949 |
| Order No.: | | | Client Sample Ref.: | | 23 | 25 | 10 | 12 | 14 | 23 | 5 | 7 | 16 |
| | | | Sample Location: | | BH05 | BH05 | BH06 | BH06 | BH06 | BH06 | BH07 | BH07 | BH07 |
| | | | Sample Type: | | SOIL | SOIL | SOIL | SOIL | SOIL | SOIL | SOIL | SOIL | SOIL |
| | | | Top Depth (m): | | 10.5 | 13.5 | 0.5 | 2.0 | 4.0 | 12.0 | 0.5 | 2.0 | 5.0 |
| | | | Date Sampled: | | 23-Jul-2021 | 23-Jul-2021 | 23-Jul-2021 | 23-Jul-2021 | 23-Jul-2021 | 23-Jul-2021 | 23-Jul-2021 | 23-Jul-2021 | 23-Jul-2021 |
| **Determinand** | **Accred.** | **SOP** | **Units** | **LOD** | | | | | | | | | |
| Moisture | N | 2030 | % | 0.020 | 10 | 5.8 | 12 | 25 | 6.2 | 14 | 24 | 6.0 | 2.8 |
| Soil Colour | N | 2040 | | N/A | Grey | Grey | Brown | Brown | Brown | Grey | Brown | Grey | Brown |
| Other Material | N | 2040 | | N/A | Stones and Roots | Stones | Stones and Roots | None | Stones | Stones | Stones | Stones | Stones |
| Soil Texture | N | 2040 | | N/A | Clay | Sand | Sand | Loam | Sand | Sand | Sand | Sand | Sand |
| pH (2.5:1) | N | 2010 | | 4.0 | 8.1 | 8.5 | 6.8 | 8.0 | 7.3 | 7.3 | 6.9 | 7.4 | 7.9 |
| Magnesium (Water Soluble) | N | 2120 | g/l | 0.010 | | | < 0.010 | | | | < 0.010 | | |
| Sulphate (2:1 Water Soluble) as SO4 | M | 2120 | g/l | 0.010 | < 0.010 | < 0.010 | < 0.010 | < 0.010 | < 0.010 | < 0.010 | < 0.010 | < 0.010 | < 0.010 |
| Chloride (Water Soluble) | M | 2220 | g/l | 0.010 | | | < 0.010 | | | | < 0.010 | | |
| Nitrate (Water Soluble) | N | 2220 | g/l | 0.010 | | | < 0.010 | | | | < 0.010 | | |

# Results - Soil

**Project: 21-0553 Riverine Community Park, Lifford**

| **Client: Causeway Geotech Ltd** | | | **Chemtest Job No.:** | | 21-25664 | 21-25664 | 21-25664 | 21-25664 | 21-25664 | 21-25664 | 21-25664 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Quotation No.: | | | **Chemtest Sample ID.:** | | 1247950 | 1247951 | 1247952 | 1247953 | 1247954 | 1247955 | 1247956 |
| Order No.: | | | Client Sample Ref.: | | 18 | 20 | 5 | 8 | 20 | 22 | 24 |
| | | | Sample Location: | | BH07 | BH07 | BH08 | BH08 | BH08 | BH08 | BH08 |
| | | | Sample Type: | | SOIL | SOIL | SOIL | SOIL | SOIL | SOIL | SOIL |
| | | | Top Depth (m): | | 7.5 | 10.5 | 0.5 | 3.0 | 6.0 | 9.0 | 12.0 |
| | | | Date Sampled: | | 23-Jul-2021 | 23-Jul-2021 | 23-Jul-2021 | 23-Jul-2021 | 23-Jul-2021 | 23-Jul-2021 | 23-Jul-2021 |
| **Determinand** | **Accred.** | **SOP** | **Units** | **LOD** | | | | | | | |
| Moisture | N | 2030 | % | 0.020 | 2.6 | 4.7 | 30 | 7.7 | 11 | 3.0 | 4.2 |
| Soil Colour | N | 2040 | | N/A | Grey | Brown | Brown | Brown | Brown | Brown | Brown |
| Other Material | N | 2040 | | N/A | Stones | Stones | Stones | Stones | Stones | Stones | Stones |
| Soil Texture | N | 2040 | | N/A | Gravel | Sand | Clay | Sand | Sand | Sand | Sand |
| pH (2.5:1) | N | 2010 | | 4.0 | 8.1 | 8.3 | 7.5 | 4.4 | 6.6 | 8.0 | 8.2 |
| Magnesium (Water Soluble) | N | 2120 | g/l | 0.010 | | | < 0.010 | | | | |
| Sulphate (2:1 Water Soluble) as SO4 | M | 2120 | g/l | 0.010 | < 0.010 | < 0.010 | < 0.010 | 0.72 | < 0.010 | < 0.010 | < 0.010 |
| Chloride (Water Soluble) | M | 2220 | g/l | 0.010 | | | 0.019 | | | | |
| Nitrate (Water Soluble) | N | 2220 | g/l | 0.010 | | | < 0.010 | | | | |

# Test Methods

| SOP | Title | Parameters included | Method summary |
|---|---|---|---|
| 2010 | pH Value of Soils | pH | pH Meter |
| 2030 | Moisture and Stone Content of Soils(Requirement of MCERTS) | Moisture content | Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C. |
| 2040 | Soil Description(Requirement of MCERTS) | Soil description | As received soil is described based upon BS5930 |
| 2120 | Water Soluble Boron, Sulphate, Magnesium & Chromium | Boron; Sulphate; Magnesium; Chromium | Aqueous extraction / ICP-OES |
| 2220 | Water soluble Chloride in Soils | Chloride | Aqueous extraction and measuremernt by 'Aquakem 600' Discrete Analyser using ferric nitrate / mercuric thiocyanate. |

## Report Information

**Key**

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

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

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

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

**Sample Deviation Codes**

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

**Sample Retention and Disposal**

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

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

# LABORATORY RESTRICTION REPORT

| | | | |
|---|---|---|---|
| Project Reference | 21-0553 | To | Neil Haggan |
| Project Name | Riverine Community Park, Lifford | Position | Project Manager |
| TR reference | 21-0553 / G01 | From | Joseph Nicholl |
| | | Position | Laboratory Quality 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 | | | |
| BH06 | 16 | 6.00 | D | Atterberg limits | Unsuitable material for test - GRAVEL | CANCEL TEST |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

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

| Laboratory Signature | Project Manager Signature |
|---|---|
| Joseph Nicholl | Neil Haggan |
| Date | Date |
| 27 July 2021 | 27 July 2021 |

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

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

www.causewaygeotech.com

**SOIL AND ROCK SAMPLE ANALYSIS**
**LABORATORY TEST REPORT**

9 August 2021

| | |
|---|---|
| **Project Name:** | Riverine Community Park, Lifford Site |
| **Project No.:** | 21-0553A |
| **Client:** | Donegal County Council |
| **Engineer:** | McAdam Design Ltd |

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.

Stephen Watson

Laboratory Manager

Signed for and on behalf of Causeway Geotech Ltd



SCS ISO 9001 CERTIFIED
SCS ISO 14001 CERTIFIED
SCS ISO 45001 CERTIFIED
UKAS MANAGEMENT SYSTEMS 9235
UKAS TESTING 10122
AGS
BRITISH DRILLING ASSOCIATION

**Project Name:** Riverine Community Park, Lifford Site

**Report Reference:** Schedule 2

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

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

| Material tested | Type of test/Properties measured/Range of measurement | Standard specifications | No. of results included in the report |
|---|---|---|---|
| SOIL | Moisture Content of Soil | BS 1377-2: 1990: Cl 3.2 | 4 |
| SOIL | Liquid and Plastic Limits of soil-1 point cone penetrometer method | BS 1377-2: 1990: Cl 4.4, 5.3 & 5.4 | 4 |
| SOIL | Particle size distribution - wet sieving | BS 1377-2: 1990: Cl 9.2 | 4 |
| SOIL | Particle size distribution - sedimentation hydrometer method | BS 1377-2: 1990: Cl 9.5 | 3 |

## SUB-CONTRACTED TESTS

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

| Material tested | Type of test/Properties measured/Range of measurement | Standard specifications | No. of results included in the report |
|---|---|---|---|
| SOIL – Subcontracted to Eurofins Chemtest Ltd *(UKAS 2183)* | BRE Test - Suite A | | 3 |
| SOIL – Subcontracted to Eurofins Chemtest Ltd *(UKAS 2183)* | BRE Test - Suite C | | 1 |

# Summary of Classification Test Results

| Project No. | Project Name |
|---|---|
| 21-0553 | Riverine Community Park, Lifford |

| Hole No. | Sample | | | | Soil Description | Density bulk | Density dry | w | Passing 425µm | LL | PL | PI | Particle density | Casagrande Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ref | Top | Base | Type | | Mg/m3 | | % | % | % | % | % | Mg/m3 | |
| INFIL 002 | 1 | 0.50 | | B | Brown gravelly silty fine to coarse SAND. | | | 14.0 | 94 | 46 -1pt | 30 | 16 | | MI |
| INFIL 003 | 1 | 0.50 | | B | Brown clayey fine to coarse SAND. | | | 42.0 | 59 | 34 -1pt | 24 | 10 | | ML/CL |
| INFIL 004 | 1 | 0.50 | | B | Brown sandy clayey SILT. | | | 37.0 | 93 | 41 -1pt | 28 | 13 | | MI |
| INFIL 004 | 2 | 1.50 | | B | Brown sandy silty CLAY. | | | 39.0 | 99 | 63 -1pt | 28 | 35 | | CH |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |

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

LAB 01R Version 4

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 | |

Date Printed

08/09/2021 00:00

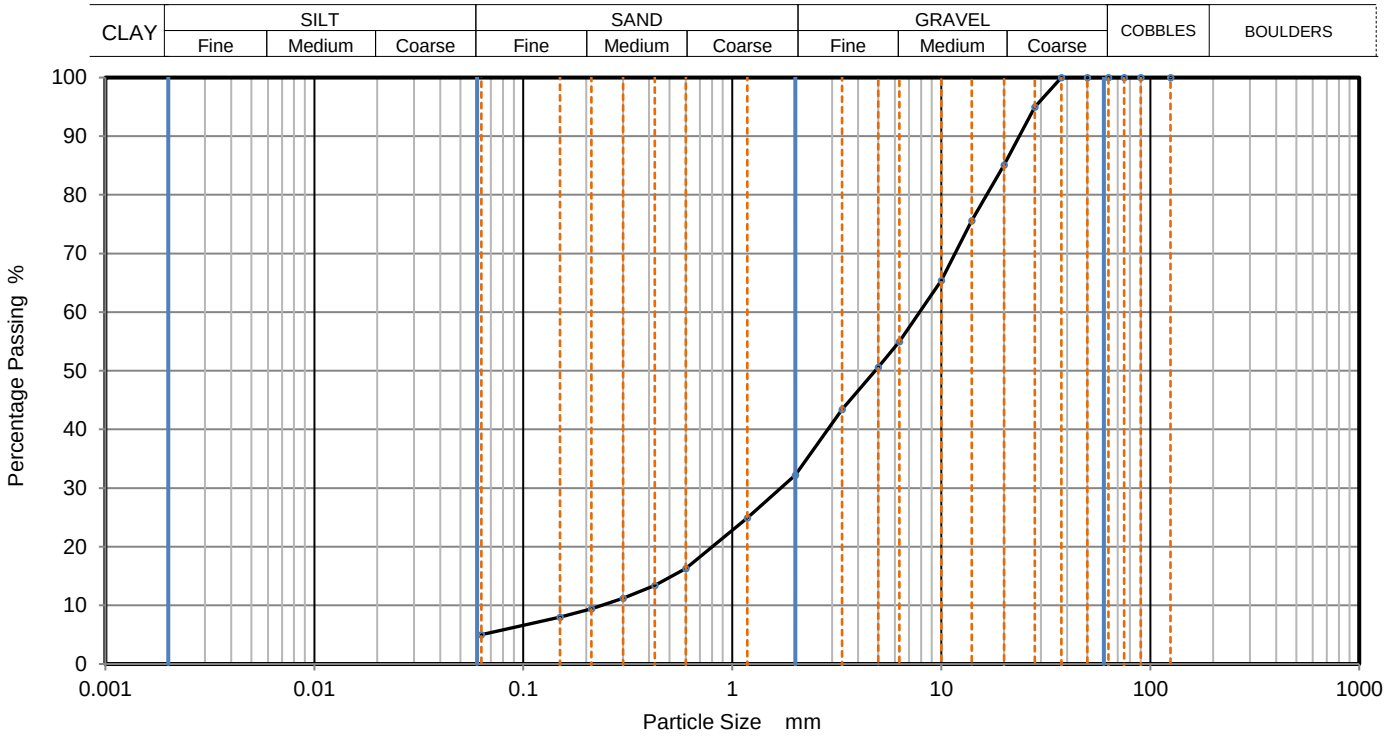
Approved By

Stephen.Watson

UKAS TESTING

10122

| CAUSEWAY GEOTECH | PARTICLE SIZE DISTRIBUTION | | | Job Ref | 21-0553 |
|---|---|---|---|---|---|
| | | | | Borehole/Pit No. | INFIL 001 |
| Site Name | Riverine Community Park, Lifford | | | Sample No. | 1 |
| Soil Description | Brown gravelly silty fine to coarse SAND. | | | Depth, m | 0.50 |
| Specimen Reference | 2 | Specimen Depth | 0.5 m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clause 9.2 | | | KeyLAB ID | Caus2021070674 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | | |
| 90 | 100 | | |
| 75 | 100 | | |
| 63 | 100 | | |
| 50 | 100 | | |
| 37.5 | 100 | | |
| 28 | 95 | | |
| 20 | 85 | | |
| 14 | 76 | | |
| 10 | 65 | | |
| 6.3 | 55 | | |
| 5 | 51 | | |
| 3.35 | 43 | | |
| 2 | 32 | | |
| 1.18 | 25 | | |
| 0.6 | 16 | | |
| 0.425 | 13 | | |
| 0.3 | 11 | | |
| 0.212 | 9 | | |
| 0.15 | 8 | | |
| 0.063 | 5 | | |

| Dry Mass of sample, g | 2813 |
|---|---|

| Sample Proportions | % dry mass |
|---|---|
| Cobbles | 0.0 |
| Gravel | 67.8 |
| Sand | 27.3 |
| | |
| Fines <0.063mm | 5.0 |

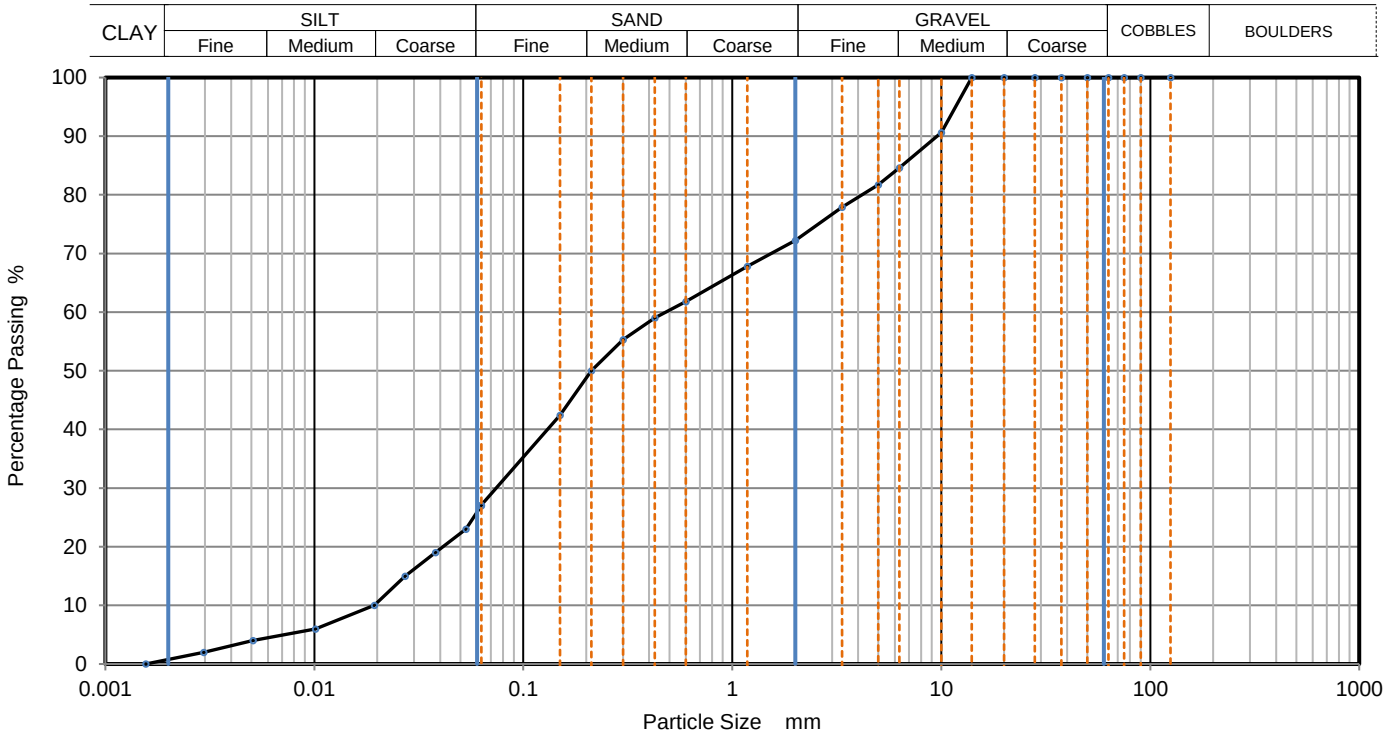
| Grading Analysis | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 7.86 |
| D30 | mm | 1.7 |
| D10 | mm | 0.237 |
| Uniformity Coefficient | | 33 |
| Curvature Coefficient | | 1.6 |

Remarks

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

| Approved |
|---|
| Stephen.Watson |

| | | | | | |
|---|---|---|---|---|---|
| CAUSEWAY GEOTECH | **PARTICLE SIZE DISTRIBUTION** | | | Job Ref | **21-0553** |
| | | | | Borehole/Pit No. | INFIL 002 |
| Site Name | Riverine Community Park, Lifford | | | Sample No. | 1 |
| Soil Description | Brown gravelly silty fine to coarse SAND. | | | Depth, m | 0.50 |
| Specimen Reference | 4 | Specimen Depth | 0.5 m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clauses 9.2 and 9.5 | | | KeyLAB ID | Caus2021070676 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | 0.06300 | 27 |
| 90 | 100 | 0.05308 | 23 |
| 75 | 100 | 0.03795 | 19 |
| 63 | 100 | 0.02713 | 15 |
| 50 | 100 | 0.01938 | 10 |
| 37.5 | 100 | 0.01011 | 6 |
| 28 | 100 | 0.00508 | 4 |
| 20 | 100 | 0.00295 | 2 |
| 14 | 100 | 0.00156 | 0 |
| 10 | 91 | | |
| 6.3 | 85 | | |
| 5 | 82 | | |
| 3.35 | 78 | | |
| 2 | 72 | | |
| 1.18 | 68 | | |
| 0.6 | 62 | Particle density | (assumed) |
| 0.425 | 59 | 2.65 | Mg/m3 |
| 0.3 | 55 | | |
| 0.212 | 50 | | |
| 0.15 | 42 | | |
| 0.063 | 27 | | |

| | |
|---|---|
| Dry Mass of sample, g | 216 |

| **Sample Proportions** | % dry mass |
|---|---|
| Cobbles | 0.0 |
| Gravel | 27.8 |
| Sand | 45.1 |
| Silt | 26.3 |
| Clay | 0.8 |

| **Grading Analysis** | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 0.481 |
| D30 | mm | 0.0743 |
| D10 | mm | 0.0181 |
| Uniformity Coefficient | | 27 |
| Curvature Coefficient | | 0.63 |

Remarks

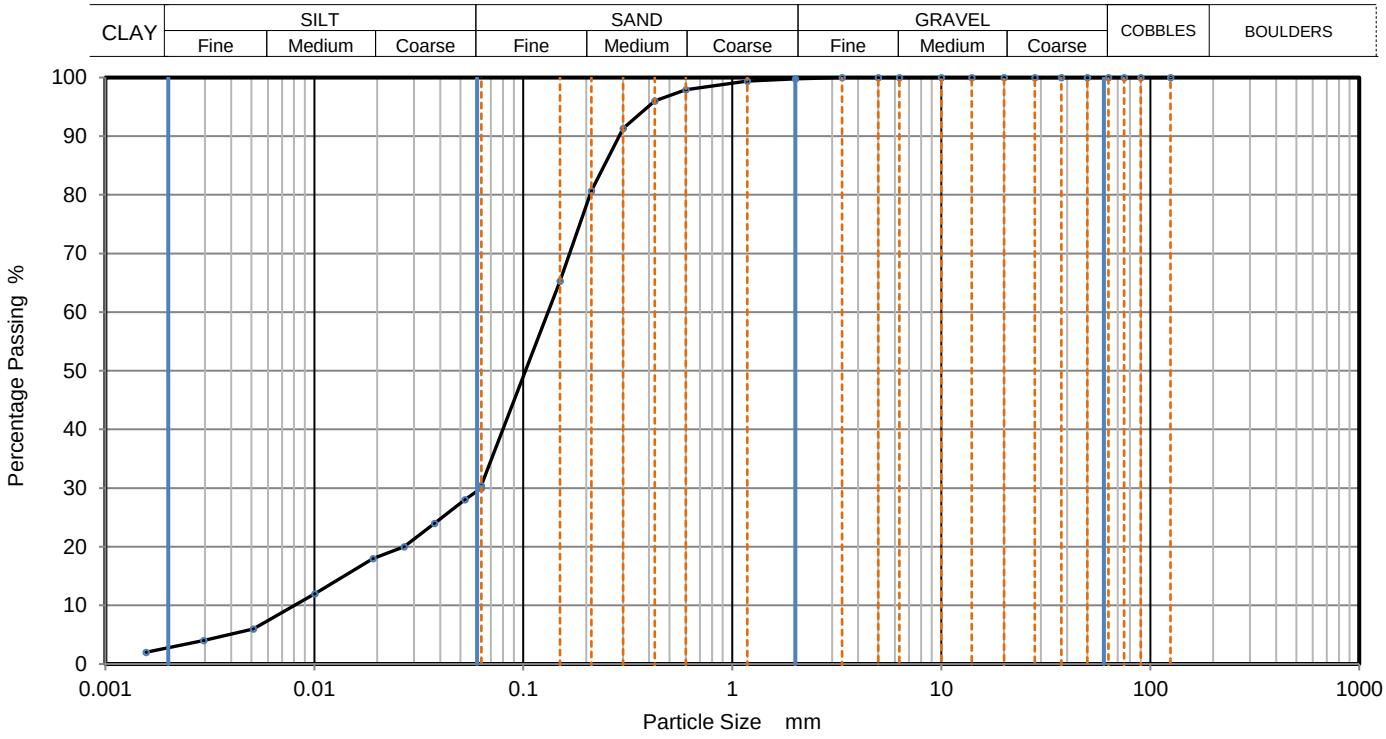
Preparation and testing in accordance with BS1377-2 :1990 unless noted below

| |
|---|
| Approved |
| Stephen.Watson |

LAB 05R Version 4

UKAS TESTING 10122

| CAUSEWAY GEOTECH | PARTICLE SIZE DISTRIBUTION | | | | Job Ref | 21-0553 |
|---|---|---|---|---|---|---|
| | | | | | Borehole/Pit No. | INFIL 003 |
| Site Name | Riverine Community Park, Lifford | | | | Sample No. | 1 |
| Soil Description | Brown clayey fine to coarse SAND. | | | | Depth, m | 0.50 |
| Specimen Reference | 4 | Specimen Depth | 0.5 | m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clauses 9.2 and 9.5 | | | | KeyLAB ID | Caus2021070678 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | 0.06300 | 30 |
| 90 | 100 | 0.05253 | 28 |
| 75 | 100 | 0.03758 | 24 |
| 63 | 100 | 0.02687 | 20 |
| 50 | 100 | 0.01911 | 18 |
| 37.5 | 100 | 0.01003 | 12 |
| 28 | 100 | 0.00509 | 6 |
| 20 | 100 | 0.00296 | 4 |
| 14 | 100 | 0.00156 | 2 |
| 10 | 100 | | |
| 6.3 | 100 | | |
| 5 | 100 | | |
| 3.35 | 100 | | |
| 2 | 100 | | |
| 1.18 | 99 | | |
| 0.6 | 98 | Particle density | (assumed) |
| 0.425 | 96 | 2.65 | Mg/m3 |
| 0.3 | 91 | | |
| 0.212 | 81 | | |
| 0.15 | 65 | | |
| 0.063 | 30 | | |

| Dry Mass of sample, g | 212 |
|---|---|

| Sample Proportions | % dry mass |
|---|---|
| Cobbles | 0.0 |
| Gravel | 0.2 |
| Sand | 69.4 |
| Silt | 27.6 |
| Clay | 2.8 |

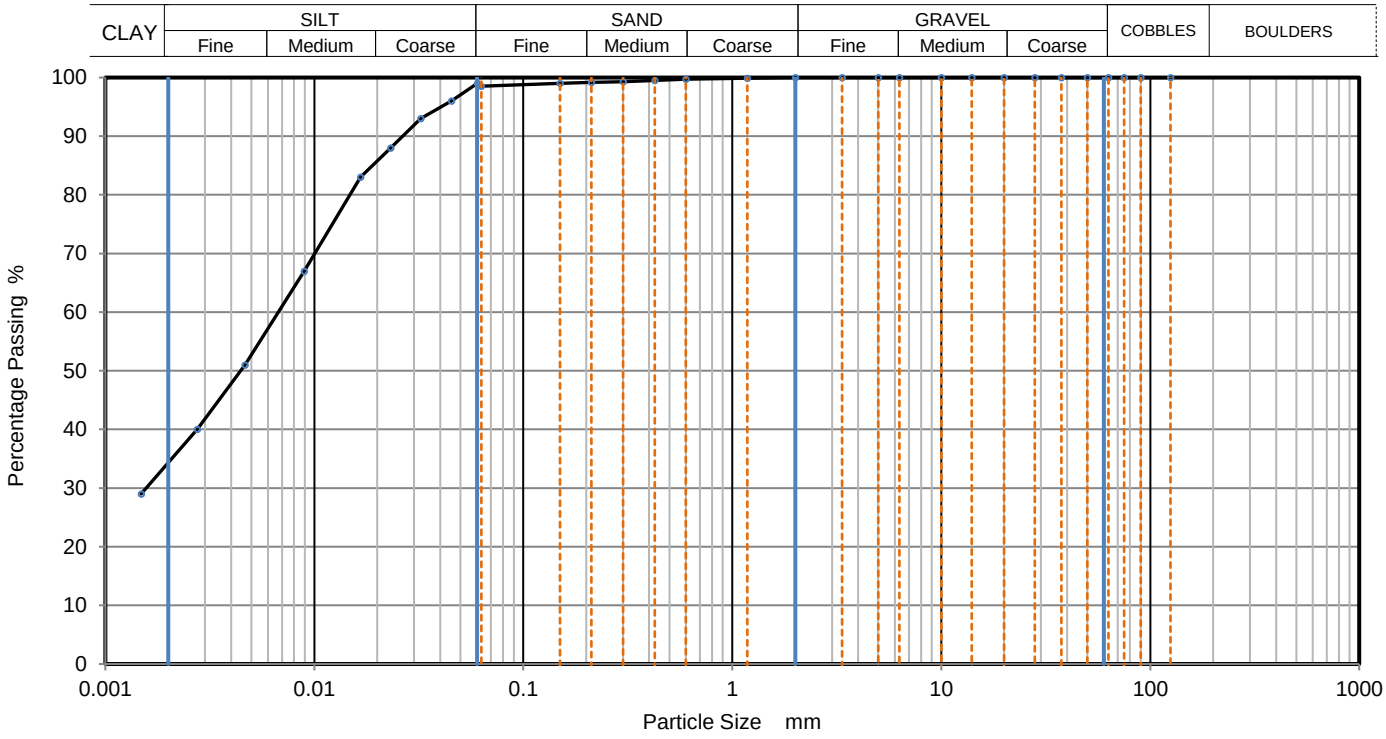
| Grading Analysis | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 0.131 |
| D30 | mm | 0.0607 |
| D10 | mm | 0.00788 |
| Uniformity Coefficient | | 17 |
| Curvature Coefficient | | 3.6 |

Remarks

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

| Approved |
|---|
| Stephen.Watson |

| CAUSEWAY GEOTECH | PARTICLE SIZE DISTRIBUTION | | | | Job Ref | 21-0553 |
|---|---|---|---|---|---|---|
| | | | | | Borehole/Pit No. | INFIL 004 |
| Site Name | Riverine Community Park, Lifford | | | | Sample No. | 2 |
| Soil Description | Brown sandy silty CLAY. | | | | Depth, m | 1.50 |
| Specimen Reference | 4 | Specimen Depth | 1.5 | m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clauses 9.2 and 9.5 | | | | KeyLAB ID | Caus2021070680 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | 0.06039 | 99 |
| 90 | 100 | 0.04526 | 96 |
| 75 | 100 | 0.03226 | 93 |
| 63 | 100 | 0.02316 | 88 |
| 50 | 100 | 0.01662 | 83 |
| 37.5 | 100 | 0.00895 | 67 |
| 28 | 100 | 0.00465 | 51 |
| 20 | 100 | 0.00275 | 40 |
| 14 | 100 | 0.00148 | 29 |
| 10 | 100 | | |
| 6.3 | 100 | | |
| 5 | 100 | | |
| 3.35 | 100 | | |
| 2 | 100 | | |
| 1.18 | 100 | | |
| 0.6 | 100 | Particle density | (assumed) |
| 0.425 | 100 | 2.65 | Mg/m3 |
| 0.3 | 99 | | |
| 0.212 | 99 | | |
| 0.15 | 99 | | |
| 0.063 | 99 | | |

Dry Mass of sample, g: 207

| Sample Proportions | % dry mass |
|---|---|
| Cobbles | 0.0 |
| Gravel | 0.0 |
| Sand | 1.5 |
| Silt | 64.1 |
| Clay | 34.4 |

| Grading Analysis | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 0.00684 |
| D30 | mm | 0.00155 |
| D10 | mm | |
| Uniformity Coefficient | | |
| Curvature Coefficient | | |

Remarks

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

| Approved |
|---|
| Stephen.Watson |

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

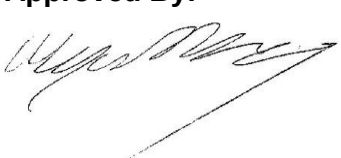
UKAS TESTING
2183

# Final Report

| | |
|---|---|
| **Report No.:** | 21-23652-1 |
| **Initial Date of Issue:** | 15-Jul-2021 |
| **Client** | Causeway Geotech Ltd |
| **Client Address:** | 8 Drumahiskey Road<br>Balnamore<br>Ballymoney<br>County Antrim<br>BT53 7QL |
| **Contact(s):** | Carin Cornwall<br>Colm Hurley<br>Darren O'Mahony<br>Gabriella Horan<br>Joe Gervin<br>John Cameron<br>Lucy Newland<br>Martin Gardiner<br>Matthew Gilbert<br>Michelle Gaffney<br>Neil Haggan<br>Paul Dunlop<br>Sean Ross<br>Stephen Franey<br>Stephen Watson<br>Stuart Abraham<br>Thomas McAllist |
| **Project** | 21-0553 Riverine Community Park, Lifford |

| | | | |
|---|---|---|---|
| **Quotation No.:** | | **Date Received:** | 09-Jul-2021 |
| **Order No.:** | | **Date Instructed:** | 09-Jul-2021 |
| **No. of Samples:** | 5 | | |
| **Turnaround (Wkdays):** | 7 | **Results Due:** | 19-Jul-2021 |
| **Date Approved:** | 15-Jul-2021 | | |

**Approved By:**



**Details:** Glynn Harvey, Technical Manager

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

# Results - Soil

**Project: 21-0553 Riverine Community Park, Lifford**

| **Client: Causeway Geotech Ltd** | | | **Chemtest Job No.:** | | 21-23652 | 21-23652 | 21-23652 | 21-23652 | 21-23652 |
|---|---|---|---|---|---|---|---|---|---|
| Quotation No.: | | | **Chemtest Sample ID.:** | | 1237620 | 1237621 | 1237622 | 1237623 | 1237624 |
| Order No.: | | | Client Sample Ref.: | | 2 | 2 | 1 | 2 | 1 |
| | | | Sample Location: | | INFIL 001 | INFIL 002 | INFIL 003 | INFIL 004 | INFIL 005 |
| | | | Sample Type: | | SOIL | SOIL | SOIL | SOIL | SOIL |
| | | | Top Depth (m): | | 1.50 | 1.50 | 0.50 | 1.50 | 0.50 |
| | | | Date Sampled: | | 08-Jul-2021 | 08-Jul-2021 | 08-Jul-2021 | 08-Jul-2021 | 08-Jul-2021 |
| **Determinand** | **Accred.** | **SOP** | **Units** | **LOD** | | | | | |
| Moisture | N | 2030 | % | 0.020 | 4.7 | 11 | 25 | 30 | |
| pH (2.5:1) | N | 2010 | | 4.0 | 8.3 | 8.1 | 8.0 | 7.8 | |
| Magnesium (Water Soluble) | N | 2120 | g/l | 0.010 | | | < 0.010 | | |
| Sulphate (2:1 Water Soluble) as SO4 | U | 2120 | g/l | 0.010 | < 0.010 | < 0.010 | < 0.010 | < 0.010 | |
| Chloride (Water Soluble) | U | 2220 | g/l | 0.010 | | | < 0.010 | | |
| Nitrate (Water Soluble) | N | 2220 | g/l | 0.010 | | | < 0.010 | | |

# Test Methods

| SOP | Title | Parameters included | Method summary |
|---|---|---|---|
| 2010 | pH Value of Soils | pH | pH Meter |
| 2030 | Moisture and Stone Content of Soils(Requirement of MCERTS) | Moisture content | Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C. |
| 2040 | Soil Description(Requirement of MCERTS) | Soil description | As received soil is described based upon BS5930 |
| 2120 | Water Soluble Boron, Sulphate, Magnesium & Chromium | Boron; Sulphate; Magnesium; Chromium | Aqueous extraction / ICP-OES |
| 2220 | Water soluble Chloride in Soils | Chloride | Aqueous extraction and measuremernt by 'Aquakem 600' Discrete Analyser using ferric nitrate / mercuric thiocyanate. |

## Report Information

**Key**

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

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

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

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

**Sample Deviation Codes**

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

**Sample Retention and Disposal**

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

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

CAUSEWAY GEOTECH

# APPENDIX J

# SPT HAMMER ENERGY MEASUREMENT REPORT



# SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

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

| | |
|---|---|
| SPT Hammer Ref: | 0199 |
| Test Date: | 27/02/2021 |
| Report Date: | 01/03/2021 |
| File Name: | 0199.spt |
| Test Operator: | NPB |

## Instrumented Rod Data

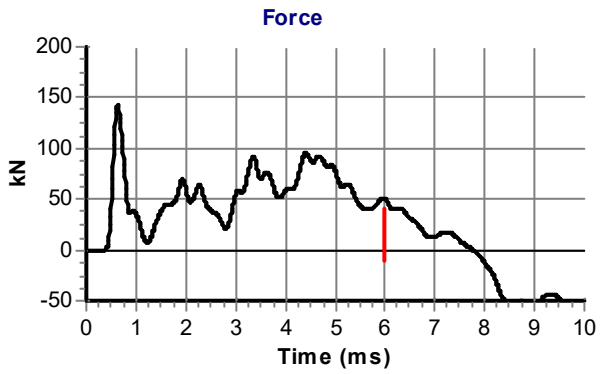
| | |
|---|---|
| Diameter $d_r$ (mm): | 54 |
| Wall Thickness $t_r$ (mm): | 6.3 |
| Assumed Modulus $E_a$ (GPa): | 208 |
| Accelerometer No.1: | 6458 |
| Accelerometer No.2: | 9607 |

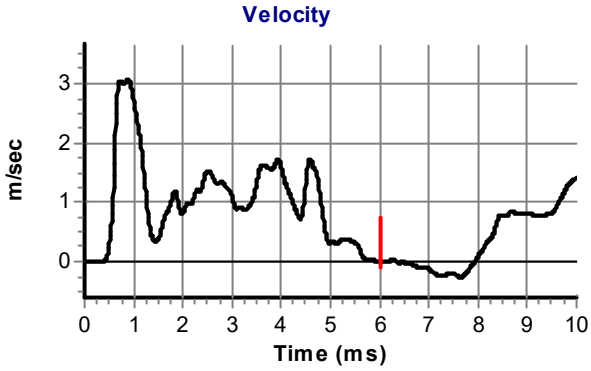
## SPT Hammer Information

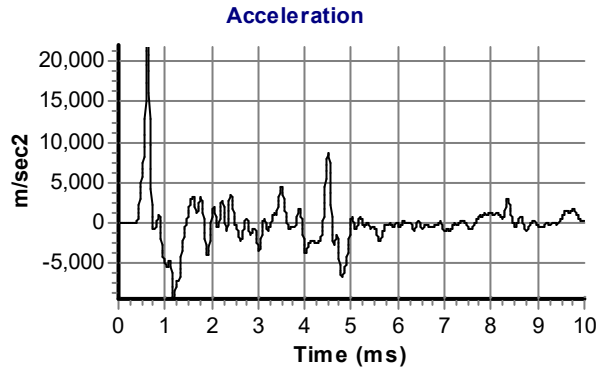
| | |
|---|---|
| Hammer Mass m (kg): | 63.5 |
| Falling Height h (mm): | 760 |
| SPT String Length L (m): | 11.0 |

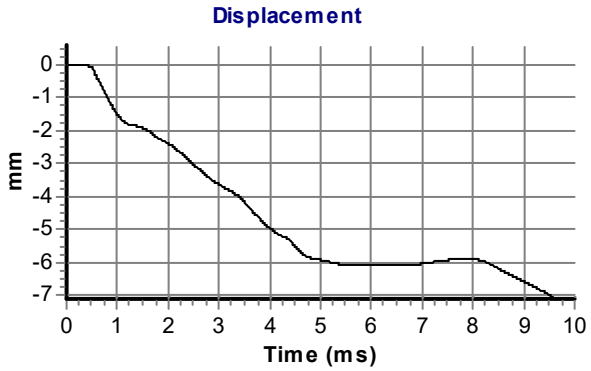
## Comments / Location

BALLYMONEY




## Calculations

| | |
|---|---|
| Area of Rod A (mm2): | 944 |
| Theoretical Energy $E_{theor}$ (J): | 473 |
| Measured Energy $E_{meas}$ (J): | 325 |

**Energy Ratio $E_r$ (%):** **69**

The recommended calibration interval is 12 months

Signed: N P Burrows

Title: Field Operations Manager

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# SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

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

| | |
|---|---|
| SPT Hammer Ref: | 0210 |
| Test Date: | 27/02/2021 |
| Report Date: | 01/03/2021 |
| File Name: | 0210.spt |
| Test Operator: | NPB |

**Instrumented Rod Data**

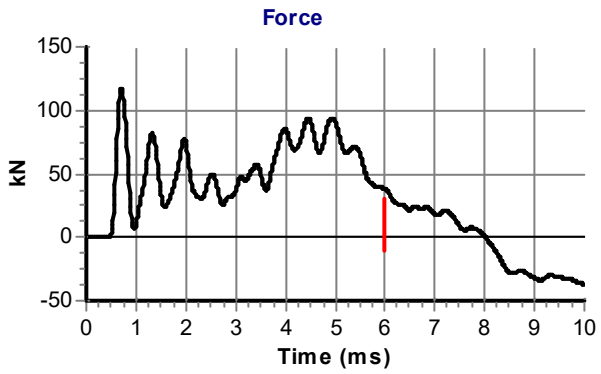
| | |
|---|---|
| Diameter $d_r$ (mm): | 54 |
| Wall Thickness $t_r$ (mm): | 6.3 |
| Assumed Modulus $E_a$ (GPa): | 208 |
| Accelerometer No.1: | 6458 |
| Accelerometer No.2: | 9607 |

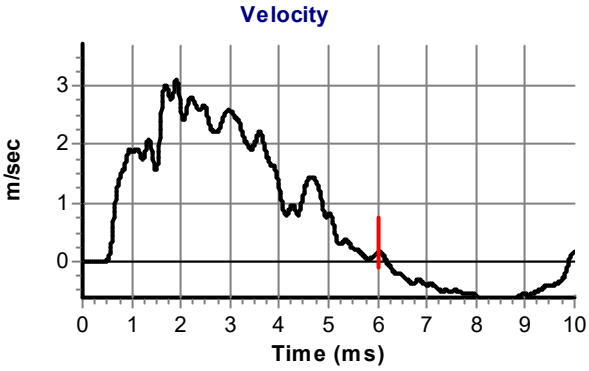
**SPT Hammer Information**

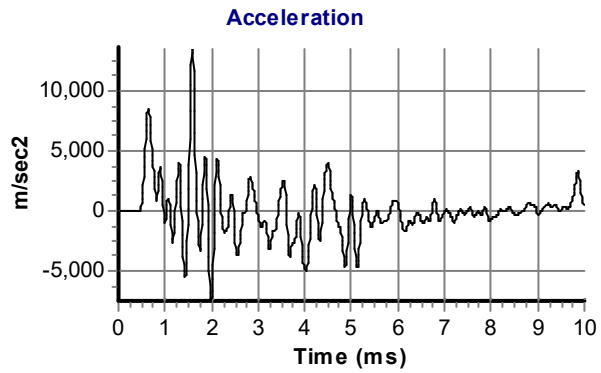
| | |
|---|---|
| Hammer Mass m (kg): | 63.5 |
| Falling Height h (mm): | 760 |
| SPT String Length L (m): | 11.0 |

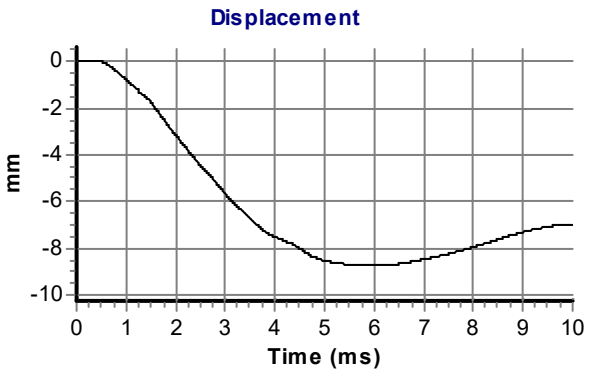
**Comments / Location**

BALLYMONEY




**Calculations**

| | |
|---|---|
| Area of Rod A (mm2): | 944 |
| Theoretical Energy $E_{theor}$ (J): | 473 |
| Measured Energy $E_{meas}$ (J): | 297 |

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

Signed: N P Burrows

Title: Field Operations Manager

The recommended calibration interval is 12 months

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## Appendix 9-8

### Geotechnical Report - Strabane

# Riverine Community Park, Strabane Site – Site Investigation

# INTERPRETATIVE REPORT

| | |
|---|---|
| Client: | Derry City and Strabane District Council |
| Client's Representative: | McAdams Design Ltd |
| Report No.: | 21-0553B INTERP |
| Date: | 18th August 2021 |

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

+44 (0)28 2766 6640
info@causewaygeotech.com
www.causewaygeotech.com

Registered in Northern Ireland. Company Number: NI610766
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

1 AUTHORITY ..... 5

2 SCOPE ..... 5

3 DESCRIPTION OF SITE ..... 5

4 SITE OPERATIONS ..... 6
4.1 Summary of site works ..... 6
4.2 Boreholes ..... 6
4.3 Standpipe installations ..... 7
4.4 Trial Pits ..... 7
4.5 Infiltration tests ..... 7
4.6 Indirect CBR tests (DCP) ..... 7
4.7 Surveying ..... 8
4.8 Groundwater and ground gas monitoring ..... 8

5 LABORATORY WORK ..... 8
5.1 Geotechnical laboratory testing of soils ..... 8

6 GROUND CONDITIONS ..... 9
6.1 General geology of the area ..... 9
6.2 Ground types encountered during investigation of the site ..... 9
6.3 Groundwater ..... 9

7 DISCUSSION ..... 10
7.1 Proposed construction ..... 10
7.2 Recommendations for construction ..... 10
7.2.1 Summary ..... 10
7.2.2 Soil strength parameters ..... 10
7.2.3 Bearing resistance ..... 11
7.2.4 Foundation construction ..... 11
7.2.5 Excavations for services ..... 13
7.2.6 Excavations in peat ..... 13
7.2.7 Soil aggressivity ..... 14
7.2.8 Access roads, car parks and hard standing ..... 15
7.3 Infiltration drainage ..... 16

8 REFERENCES ..... 16

## APPENDICES


| | |
|---|---|
| Appendix A | Site and exploratory hole location plans |
| Appendix B | Borehole logs |
| Appendix C | Soakaway logs and test results |
| Appendix D | Soakaway photographs |
| Appendix E | Indirect in-situ CBR test results |
| Appendix F | Groundwater monitoring records |
| Appendix G | Geotechnical laboratory test results |
| Appendix H | SPT hammer energy measurement reports |

## Document Control Sheet

| | | | | | |
|---|---|---|---|---|---|
| **Report No.:** | | 21-0553B - INTERPRETATIVE | | | |
| **Project Title:** | | Riverine Community Park, Strabane – Site Investigation | | | |
| **Client:** | | Derry City and Strabane District Council | | | |
| **Client's Representative:** | | McAdams Design Ltd | | | |
| **Revision:** | A01 | **Status:** | Final for issue | **Issue Date:** | 18th August 2021 |
| **Prepared by:** | | **Reviewed by:** | | **Approved by:** | |
|  Carin Cornwall BSc MSc PhD | |  Neil Haggan BSc (Hons) MSc FGS | |  Darren O'Mahony BSc MSc MIEI EurGeol PGeo | |

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+A1:2020, Code of practice for site investigations.

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

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. |
| (Y for Z/ Y for Z) | Incomplete standard penetration test where the full test length was not achieved. The blows 'X' represent the total blows for the given seating or test length 'Z' (mm). |
| N=X | SPT blow count 'N' given by the summation of the blows 'X' required to drive the full test length (300mm). |
| HVP / HVR | In situ hand vane test result (HVP) and vane test residual result (HVR). Results presented in kPa. |
| V<br>VR | Shear vane test (borehole). Shear strength stated in kPa.<br>V: undisturbed vane shear strength VR: remoulded vane shear strength |
| Soil consistency description | In cohesive soils, where samples are disturbed and there are no suitable laboratory tests, N values may be used to indicate consistency on borehole logs – a median relationship of Nx5=Cu is used (as set out in Stroud & Butler 1975). |
| dd-mm-yyyy | Date at the end and start of shifts, shown at the relevant borehole depth. Corresponding casing and water depths shown in the adjacent columns. |
| ▽ | Water strike: initial depth of strike. |
| ▼ | Water strike: depth water rose to. |
| Abbreviations relating to rock core – reference Clause 36.4.4 of BS 5930: 2015 | |
| TCR (%) | Total Core Recovery: Ratio of rock/soil core recovered (both solid and non-intact) to the total length of core run. |
| SCR (%) | Solid Core Recovery: Ratio of solid core to the total length of core run. Solid core has a full diameter, uninterrupted by natural discontinuities, but not necessarily a full circumference and is measured along the core axis between natural fractures. |
| RQD (%) | Rock Quality Designation: Ratio of total length of solid core pieces greater than 100mm to the total length of core run. |
| FI | Fracture Index: Number of natural discontinuities per metre over an indicated length of core of similar intensity of fracturing. |
| NI | Non Intact: Used where the rock material was recovered fragmented, for example as fine to coarse gravel size particles. |
| AZCL | Assessed zone of core loss: The estimated depth range where core was not recovered. |
| DIF | Drilling induced fracture: A fracture of non-geological origin brought about by the rock coring. |
| (xxx/xxx/xxx) | Spacing between discontinuities (minimum/average/maximum) measured in millimetres. |

# Riverine Community Park, Strabane

## 1 AUTHORITY

On the instructions of McAdams Design Ltd, ("the Client's Representative"), acting on the behalf of Derry City and Strabane District Council ("the Client"), a ground investigation was undertaken at the above location to provide geotechnical information for input to the design and construction of a proposed community park development.

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

All information given in this report is based upon the ground conditions encountered during the 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, soakaway tests, indirect CBR tests, ground water monitoring, soil sampling, in-situ and laboratory testing, and the preparation of a report on the findings including recommendations for construction.

## 3 DESCRIPTION OF SITE

As shown on the site location plans in Appendix A, the works were conducted on both sides of the River Foyle at Lifford and Strabane. On the Strabane side, the site areas included the old Traveller Park and surrounding lands, private farmlands to the north near the existing WwTW and associated adjacent public lands along the eastern bank of the river.

The site is flat within the area of the Travellers' site with surrounding areas generally overgrown and sloping downwards towards the riverbank.

# 4 SITE OPERATIONS

## 4.1 Summary of site works

Site operations, which were conducted between 20th May and 8th July 2021, comprised:

- one light cable percussion boreholes
- rotary percussion follow-on in one borehole
- a standpipe installation in one borehole
- three machine dug trial pits
- an infiltration test performed in three trial pits
- indirect CBR tests at thirty-three 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

One borehole (BH03) was put down to completion in minimum 200mm diameter using a light cable percussion boring rig and rotary follow-on drilling techniques. Where the cable percussion borehole could not be advanced, rotary percussive methods were used to advance the borehole to scheduled completion depth. Symmetrix cased full-hole drilling was used, with SPTs carried out at standard intervals as required.

A hand dug inspection pit was carried out between ground level and 1.20m depth to ensure the borehole was put down at a location clear of services or subsurface obstructions.

Disturbed (bulk and small bag) samples were taken within the encountered strata. Undisturbed (UT100) 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+A1:2011 at standard depth intervals using the split spoon sampler ($SPT_{(s)}$) or solid cone attachment ($SPT_{(c)}$). The penetrations are stated for those tests for which the full 150mm seating drive or 300mm test drive was not possible. The N-values provided on the borehole logs are uncorrected and no allowance has been made for energy ratio corrections. The SPT hammer energy measurement report is provided in Appendix H.

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

Where water was added to assist with boring, a note has been added to the log to account for same. Appendix B presents the borehole logs.

## 4.3 Standpipe installations

A groundwater monitoring standpipe was installed in borehole BH03.

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

## 4.4 Trial Pits

Three trial pits (INFIL 005 to INFIL 007) were excavated using an 8t tracked excavator fitted with a 600mm wide bucket, to depths of 2.00-2.10m. Both trial pits were excavated to allow completion of infiltration test.

Disturbed (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 three locations (INFIL 005 to INFIL 007) in accordance with BRE Digest 365 - Soakaways (BRE, 2016). The tests were conducted in similarly numbered trial pits.

The absence of the outflow from INFIL 005 and INFIL 007 precluded calculation of infiltration coefficients; results were obtained for the INFIL 006 location.

Appendix C presents the results and analysis of the infiltration tests with photographs of the trial pits in Appendix D.

## 4.6 Indirect CBR tests (DCP)

An indirect CBR test was conducted at thirty-two locations (CBR29 – CBR49, CBR51 - CBR59, INFIL 005 - INFIL 007) using a Dynamic Cone Penetrometer (DCP). The equipment was developed in conjunction with the UK Transport Research Laboratory, is used widely throughout the world, and is referred to in the UK Highway Agency Interim Advice Note 73/06.

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

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

The frequently elevated CBR values at depth 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. All elevations given are referenced to existing ground level for all exploratory hole locations.

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 over four rounds. Ground water monitoring was carried out using a water interface probe. A digital datalogger was also installed in boreholes BH03 for a period of approximately 1 week; the reported data has been provided separately.

The monitoring records are presented in Appendix F.

# 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.
- **compressibility:** one dimensional consolidation (oedometer)
- **direct shear:** small shear box tests
- **soil chemistry:** pH and water-soluble sulphate content, organic matter content, BRE Suite A (greenfield – no pyrite), and BRE Suite C (brownfield – no pyrite)

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 tidal flat deposits, peat, and fluvioglacial sands and gravels. These deposits are underlain at depth by quartzites of the Dungiven Quartzite Formations.

## 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 100-250mm thickness across the site.
- **Made Ground (sub-base):** approximately 500mm of aggregate fill beneath the topsoil in INFIL 006.
- **Made Ground (fill):** reworked sandy gravelly fill with fragments of concrete, timber, red brick, glass, metal, roofing tiles and crockery found at 600mm depth immediately beneath the granular fill in INFIL 006 extending to a depth of 1.70m.
- **Recent deposits (peat):** pseudo-fibrous peat with roots and rootlets encountered in INFIL 007 from 0.25m-0.80m.
- **Tidal flat deposits:** typically, very soft to soft organic silts/clays or very loose to loose silty sands found immediately beneath the topsoil in the majority of site areas.
- **Fluvioglacial deposits:** typically, medium dense to very dense sands and gravels, frequently with cobbles and boulders. Found to persist in BH03 to 20.00m termination depth.

## 6.3 Groundwater

Groundwater was encountered during percussion boring through soil as water strikes in BH03; struck at 9.00m and rose to 2.00m (20mins). Groundwater was also encountered as seepage in trial pit INFIL 005 at 2.00m; both other trial pits were dry.

The groundwater at depth beneath the site appears to be under pressure, likely affected by the tidal nature of the River Foyle running adjacent to the site. In a number of holes there are “fines” noted in the granular material immediately above the layer containing the water strikes which would go some way to explaining why we are seeing the large groundwater rises noted on the logs when the rotary rig penetrates the groundwater bearing strata.

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

Continued monitoring of the installed standpipes will give an indication of the seasonal variation in groundwater level which should be factored into design considerations.

Details of further groundwater monitoring, are presented in Appendix F.

# 7 DISCUSSION

## 7.1 Proposed construction

It is proposed to construct a new community park development on the site with footbridge and associated infrastructure. There will be a number of structures including a pedestrian and cycle bridge between Lifford and Strabane, Riverine Park Building, multi-functional outdoor space and external stage provision, play area, river walk and access, landscaped greenspaces interlaced with a network of pathways and cycleways, wetlands supported by car parking provision.

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

## 7.2 Recommendations for construction

### 7.2.1 Summary

The ground conditions across the site (highly variable alluvial deposits, with fluvioglacial material at depth), coupled with the relatively shallow groundwater table will render the implementation of any shallow (spread) foundations problematic, and in most areas of the site not suitable. For the proposed footbridge it follows that the most practicable solution for installing safe working foundations will be by a "deep" foundation method, such as piling to transfer loadings to depth.

### 7.2.2 Soil strength parameters

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

$$C_u = f_1 \times N$$

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

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

### 7.2.3 Bearing resistance

The undrained bearing resistance as displayed in Annex D of EN 1997-1 gives the following equation:

$$\frac{R}{A'} = (\pi + 2)c_u b_c s_c i_c m + q$$

Where:

$c_u$ = the soil's undrained shear strength
q = the total overburden pressure at the foundation base
R = design resistance
A' = area of foundation (unknown at this stage)
b = base inclination factor
s = shape factor
i = load inclination factor
m = 0.70 material factor (glacial till in Northern Ireland)

The drained bearing resistance of a spread foundation $q_{ult}$ is shown in the following equation:

$$q_{ult} = c'N_c + q'N_q + \frac{\gamma'BN_\gamma}{2}$$

Where:

c' = the soil's effective cohesion
q' = the effective overburden pressure at the foundation base
γ = the effective weight density of the soil below the foundation
$N_c$, $N_q$, $N_\gamma$ = bearing capacity factors

This table does not take into account the variations in soil composition, and the effects of differential movement within a particular structure. Calculation of the design bearing resistance over the entire structure will entail a knowledge of the magnitude and distribution of the structural actions.

In the UK the Eurocodes are applied using Design Approach 1, of which there are two combinations. In Design Approach 1, Combination 1, partial factors are applied to actions alone. In Design Approach 1, Combination 2 the partial factors are mainly applied to the material factors.

### 7.2.4 Foundation construction

Foundations should transfer loading to below any Made Ground or subsoil. The recommended foundation construction depths and design resistances at the borehole locations are presented in Table 1.

Design resistances for Design Approach 1 - Combinations 1 and 2 are both shown in the table on the following page. The density of overburden soils has been assumed to be 20kN/m3.

**Table 1: Base foundations construction recommendations**

| Borehole | Depth below EGL* to suitable bearing stratum (m) | Design resistance kPa DA1 Comb1/2 | Strata description | Foundation type | Groundwater mbgl |
|---|---|---|---|---|---|
| BH03 | 14.00m | 1770/683 | Very dense GRAVEL | Piled | Struck at 9.00m<br>Install 2.50m |

*Existing Ground Level

This table presents the minimum founding level and the bearing resistance expected at these levels. Where the prescribed bearing resistance is insufficient to support the structural loads, increased bearing pressures may be achieved at greater depths. Foundations placed at the depths indicated above are assumed to be 1.00m in width. Shape factors, inclination factors and depth factors have all been ignored and therefore have a value of 1. The self-weight of foundations has also been ignored.

The practicable alternative foundation solutions are:

1. Piling to transfer loadings to depth:

Piling to transfer loadings to depth is suggested to be the most practicable and applicable option given the depth to a consistent bearing stratum across the site, coupled with the relatively shallow water table which would be problematic for any open trench shallow foundation systems.

Driven piles are the preferred pile type – of precast concrete or steel/ductile iron. The piles should be driven to a predetermined set – each pile will, therefore, be effectively proof tested by the installation method.

If the surrounding land use precludes the use of hard drive piles, due to environmental restrictions with respect to noise and vibration, low vibration driven piles, continuous flight auger (CFA) or continuous helical displacement (CHD) piles will be required.

Piles will acquire capacity from shaft friction through the alluvial and glacial deposits, and end bearing within the very dense gravels.

Where site levels are to be raised, piles should be designed to resist additional loading that will arise due to negative skin friction along the pile length passing through Made Ground and soft soils.

The detailed design of piles should be undertaken in conjunction with specialist piling contractors. Their proposals should include the means to verify that the required load capacity has been achieved: for example, dynamic pile tests and/or static load tests.

### 7.2.5 Excavations for services

For the installation of services ducts/trenches, it is suggested that open trenching will be the most practicable construction method. Generally speaking, the ground conditions should render the use of open trenching by backhoe excavator possible, with some trench support required for the uppermost peat-bearing/granular stratum.

Where working in open trenches, it is thought that trench support systems, by way of a trench box (or possibly sheet piles), will be required to maintain trench stability and safe working conditions. Groundwater control at these locations should be possible by means of sump pumping.

To preclude the eventuality of differential settlements in pipes, they should be laid on a consistent stratum of appropriate allowable bearing capacity and protected with appropriate fill cover.

Where ducts and chambers must be installed in areas where localised soft spots are encountered, the use of geogrid reinforcement along the base of the excavation on is recommended. This will stiffen the base of the trench and help control longitudinal differential settlement.

Backfilling of trenches may be completed by using compacted Cl 804 granular fill and reinstated as appropriate.

### 7.2.6 Excavations in peat

The site logs show some peat deposits in the proposed car park area in the northeast of the site. It is found to be at 550mm thick in INFIL 007 at the eastern side of the car park site (to a localized maximum depth of 0.80m below ground level).

Generally speaking, where peat is present in excess of 2.50m thickness, it is known to pose problems in excavations. The thickness of peat present across the site typically falls well below this threshold, and as such the proposed locations should be considered viable, with insignificant risk ratings with regard to peat slide potential.

Given the mean peat thickness across the locations of any proposed pipe/ducts routes, there should be no significant impact on the proposed construction.

#### 7.2.6.1 Mitigation measures

To further reduce the risk for peat slide potential, a number of mitigation measures may be adopted:

- Spoil heaps should not be spread over existing peat layers in thickness >0.50m and should not be placed downslope of adjacent peat. Instead, it should be deposited on the flanks of the excavation and spread out to limit the surcharge pressure on sensitive peat

- Maintain vigilance of open excavations during and after periods of prolonged precipitation, where risk of mobility of peat is greatest

- Trench support systems should be employed – locally trench boxes should suffice, in regions of laterally extensive peat then a more fixed shoring system should be installed.

- The duration that the excavation is open should be limited

- A comprehensive monitoring regime should be set up during construction works such that ground movement and groundwater conditions are being constantly monitored by a qualified, competent and experienced professional.

#### 7.2.6.2 Conclusion

By adhering to best practicable means and adopting the mitigation measures outlined above, coupled with the generally thin peat deposits (<1m thick) and lack of significant shallow groundwater strikes in trial pit excavations, it is thought that there is minimal potential for adverse impact to the stability of the peat land across the site.

### 7.2.7 Soil aggressivity

An assessment of the Aggressive Chemical Environment for Concrete (ACEC) was undertaken through reference to the Building Research Establishment (BRE) Special Digest 1 (2017).

As noted by BRE Special Digest 1, sulphates in the soil and groundwater are the chemical agents most likely to attack concrete. The extent to which sulphates affect concrete is linked to their concentrations, the type of ground, the presence of groundwater, the type of concrete and the form of construction in which concrete is used.

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

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

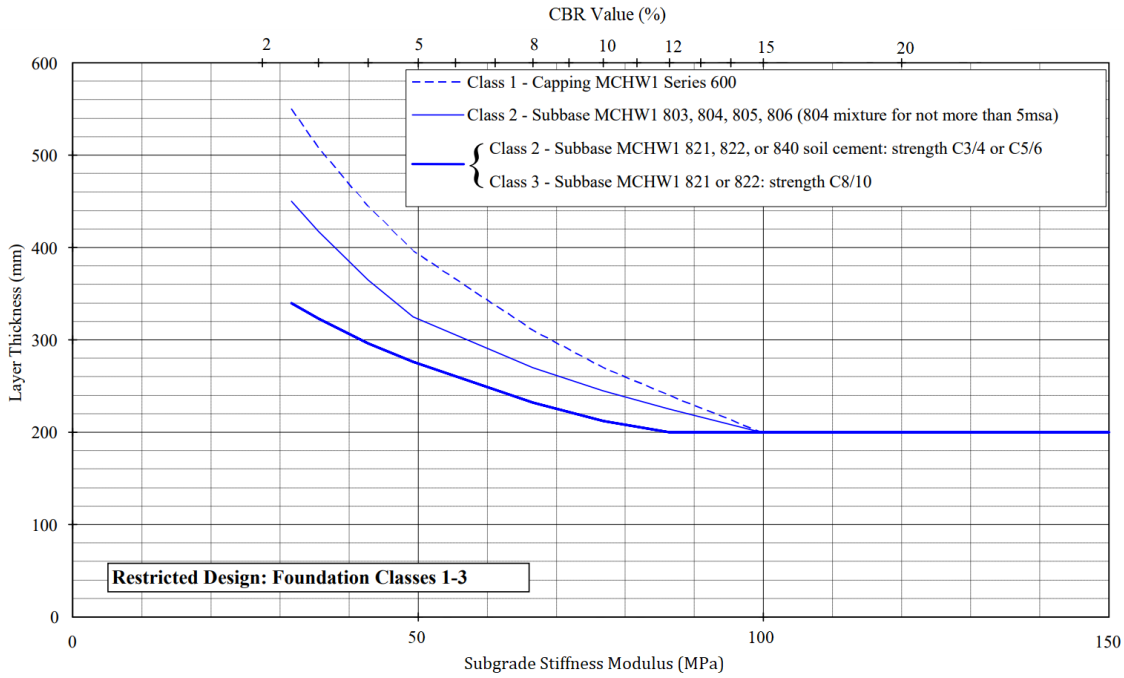
For the purposes of this report the site was classified as not having been subject to previous industrial development and not perceived as containing pyrite.

The results of chemical tests (pH and water-soluble sulphate contents) on soil samples indicate Design Sulphate Class DS-2 and ACEC Class AC-1s – reference Table C1 of BRE Special Digest 1 (Building Research Establishment, 2005). The Special Digest does not require any measures to protect underground concrete elements greater that 140mm thick.

### 7.2.8 Access roads, car parks and hard standing

Based on a summary of the CBR tests undertaken at the site, it is envisaged that the upper alluvial layers at the site would be suitable for the placement of road make up layers. Most areas across the site have CBR values in excess of 5% at a depth of 0.5mbgl.

2.1 of volume 7 section2 of the Design Manual for Roads and Bridges (below), gives guidance on the average thickness of the pavement layers in relation to the CBR results. As can be seen, a CBR in excess of 5% requires a 400mm thick capping layer.




Table

**Table 2.1 (DMRB Vol.7 Sec2) 2009**

Testing indicated potentially lower CBR values in the north-eastern parts of the site (e.g. CBR 053, 055, 057). The above plot should be used to determine the thicknesses of any capping or sub-base layers that may need to be placed in these areas.

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

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

## 7.3 Infiltration drainage

An infiltration test was carried out in trial pit INFIL 006 and the rate of infiltration was calculated as 1.584m/hr. The rates of infiltration coupled with the soil descriptions imply that the subsoil may be considered suitable media for an infiltration drainage system.

Infiltration tests were also carried out in trial pits INFIL 005 and INFIL 007; the rate of infiltration was too small to determine at both locations. The low-permeability fine-grained soils are therefore considered to be poor infiltration media and would be deemed unsuitable for the implementation of infiltration drainage systems at these locations.

Reference should be made the Sustainable Drainage Systems (SuDS) design guidance, taking into account meteorological conditions and a hydrogeological assessment.

# 8 REFERENCES

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

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

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

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

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

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

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

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

CAUSEWAY GEOTECH

# APPENDIX A

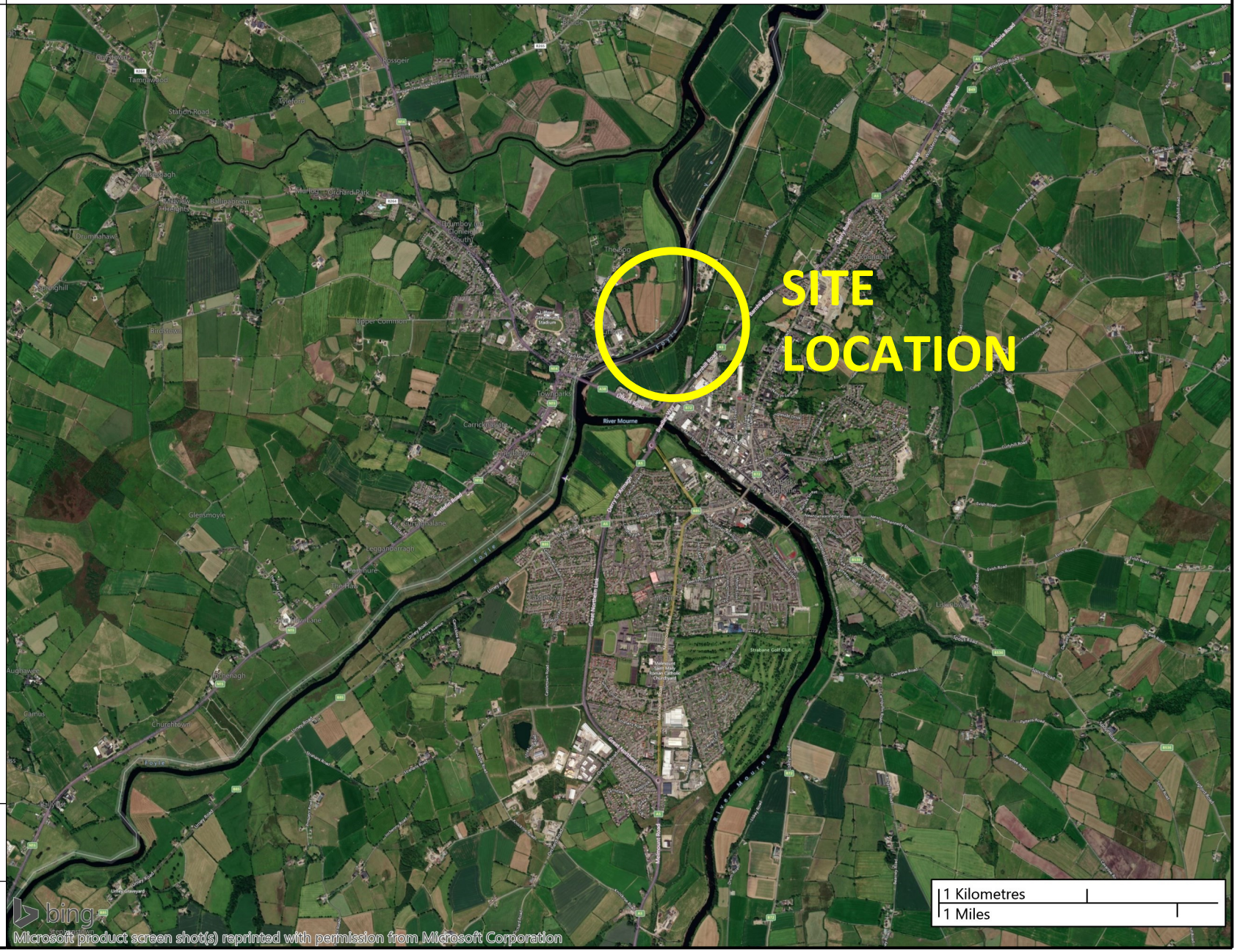
# SITE AND EXPLORATORY HOLE LOCATION PLAN



CAUSEWAY GEOTECH

| | | | |
|---|---|---|---|
| **Project No.:** | 21-0553B | **Client:** | Derry City and Strabane District Council |
| **Project Name:** | Riverine Community Park, Strabane Site | **Client's Representative:** | McAdam Design Ltd |

Legend Key




**Title:**

Site Location Plan

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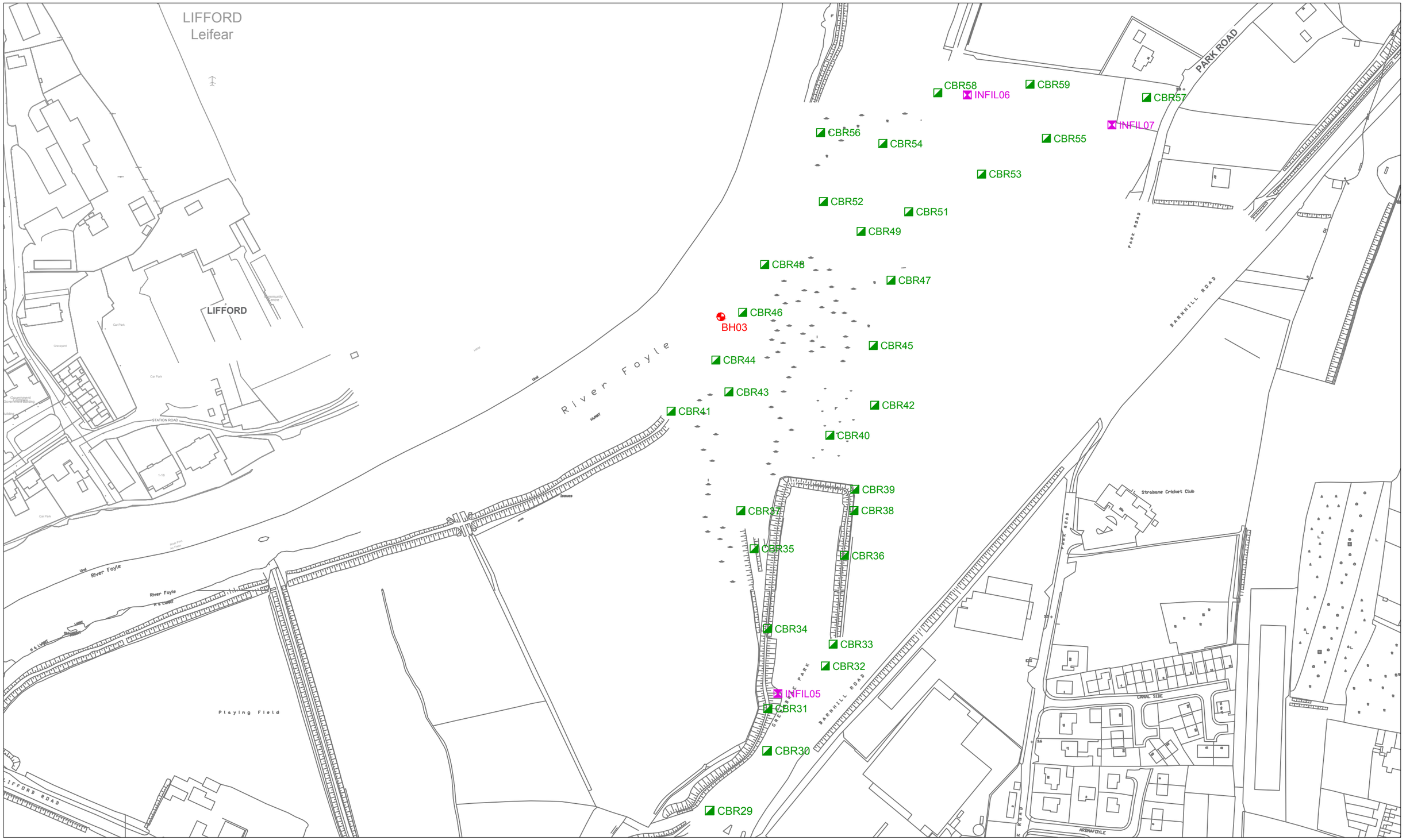



| | | | |
|---|---|---|---|
| PROJECT: Riverine Community Park, Strabane Site | | TITLE: Exploratory hole location plan | |
| CLIENT: Derry City and Strabane District Council | KEY: Borehole; California Bearing Ratio; Infiltration Test | CAUSEWAY GEOTECH | SCALE: NTS@A3 |
| ENGINEER: McAdam Design Ltd | | | DRWN: BS / CHCK: NH |
| DATE: 26/07/2021 | SERIES: 1 of 1 | DWG No: 21-0553B-EHL-001 | |

CAUSEWAY GEOTECH

# APPENDIX B

# BOREHOLE LOGS



CAUSEWAY GEOTECH

| Project No. | Project Name: | Borehole ID |
|---|---|---|
| 21-0553 | Riverine Community Park, Strabane Site | BH03 |
| | Client: Derry City and Strabane District Council | |
| | Client's Rep: McAdam Design Ltd | |

| Method | Plant Used | Top (m) | Base (m) | Coordinates |
|---|---|---|---|---|
| Cable Percussion | Dando 2000 | 0.00 | 10.00 | |
| Rotary Drilling | Comacchio 405 | 10.00 | 20.00 | 234049.49 E |
| | | | | 398606.58 N |

| Final Depth: | 20.00 m | Start Date: | 16/06/2021 | Driller: | MK+KW | Sheet 1 of 3 |
|---|---|---|---|---|---|---|
| Elevation: | 3.37 mOD | End Date: | 17/06/2021 | Logger: | NH | Scale: 1:50 |
| | | | | | | FINAL |

| Depth (m) | Sample / Tests | Field Records | Casing Depth (m) | Water Depth (m) | Level mOD | Depth (m) | Legend | Description |
|---|---|---|---|---|---|---|---|---|
| | | | | | 3.17 | 0.20 | | TOPSOIL with grass |
| 0.50 | B1 | | | | | | | Very loose brown slightly gravelly very silty fine to coarse SAND. Gravel is subangular to subrounded fine to medium. |
| 0.50 | D3 | | | | | | | |
| 1.00 | B2 | | | | | | | |
| 1.00 | D4 | | | | | | | |
| 1.20 - 1.65 | SPT (C) | N=2 (0,1/0,1,0,1) Hammer SN = 0199 | 1.20 | Dry | | | | |
| 1.50 | | 16-06-2021 | 1.50 | Dry | 1.77 | 1.60 | | Very soft brownish grey slightly sandy clayey SILT. Sand is fine to medium. |
| 2.00 | B5 | | | | | | | |
| 2.00 | D13 | | | | | | | |
| 2.00 - 2.45 | UT21 | Ublow=6 80% | 2.00 | 1.00 | | | | |
| | | | | | 0.77 | 2.60 | | Soft greyish brown organic clayey SILT. |
| 3.00 | B6 | | | | | | | |
| 3.00 | D14 | | | | 0.27 | 3.10 | | Dense to very dense grey sandy subangular to subrounded fine to coarse GRAVEL with high cobble and boulder content. Sand is fine to coarse. Cobbles and boulders are subangular to subrounded. |
| 3.00 - 3.45 | SPT (C) | N=44 (1,3/8,10,12,14) Hammer SN = 0199 | 3.00 | 1.50 | | | | |
| 4.00 | B7 | | | | | | | |
| 4.00 | D15 | | | | | | | |
| 4.00 - 4.09 | SPT (C) | N=50 (25 for 80mm/50 for 10mm) Hammer SN = 0199 | 4.00 | 2.00 | | | | |
| 5.00 | B8 | | | | | | | |
| 5.00 | D16 | | | | | | | |
| 5.00 - 5.40 | SPT (C) | N=50 (5,8/50 for 255mm) Hammer SN = 0199 | 5.00 | 3.00 | | | | |
| 6.00 | B9 | | | | -2.63 | 6.00 | | Dense grey fine to coarse SAND and subangular to subrounded fine to coarse GRAVEL with low cobble and boulder content. Cobbles and boulders are subangular to subrounded. |
| 6.00 | D17 | | | | | | | |
| 6.00 - 6.45 | SPT (C) | N=41 (7,11/15,10,8,8) Hammer SN = 0199 | 6.00 | 3.00 | | | | |
| 7.50 | B10 | | | | | | | |
| 7.50 | D18 | | | | | | | |
| 7.50 - 7.95 | SPT (C) | N=43 (5,8/9,10,14,10) Hammer SN = 0199 | 7.50 | 3.00 | | | | |
| 9.00 | B11 | | | | | | | |
| 9.00 | D19 | | | | | | | |

Water

Backfill

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

**Water Strikes**

| Struck at (m) | Casing to (m) | Time (min) | Rose to (m) |
|---|---|---|---|
| 9.00 | 9.00 | 20 | 2.00 |

**Casing Details**

| To (m) | Diam (mm) |
|---|---|
| 10.00 | 200 |
| 20.00 | 200 |

**Water Added**

| From (m) | To (m) |
|---|---|
| 1.20 | 4.00 |

**Chiselling Details**

| From (m) | To (m) | Time (hh:mm) |
|---|---|---|
| 9.80 | 10.00 | 01:00 |

**Remarks**

Hand dug inspection pit excavated to 1.20m
Standpipe installation
No SPT at 1.00m due to blowing sands

**Core Barrel**

**Flush Type**

**Termination Reason**

Terminated at 20.00m without encountering bedrock

**Last Updated**

11/08/2021

AGS

CAUSEWAY GEOTECH

| Project No. | Project Name: | Borehole ID |
|---|---|---|
| 21-0553 | Riverine Community Park, Strabane Site | BH03 |
| | Client: Derry City and Strabane District Council | |
| | Client's Rep: McAdam Design Ltd | |

| Method | Plant Used | Top (m) | Base (m) | Coordinates |
|---|---|---|---|---|
| Cable Percussion | Dando 2000 | 0.00 | 10.00 | |
| Rotary Drilling | Comacchio 405 | 10.00 | 20.00 | 234049.49 E |
| | | | | 398606.58 N |

| Final Depth: | 20.00 m | Start Date: | 16/06/2021 | Driller: | MK+KW | Sheet 2 of 3 |
|---|---|---|---|---|---|---|
| Elevation: | 3.37 mOD | End Date: | 17/06/2021 | Logger: | NH | Scale: 1:50 |
| | | | | | | FINAL |

| Depth (m) | Sample / Tests | Field Records | Casing Depth (m) | Water Depth (m) | Level mOD | Depth (m) | Legend | Description | Water | Backfill |
|---|---|---|---|---|---|---|---|---|---|---|
| 9.00 - 9.45 | SPT (C) | N=30 (4,4/5,6,9,10) Hammer SN = 0199<br>Strong inflow at 9.00m | 9.00 | 3.50 | | | | Dense grey fine to coarse SAND and subangular to subrounded fine to coarse GRAVEL with low cobble and boulder content. Cobbles and boulders are subangular to subrounded. | | |
| 10.00 | B12 | | | | -6.63 | 10.00 | | | | |
| 10.00 | D20 | | | | | | | Dense to very dense greyish brown very sandy subangular to subrounded fine to coarse GRAVEL with high cobble content. Sand is fine to coarse. Cobbles are subangular to subrounded. | | |
| 10.00 - 10.01 | SPT (C) | N=50 (25 for 5mm/50 for 5mm) Hammer SN = 0199 | 10.0 | 3.00 | | | | | | |
| 10.00 | | 17-06-2021 | 10.0 | 3.00 | | | | | | |
| 11.50 - 11.79 | SPT (C) | N=50 (25 for 145mm/50 for 145mm) Hammer SN = 0210 | 11.5 | 2.00 | | | | | | |
| | | | | | -8.63 | 12.00 | | Greyish brown gravelly silty fine to coarse SAND. Gravel is subangular to subrounded fine to coarse. (Blowing) | | |
| | | | | | -10.63 | 14.00 | | Very dense grey very sandy subangular to subrounded fine to coarse GRAVEL with high cobble content. Sand is fine to coarse. Cobbles are subangular to subrounded. | | |
| 14.50 - 14.74 | SPT (C) | N=50 (25 for 95mm/50 for 140mm) Hammer SN = 0210 | 14.5 | 2.00 | | | | | | |
| 16.00 - 16.26 | SPT (C) | N=50 (25 for 105mm/50 for 155mm) Hammer SN = 0210 | 16.0 | 2.00 | | | | | | |
| 17.50 - 17.77 | SPT (C) | N=50 (25 for 100mm/50 for 170mm) Hammer SN = 0210 | 17.5 | 2.00 | | | | | | |

**Water Strikes**

| Struck at (m) | Casing to (m) | Time (min) | Rose to (m) |
|---|---|---|---|
| 9.00 | 9.00 | 20 | 2.00 |

**Casing Details**

| To (m) | Diam (mm) |
|---|---|
| 10.00 | 200 |
| 20.00 | 200 |

**Water Added**

| From (m) | To (m) |
|---|---|
| 1.20 | 4.00 |

**Chiselling Details**

| From (m) | To (m) | Time (hh:mm) |
|---|---|---|
| 9.80 | 10.00 | 01:00 |

**Remarks**

Hand dug inspection pit excavated to 1.20m
Standpipe installation
No SPT at 1.00m due to blowing sands

**Core Barrel**

**Flush Type**

**Termination Reason**

Terminated at 20.00m without encountering bedrock

**Last Updated**

11/08/2021

AGS

CAUSEWAY GEOTECH

| Project No. | Project Name: | Borehole ID |
|---|---|---|
| 21-0553 | Riverine Community Park, Strabane Site | BH03 |
| | Client: Derry City and Strabane District Council | |
| | Client's Rep: McAdam Design Ltd | |

| Method | Plant Used | Top (m) | Base (m) | Coordinates |
|---|---|---|---|---|
| Cable Percussion<br>Rotary Drilling | Dando 2000<br>Comacchio 405 | 0.00<br>10.00 | 10.00<br>20.00 | 234049.49 E<br>398606.58 N |

| Final Depth: | 20.00 m | Start Date: | 16/06/2021 | Driller: | MK+KW | Sheet 3 of 3<br>Scale: 1:50 |
|---|---|---|---|---|---|---|
| Elevation: | 3.37 mOD | End Date: | 17/06/2021 | Logger: | NH | FINAL |

| Depth (m) | Sample / Tests | Field Records | Casing Depth (m) | Water Depth (m) | Level mOD | Depth (m) | Legend | Description | Water | Backfill |
|---|---|---|---|---|---|---|---|---|---|---|
| 19.00 - 19.24 | SPT (C) | N=50 (25 for 85mm/50 for 155mm) Hammer SN = 0210 | 19.0 | 2.00 | | | | Very dense grey very sandy subangular to subrounded fine to coarse GRAVEL with high cobble content. Sand is fine to coarse. Cobbles are subangular to subrounded. | | |
| 20.00 - 20.20 | SPT (C) | N=50 (25 for 70mm/50 for 125mm) Hammer SN = 0210 | 20.0 | 2.00 | -16.63 | 20.00 | | End of Borehole at 20.00m | | |

19.0 19.5 20.0 20.5 21.0 21.5 22.0 22.5 23.0 23.5 24.0 24.5 25.0 25.5 26.0 26.5 27.0 27.5

**Water Strikes**

| Struck at (m) | Casing to (m) | Time (min) | Rose to (m) |
|---|---|---|---|
| 9.00 | 9.00 | 20 | 2.00 |

**Casing Details**

| To (m) | Diam (mm) |
|---|---|
| 10.00 | 200 |
| 20.00 | 200 |

**Water Added**

| From (m) | To (m) |
|---|---|
| 1.20 | 4.00 |

**Remarks**

Hand dug inspection pit excavated to 1.20m
Standpipe installation
No SPT at 1.00m due to blowing sands

| Core Barrel | Flush Type | Termination Reason | Last Updated |
|---|---|---|---|
| | | Terminated at 20.00m without encountering bedrock | 11/08/2021 |

AGS

CAUSEWAY GEOTECH

# APPENDIX C

# SOAKAWAY LOGS AND TEST RESULTS



CAUSEWAY GEOTECH

| | | | |
|---|---|---|---|
| **Project No.** 21-0553 | **Project Name:** Riverine Community Park, Strabane Site | | **Trial Pit ID** INFIL 005 |
| **Coordinates** 234092.61 E 398322.22 N | **Client:** Derry City and Strabane District Council | | |
| **Method:** Trial Pitting | **Client's Representative:** McAdam Design Ltd | | Sheet 1 of 1 Scale: 1:25 |
| **Plant:** 3T Tracked Excavator | **Elevation** 4.17 mOD | **Date:** 20/05/2021 | **Logger:** JAC | FINAL |

| Depth (m) | Sample / Tests | Field Records | Level (mOD) | Depth (m) | Legend | Description | Water |
|---|---|---|---|---|---|---|---|
| | | | 4.07 | 0.10 | | TOPSOIL | |
| | | | 3.87 | 0.30 | | MADE GROUND: Light brown fine to coarse SAND. | |
| 0.50 | B1 | | | | | MADE GROUND: Dark grey silty fine to coarse SAND with fragments of red brick, cinders and glass. | |
| | | | 3.57 | 0.60 | | Grey very silty fine to medium SAND with bands of grey sandy silt. | |
| 1.00 | B2 | | | | | | |
| | | | 2.77 | 1.40 | | Soft to firm grey slightly sandy SILT. Sand is fine to coarse. | |
| 1.60 | B3 | | | | | | |
| | | Light seepage at 2.00m | 2.17 | 2.00 | | End of trial pit at 2.00m | |

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5

| Water Strikes | |
|---|---|
| Struck at (m) | Remarks |
| 2.00 | Light seepage at 2.00m |

**Depth:** 2.00
**Width:** 0.50
**Length:** 1.30

**Remarks:**
Pit completed for Soakaway test location

| Stability: | Termination Reason: | Last Updated |
|---|---|---|
| Unstable | Terminated at scheduled depth | 11/08/2021 |

AGS

# Soakaway Infiltration Test

**Project No.:** 21-0553B
**Site:** Riverine Community Park, Strabane Site
**Test Location:** INFIL 005
**Test Date:** 20 May 2021

| | width (m) | length (m) |
|---|---|---|
| test pit top dimensions | 0.50 | 1.30 |
| test pit base dimensions | 0.50 | 0.90 |
| test pit depth (m) | 2.00 | |

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

depth to groundwater before adding water (m) = Dry

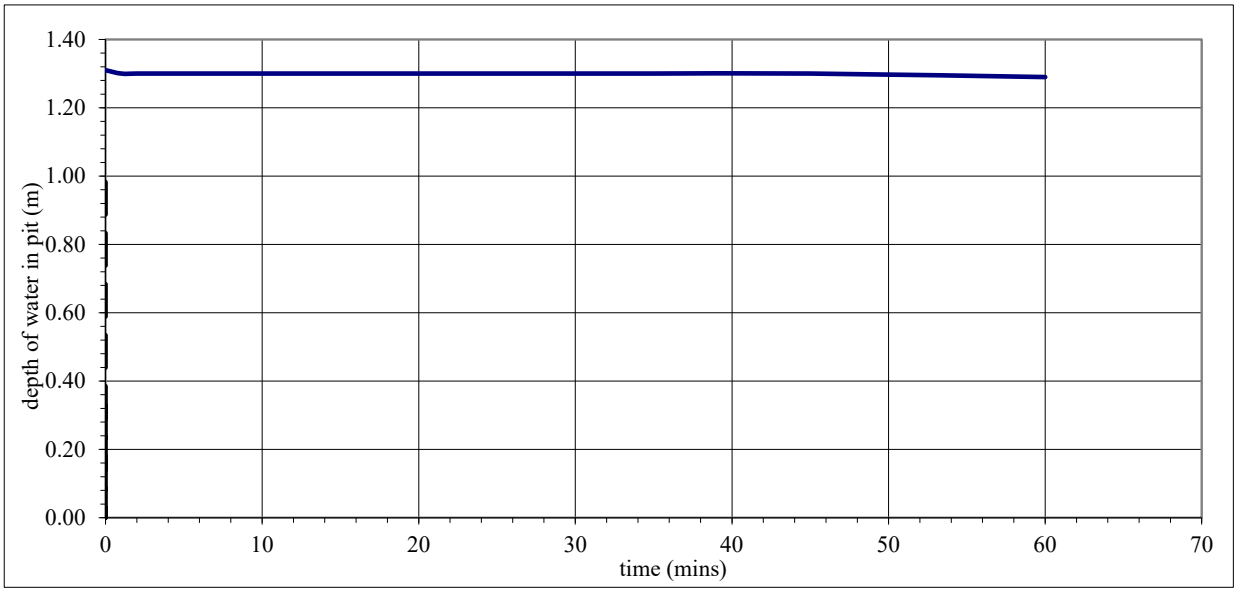
| time (mins) | depth to water surface (m) | depth of water in pit (m) |
|---|---|---|
| 0 | 0.69 | 1.31 |
| 1 | 0.70 | 1.30 |
| 2 | 0.70 | 1.30 |
| 3 | 0.70 | 1.30 |
| 4 | 0.70 | 1.30 |
| 5 | 0.70 | 1.30 |
| 7 | 0.70 | 1.30 |
| 10 | 0.70 | 1.30 |
| 15 | 0.70 | 1.30 |
| 20 | 0.70 | 1.30 |
| 25 | 0.70 | 1.30 |
| 30 | 0.70 | 1.30 |
| 35 | 0.70 | 1.30 |
| 45 | 0.70 | 1.30 |
| 60 | 0.71 | 1.29 |
| | | |
| | | |
| | | |
| | | |

From graph below:
test start - 75% depth at
0.9825 m water depth
time is not determined

test end - 25% depth at
0.3275 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) |
|---|---|---|---|---|---|---|---|
| | 1.02 | 0.9825 | | 0.34 | 2.39 | | |
| | 1.67 | 0.3275 | | | | | |



CAUSEWAY GEOTECH

| | | | |
|---|---|---|---|
| **Project No.** 21-0553 | **Project Name:** Riverine Community Park, Strabane Site | | **Trial Pit ID** INFIL 006 |
| **Coordinates** 234235.56 E 398774.01 N | **Client:** Derry City and Strabane District Council | | |
| **Method:** Trial Pitting | **Client's Representative:** McAdam Design Ltd | | Sheet 1 of 1 Scale: 1:25 |
| **Plant:** 8T Tracked Excavator | **Elevation** 3.79 mOD | **Date:** 08/07/2021 | **Logger:** JAC | FINAL |

| Depth (m) | Sample / Tests | Field Records | Level (mOD) | Depth (m) | Legend | Description | Water |
|---|---|---|---|---|---|---|---|
| | | | 3.69 | 0.10 | | TOPSOIL | |
| 0.50 | B1 | | | | | MADE GROUND: Brown slightly silty sandy subrounded to rounded fine to coarse GRAVEL. Sand is fine to coarse. | |
| | | | 3.19 | 0.60 | | MADE GROUND: Grey very sandy silty subangular to subrounded fine to coarse GRAVEL with fragments of timber red brick, glass, crockery, metal bar, concrete fence, roots and roofing slate. Sand is fine to coarse. | |
| 1.50 | B2 | | | | | | |
| | | | 2.09 | 1.70 | | Soft brownish grey slightly sandy slightly gravelly organic clayey SILT. Sand is fine to coarse. Gravel is subangular to subrounded fine. | |
| 1.90 | B3 | | | | | | |
| | | | 1.69 | 2.10 | | End of trial pit at 2.10m | |

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5

| Water Strikes | |
|---|---|
| Struck at (m) | Remarks |
| | |

**Depth:** 2.10
**Width:** 0.80
**Length:** 2.90

**Remarks:**
Pit completed for Soakaway test location
No groundwater encountered

| Stability: | Termination Reason: | Last Updated |
|---|---|---|
| Unstable | Terminated at scheduled depth | 11/08/2021 |

AGS

# Soakaway Infiltration Test

**Project No.:** 21-0553B
**Site:** Riverine Community Park, Strabane Site
**Test Location:** INFIL 006
**Test Date:** 08 July 2021

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

| | width (m) | length (m) |
|---|---|---|
| test pit top dimensions | 2.90 | 2.60 |
| test pit base dimensions | 0.80 | 0.80 |

test pit depth (m) 2.10

depth to groundwater before adding water (m) = Dry

| time (mins) | depth to water surface (m) | depth of water in pit (m) |
|---|---|---|
| 0 | 0.53 | 1.57 |
| 1 | 0.61 | 1.49 |
| 2 | 0.69 | 1.41 |
| 3 | 0.76 | 1.34 |
| 4 | 0.83 | 1.27 |
| 5 | 0.90 | 1.20 |
| 7 | 1.03 | 1.07 |
| 10 | 1.20 | 0.90 |
| 15 | 1.44 | 0.66 |
| 20 | 1.67 | 0.43 |
| 25 | 1.70 | 0.40 |
| 30 | 1.71 | 0.39 |
| 35 | 1.71 | 0.39 |
| 45 | 1.72 | 0.38 |
| 60 | 1.73 | 0.37 |
| | | |
| | | |
| | | |
| | | |

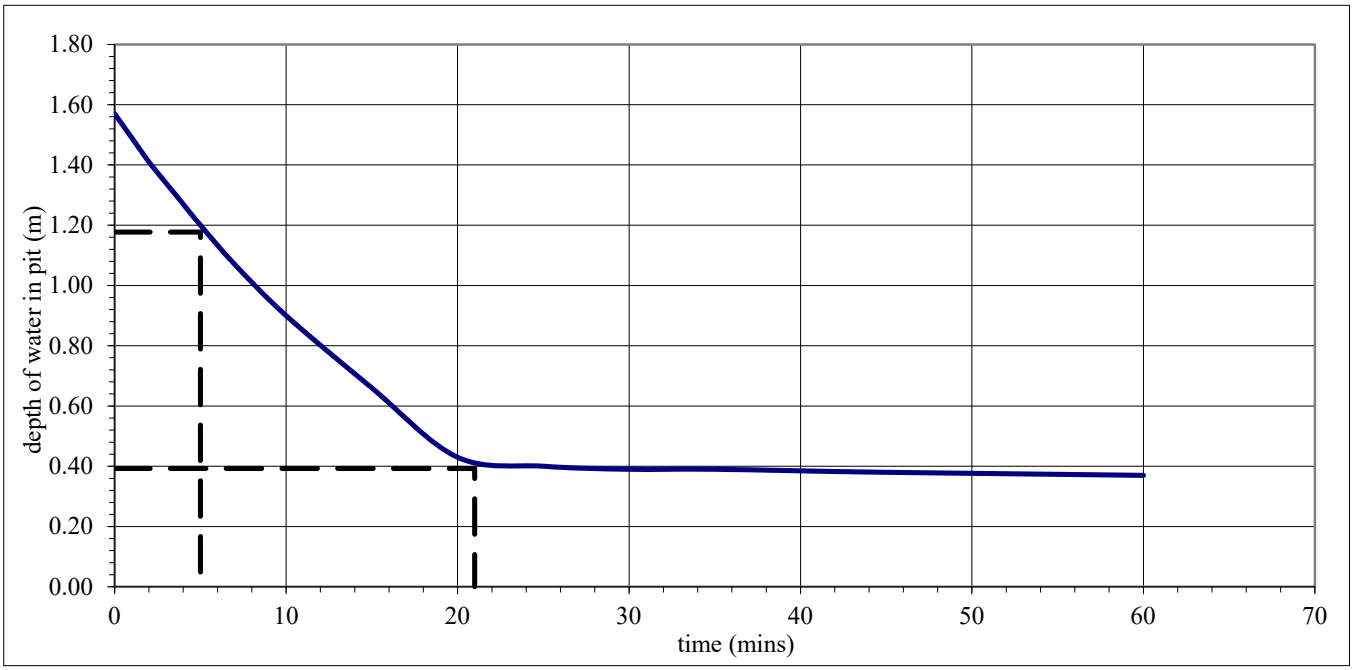
From graph below:

test start - 75% depth at
1.1775 m water depth
time is 5.0 minutes

test end - 25% depth at
0.3925 m water depth
time is 21.0 minutes

**test infiltration rate (q) = 1.584 m/h**

| 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) |
|---|---|---|---|---|---|---|---|
| 5 | 0.92 | 1.1775 | 16 | 1.94 | 4.58 | 2.6E-02 | 1.584 |
| 21 | 1.71 | 0.3925 | | | | | |



CAUSEWAY GEOTECH

| | | | |
|---|---|---|---|
| **Project No.** 21-0553 | **Project Name:** Riverine Community Park, Strabane Site | | **Trial Pit ID** INFIL 007 |
| **Coordinates** 234344.66 E 398751.45 N | **Client:** Derry City and Strabane District Council | | |
| **Method:** Trial Pitting | **Client's Representative:** McAdam Design Ltd | | Sheet 1 of 1 Scale: 1:25 |
| **Plant:** 8T Tracked Excavator | **Elevation** 4.12 mOD | **Date:** 08/07/2021 | **Logger:** JAC | FINAL |

| Depth (m) | Sample / Tests | Field Records | Level (mOD) | Depth (m) | Legend | Description | Water |
|---|---|---|---|---|---|---|---|
| | | | 3.87 | 0.25 | | TOPSOIL | |
| 0.50 | B1 | | | | | Firm brown slightly silty pseudo-fibrous PEAT with occasional roots and rootlets. | |
| | | | 3.32 | 0.80 | | Soft brownish grey slightly sandy slightly gravelly organic SILT. Sand is fine to coarse. Gravel is subangular to subrounded fine. | |
| 1.50 | B2 | | | | | | |
| | | | 2.12 | 2.00 | | End of trial pit at 2.00m | |

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5

| Water Strikes | |
|---|---|
| Struck at (m) | Remarks |

**Depth:** 2.00
**Width:** 0.70
**Length:** 3.00

**Remarks:**
Pit completed for Soakaway test location
No groundwater encountered

| Stability: | Termination Reason: | Last Updated |
|---|---|---|
| Stable | Terminated at scheduled depth | 11/08/2021 |

AGS

# Soakaway Infiltration Test

**Project No.:** 21-0553B
**Site:** Riverine Community Park, Strabane Site
**Test Location:** INFIL 007
**Test Date:** 08 July 2021

*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 | 3..0 |
| test pit base dimensions | 0.70 | 2.40 |

test pit depth (m) 2.00

depth to groundwater before adding water (m) = Dry

| time (mins) | depth to water surface (m) | depth of water in pit (m) |
|---|---|---|
| 0 | 0.47 | 1.53 |
| 1 | 0.51 | 1.49 |
| 2 | 0.55 | 1.45 |
| 3 | 0.59 | 1.41 |
| 4 | 0.62 | 1.38 |
| 5 | 0.65 | 1.35 |
| 7 | 0.67 | 1.33 |
| 10 | 0.69 | 1.31 |
| 15 | 0.73 | 1.27 |
| 20 | 0.77 | 1.23 |
| 25 | 0.79 | 1.21 |
| 30 | 0.79 | 1.21 |
| 35 | 0.79 | 1.21 |
| 45 | 0.80 | 1.20 |
| 60 | 0.80 | 1.20 |
| | | |
| | | |
| | | |
| | | |

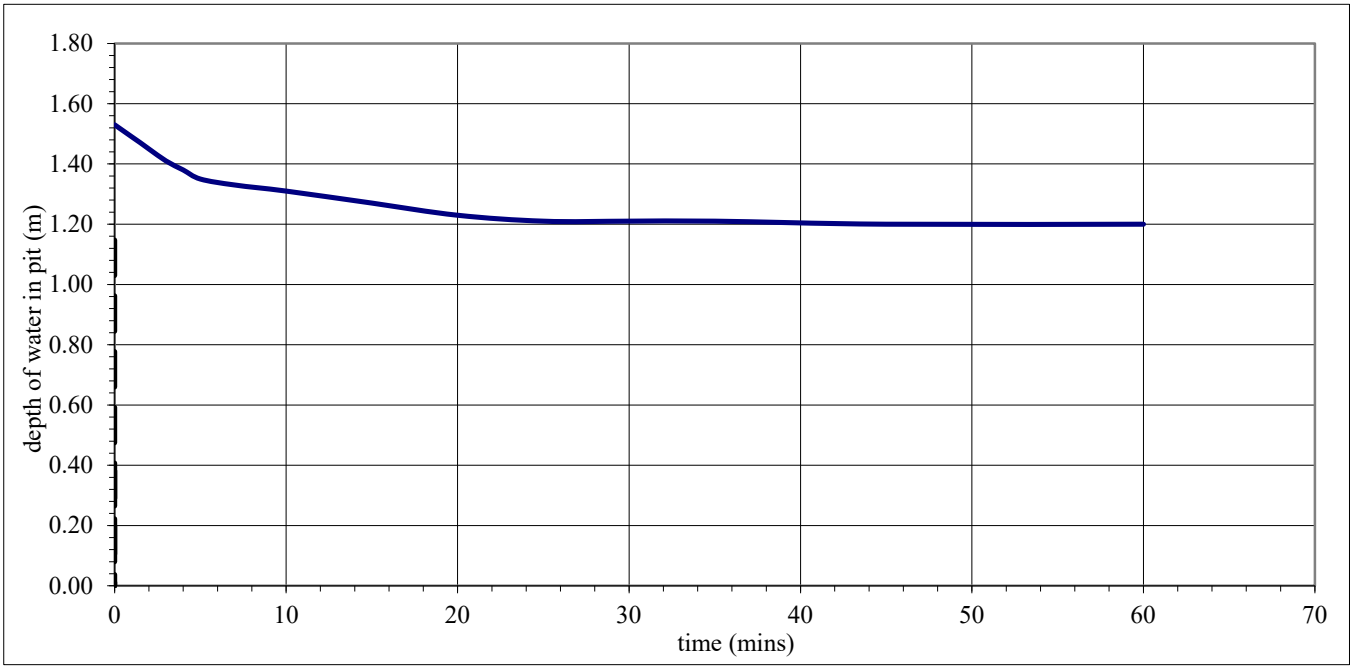
From graph below:

test start - 75% depth at
1.1475 m water depth
time is not determined

test end - 25% depth at
0.3825 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) |
|---|---|---|---|---|---|---|---|
| | 0.85 | 1.1475 | | #VALUE! | #VALUE! | | |
| | 1.62 | 0.3825 | | | | | |



CAUSEWAY GEOTECH

# APPENDIX D

# SOAKAWAY PIT PHOTOGRAPHS






**Soakaway Pit: INFIL 005**



**Soakaway Pit: INFIL 005**



**Soakaway Pit: INFIL 005**




**Soakaway Pit: INFIL 005**




**Soakaway Pit: INFIL 006**



CAUSEWAY GEOTECH



**Soakaway Pit: INFIL 006**




**Soakaway Pit: INFIL 006**




**Soakaway Pit: INFIL 007**



CAUSEWAY GEOTECH



**Soakaway Pit: INFIL 007**




**Soakaway Pit: INFIL 007**

CAUSEWAY GEOTECH

# APPENDIX E

# INDIRECT IN-SITU CBR TEST RESULTS



# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

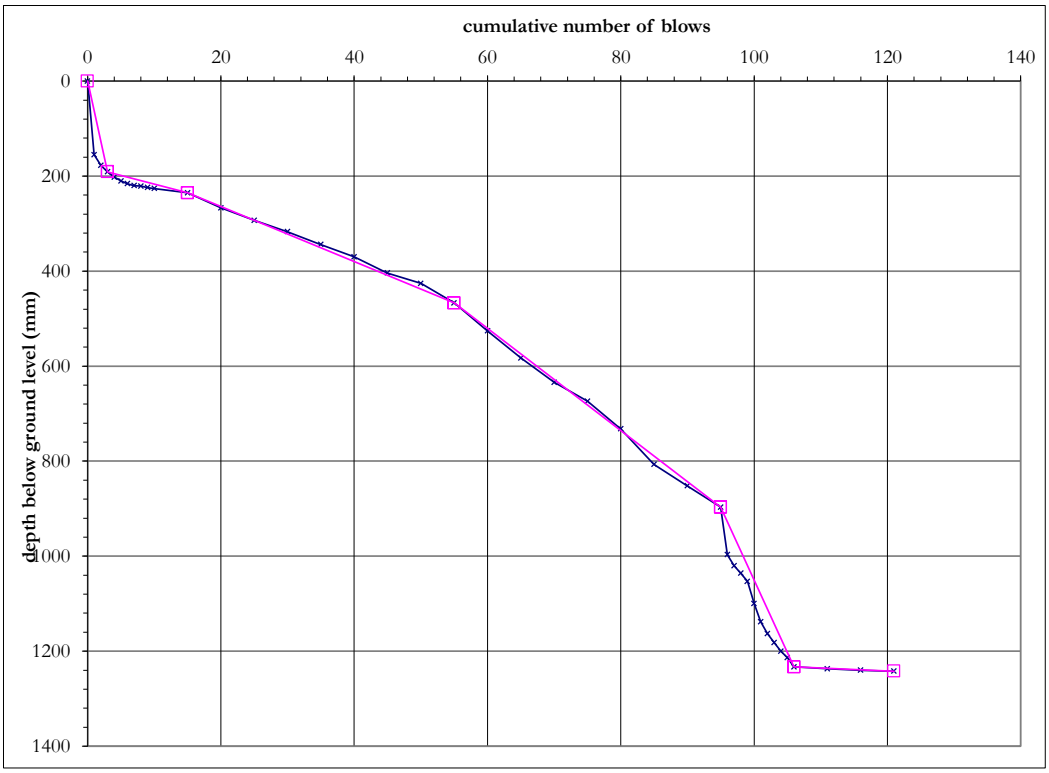
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Strabane |

| | |
|---|---|
| **Test Number** | CBR 029 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 25/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 64 | 3.7 |
| 191 | | |
| 191 | 3.7 | 76 |
| 235 | | |
| 235 | 5.8 | 47 |
| 467 | | |
| 467 | 11 | 25 |
| 897 | | |
| 897 | 31 | 8.1 |
| 1233 | | |
| 1233 | 0.6 | >100 |
| 1242 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 3.7<br>Max: >100 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

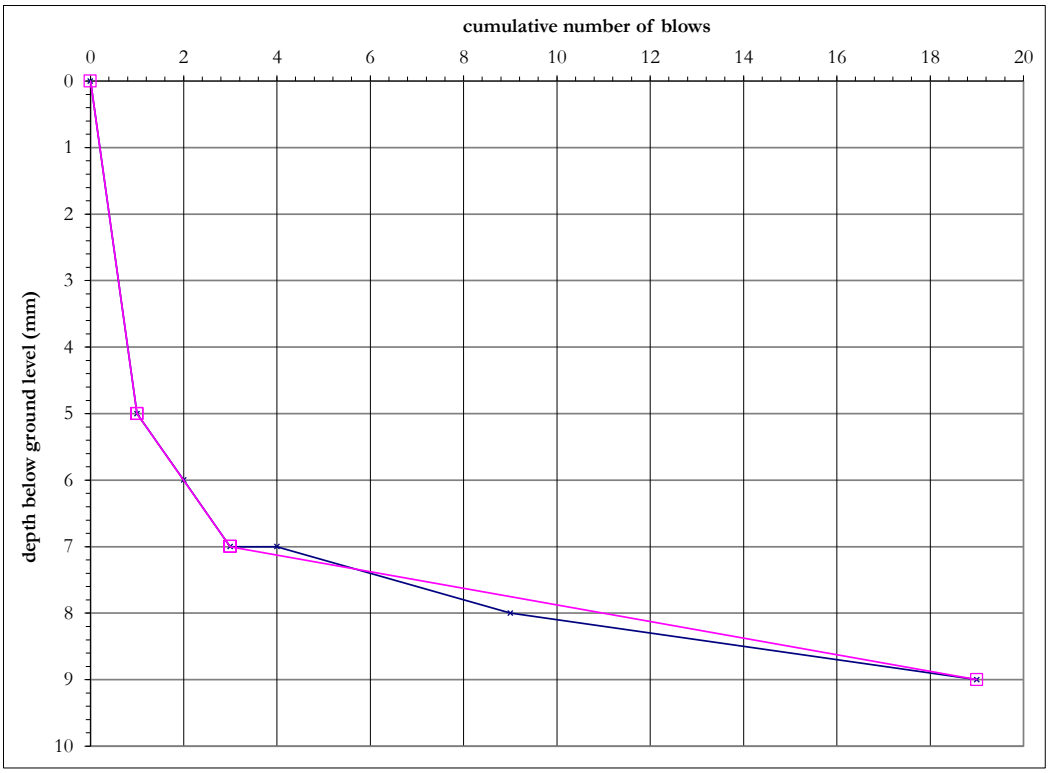
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Strabane |

| | |
|---|---|
| **Test Number** | CBR 030 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 25/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 5 | 55 |
| 5 | | |
| 5 | 1 | >100 |
| 7 | | |
| 7 | 0.1 | >100 |
| 9 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 55<br>Max: >100 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

UKAS TESTING 10122

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

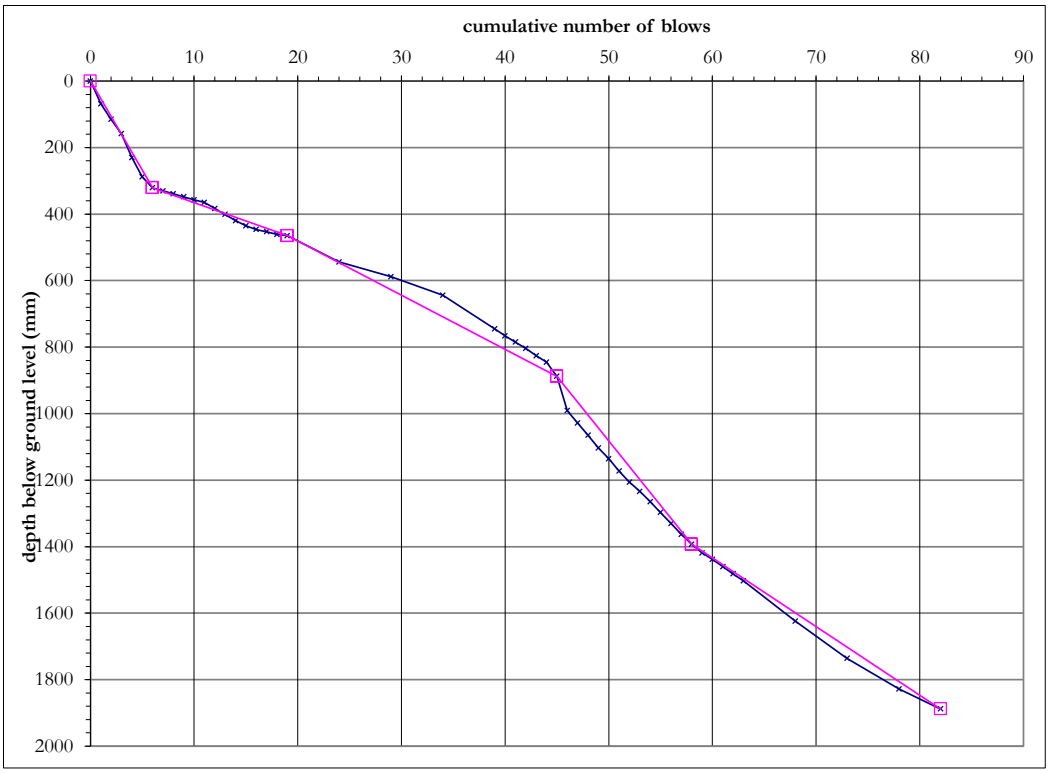
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Strabane |

| | |
|---|---|
| **Test Number** | CBR 031 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 25/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 54 | 4.5 |
| 321 | | |
| | | |
| 321 | 11 | 24 |
| 465 | | |
| | | |
| 465 | 16 | 16 |
| 888 | | |
| | | |
| 888 | 39 | 6.3 |
| 1393 | | |
| | | |
| 1393 | 21 | 12 |
| 1888 | | |
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|---|---|---|
| **CBR Range** | Min: 4.5<br>Max: 24 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

UKAS TESTING 10122

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

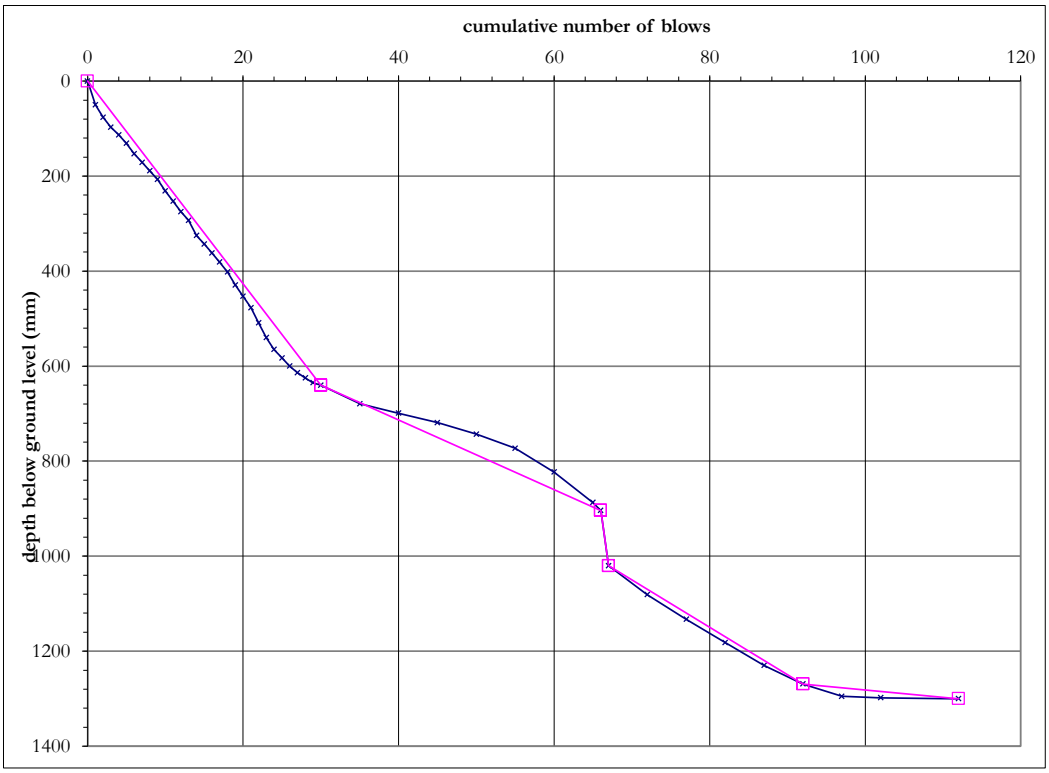
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Strabane |

| | |
|---|---|
| **Test Number** | CBR 032 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 25/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 21 | 12 |
| 640 | | |
| 640 | 7.3 | 37 |
| 904 | | |
| 904 | 116 | 2 |
| 1020 | | |
| 1020 | 10 | 27 |
| 1269 | | |
| 1269 | 1.6 | >100 |
| 1300 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 2<br>Max: >100 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

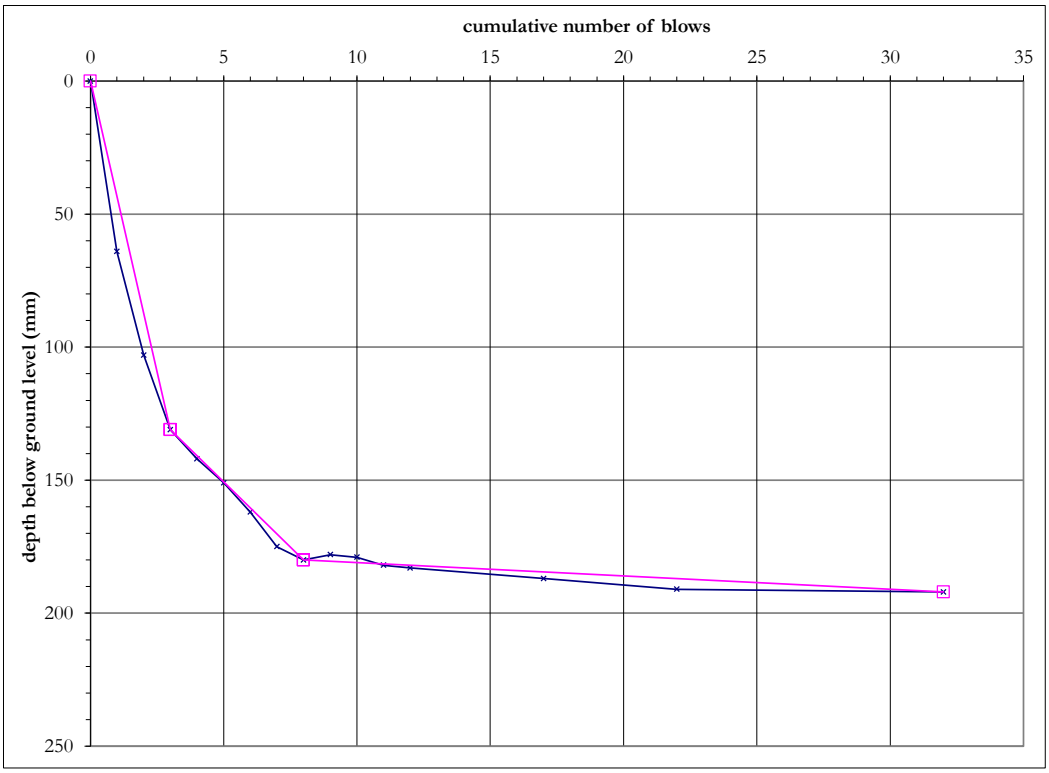
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Strabane |

| | |
|---|---|
| **Test Number** | CBR 033 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 25/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 44 | 5.6 |
| 131 | | |
| | | |
| 131 | 9.8 | 27 |
| 180 | | |
| | | |
| 180 | 0.5 | >100 |
| 192 | | |
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|---|---|---|
| **CBR Range** | Min: 5.6<br>Max: >100 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

UKAS TESTING 10122

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

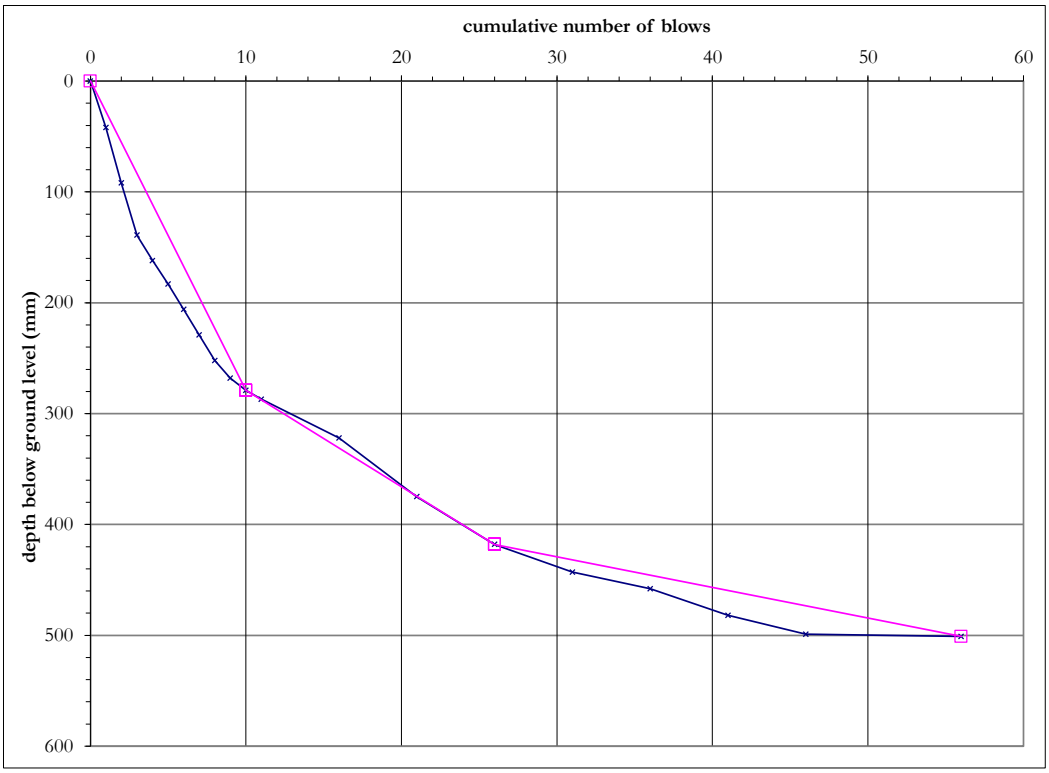
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Strabane |

| | |
|---|---|
| **Test Number** | CBR 034 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 26/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 28 | 9 |
| 279 | | |
| | | |
| 279 | 8.7 | 31 |
| 418 | | |
| | | |
| 418 | 2.8 | >100 |
| 501 | | |
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|---|---|---|
| **CBR Range** | Min: 9<br>Max: >100 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

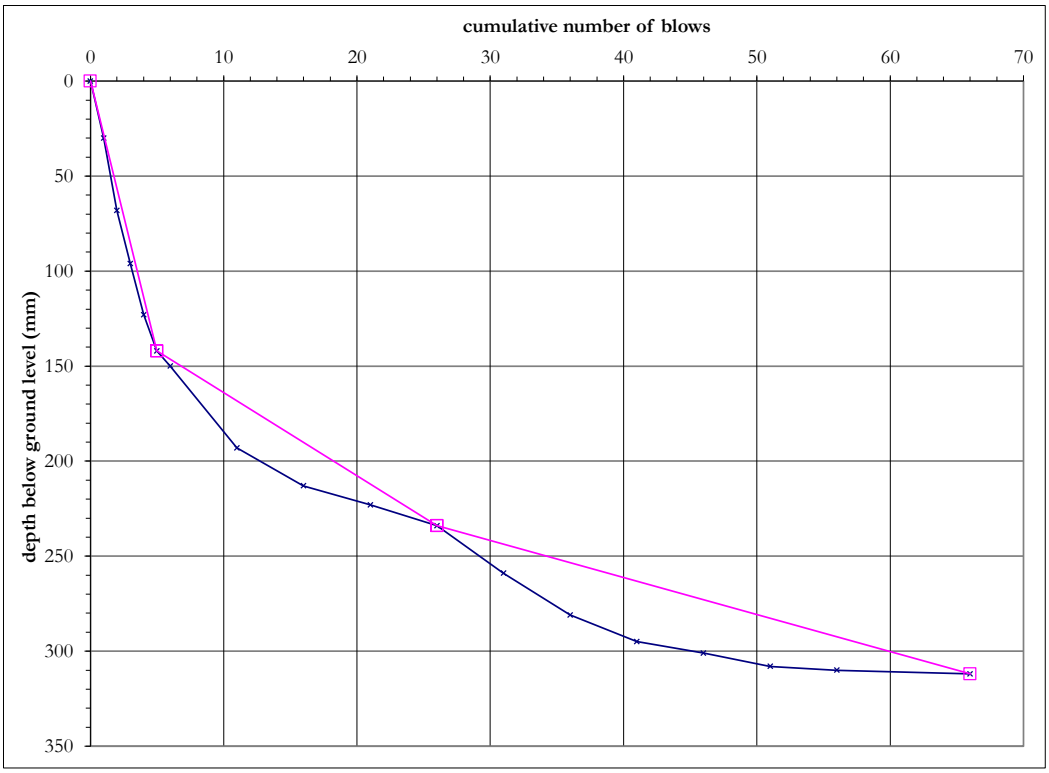
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Strabane |

| | |
|---|---|
| **Test Number** | CBR 035 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 26/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 28 | 8.8 |
| 142 | | |
| | | |
| 142 | 4.4 | 63 |
| 234 | | |
| | | |
| 234 | 2 | >100 |
| 312 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 8.8<br>Max: >100 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

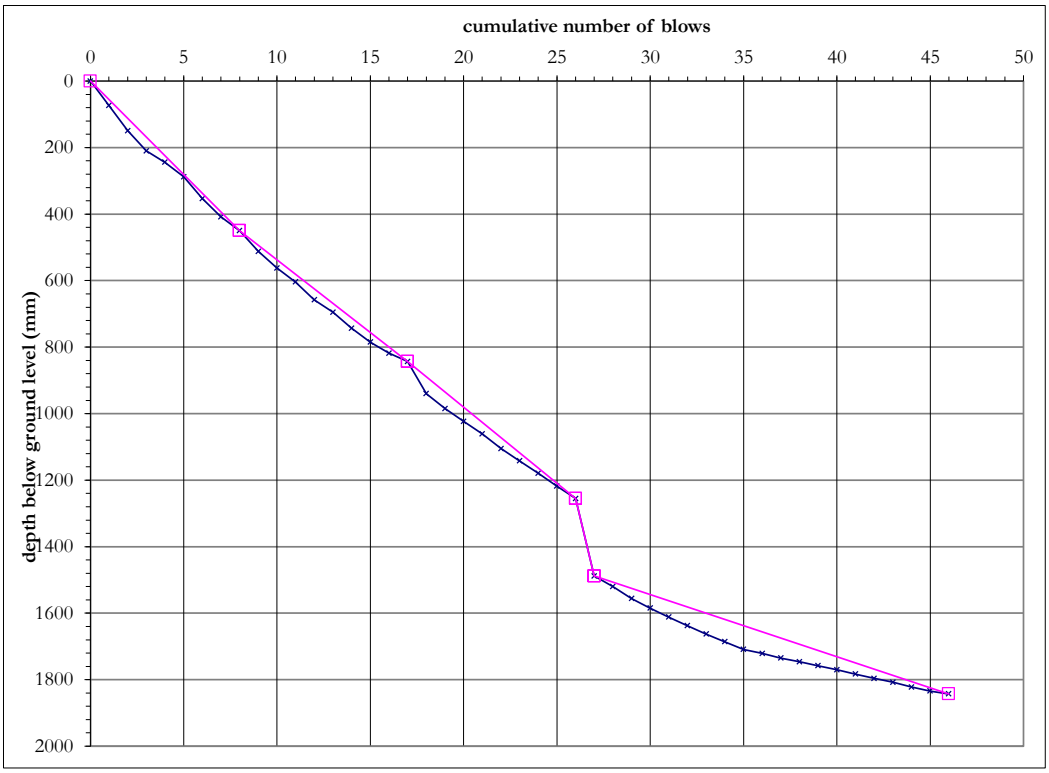
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Strabane |

| | |
|---|---|
| **Test Number** | CBR 036 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 25/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 56 | 4.3 |
| 450 | | |
| 450 | 44 | 5.6 |
| 843 | | |
| 843 | 46 | 5.3 |
| 1255 | | |
| 1255 | 233 | 0.9 |
| 1488 | | |
| 1488 | 19 | 14 |
| 1843 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 0.9<br>Max: 14 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

UKAS TESTING 10122

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

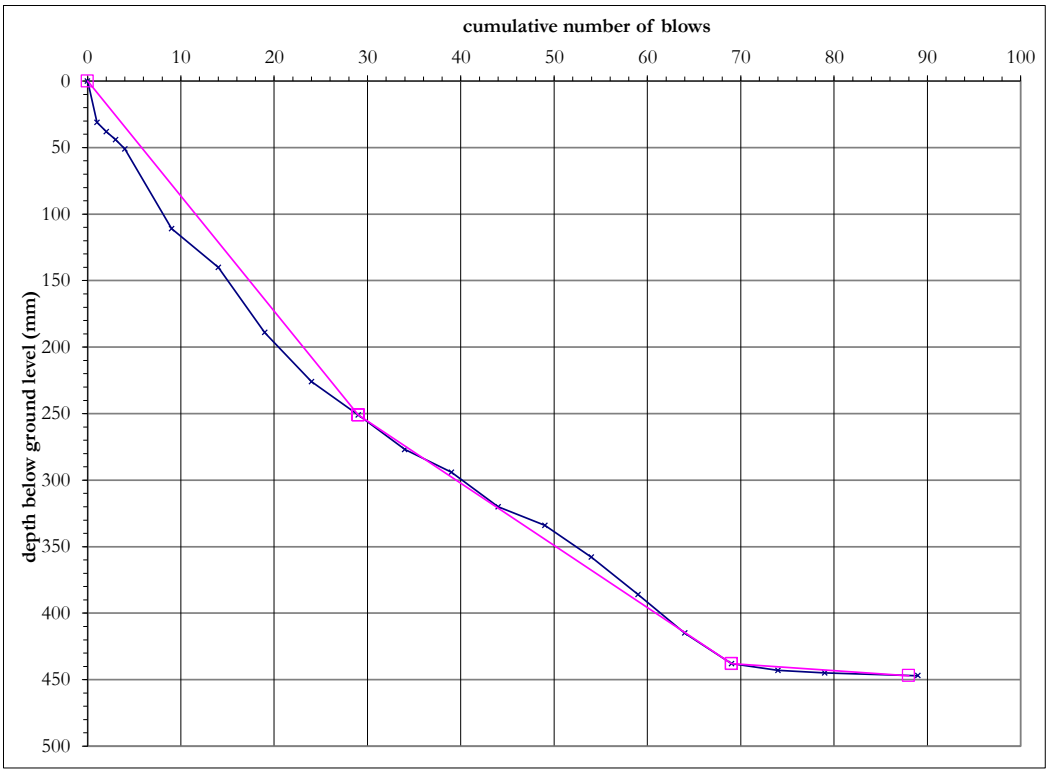
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Strabane |

| | |
|---|---|
| **Test Number** | CBR 037 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 26/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 8.7 | 31 |
| 251 | | |
| | | |
| 251 | 4.7 | 59 |
| 438 | | |
| | | |
| 438 | 0.5 | >100 |
| 447 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 31<br>Max: >100 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

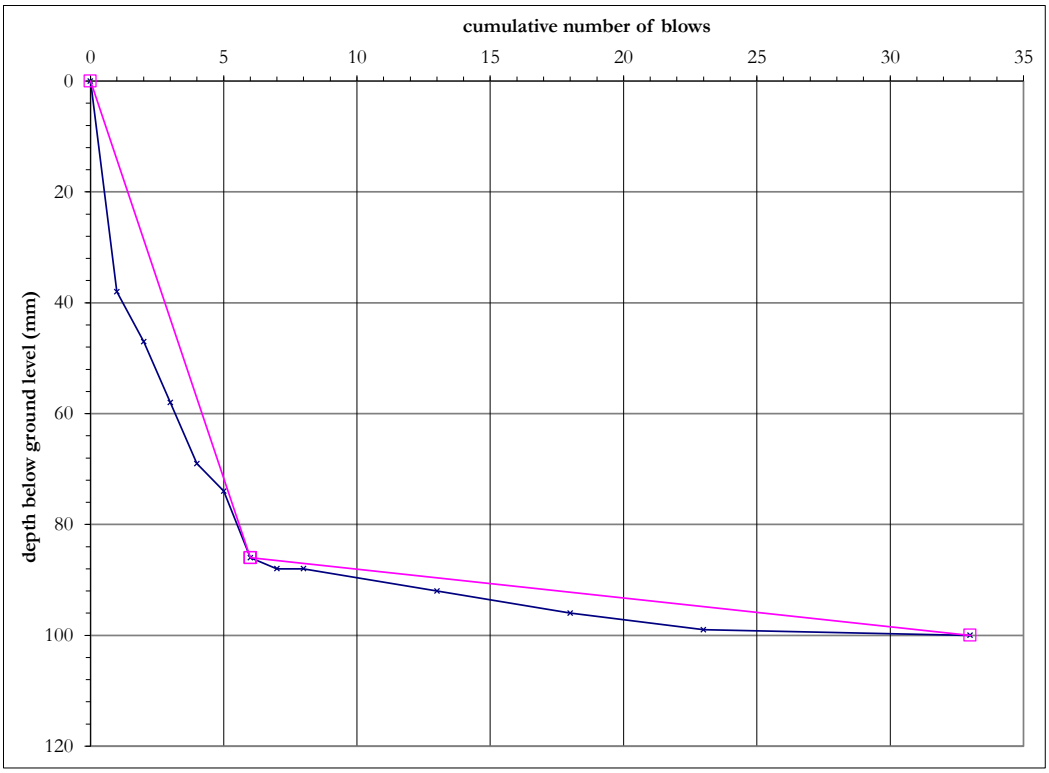
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Strabane |

| | |
|---|---|
| **Test Number** | CBR 038 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 25/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 14 | 18 |
| 86 | | |
| | | |
| 86 | 0.5 | >100 |
| 100 | | |

| CBR Range | | |
|---|---|---|
| | Min: 18<br>Max: >100 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

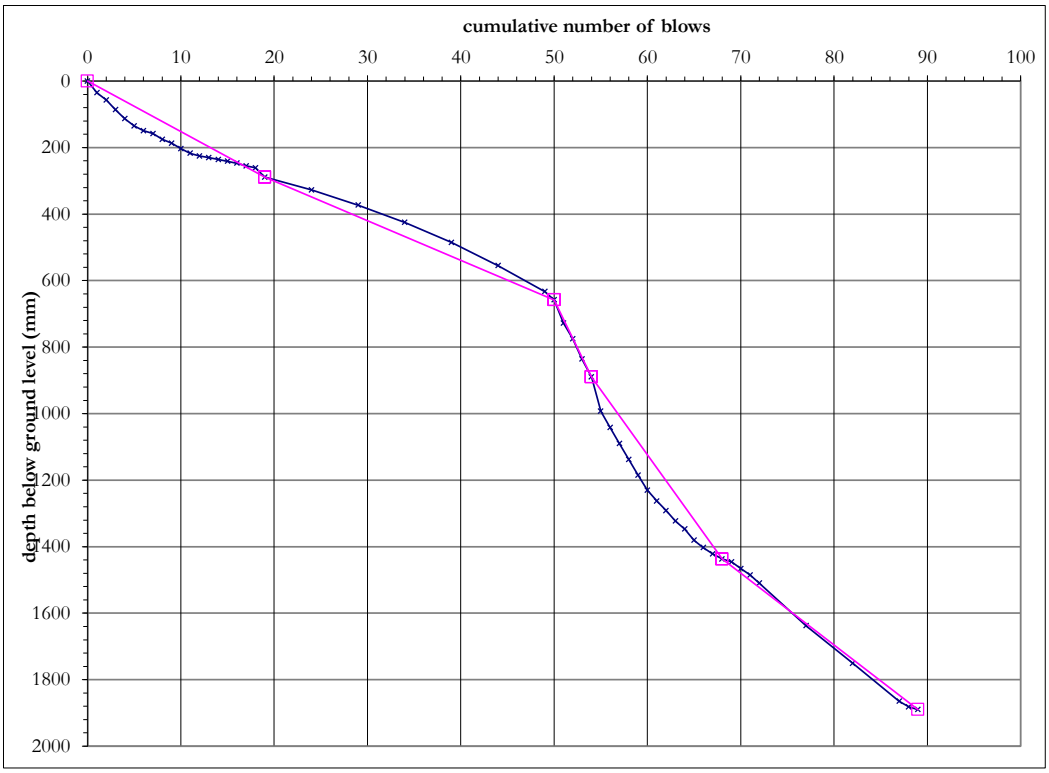
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Strabane |

| | |
|---|---|
| **Test Number** | CBR 039 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 25/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 15 | 17 |
| 289 | | |
| 289 | 12 | 22 |
| 658 | | |
| 658 | 58 | 4.1 |
| 890 | | |
| 890 | 39 | 6.3 |
| 1437 | | |
| 1437 | 22 | 12 |
| 1890 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 4.1<br>Max: 22 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

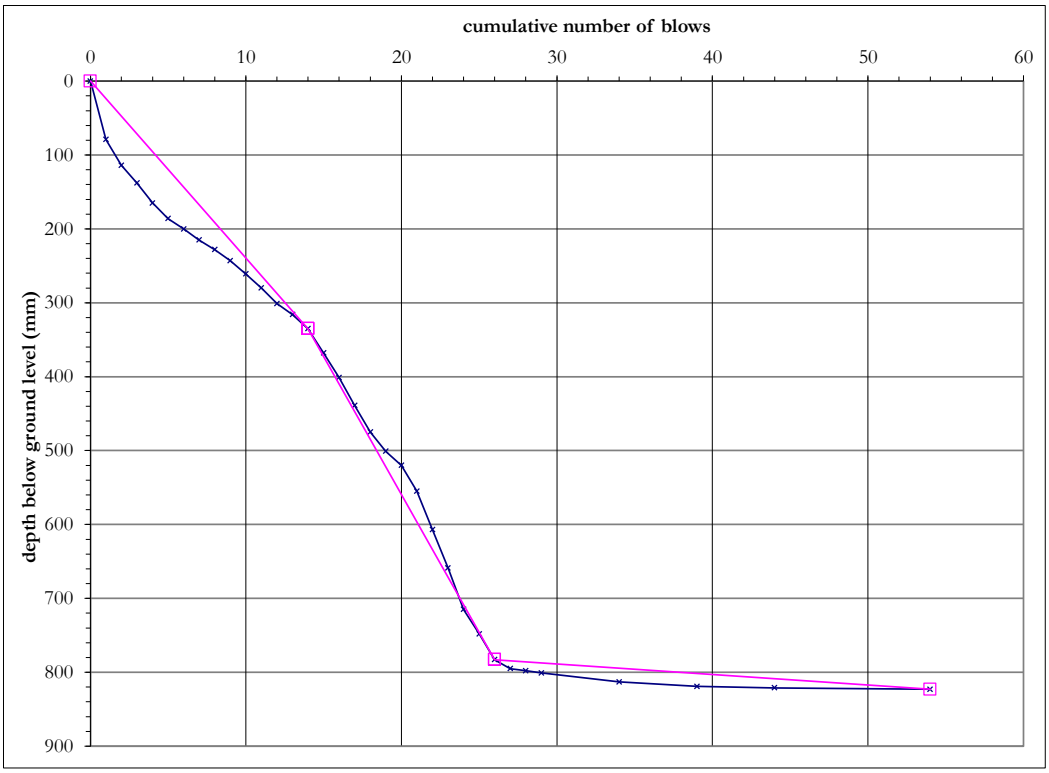
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Strabane |

| | |
|---|---|
| **Test Number** | CBR 040 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 25/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 24 | 11 |
| 335 | | |
| | | |
| 335 | 37 | 6.6 |
| 783 | | |
| | | |
| 783 | 1.4 | >100 |
| 823 | | |
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|---|---|---|
| **CBR Range** | Min: 6.6<br>Max: >100 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

UKAS TESTING 10122

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

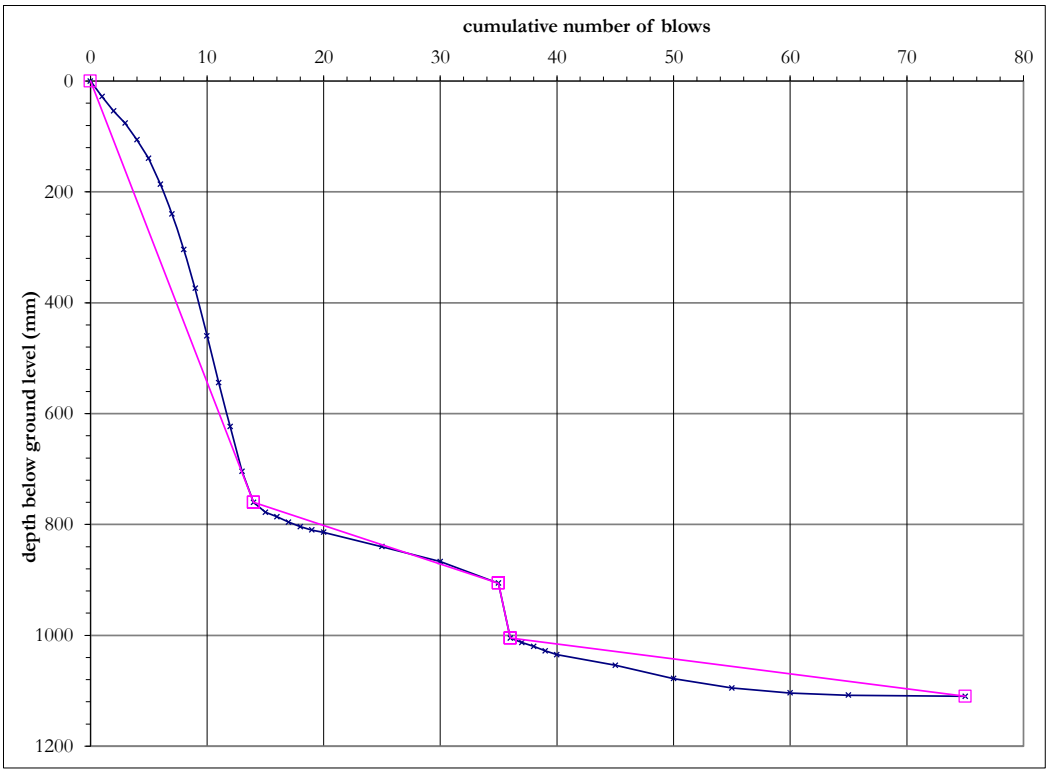
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Strabane |

| | |
|---|---|
| **Test Number** | CBR 041 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 26/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 54 | 4.4 |
| 760 | | |
| | | |
| 760 | 7 | 39 |
| 906 | | |
| | | |
| 906 | 99 | 2.3 |
| 1005 | | |
| | | |
| 1005 | 2.7 | >100 |
| 1110 | | |
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|---|---|---|
| **CBR Range** | Min: 2.3<br>Max: >100 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

UKAS TESTING 10122

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

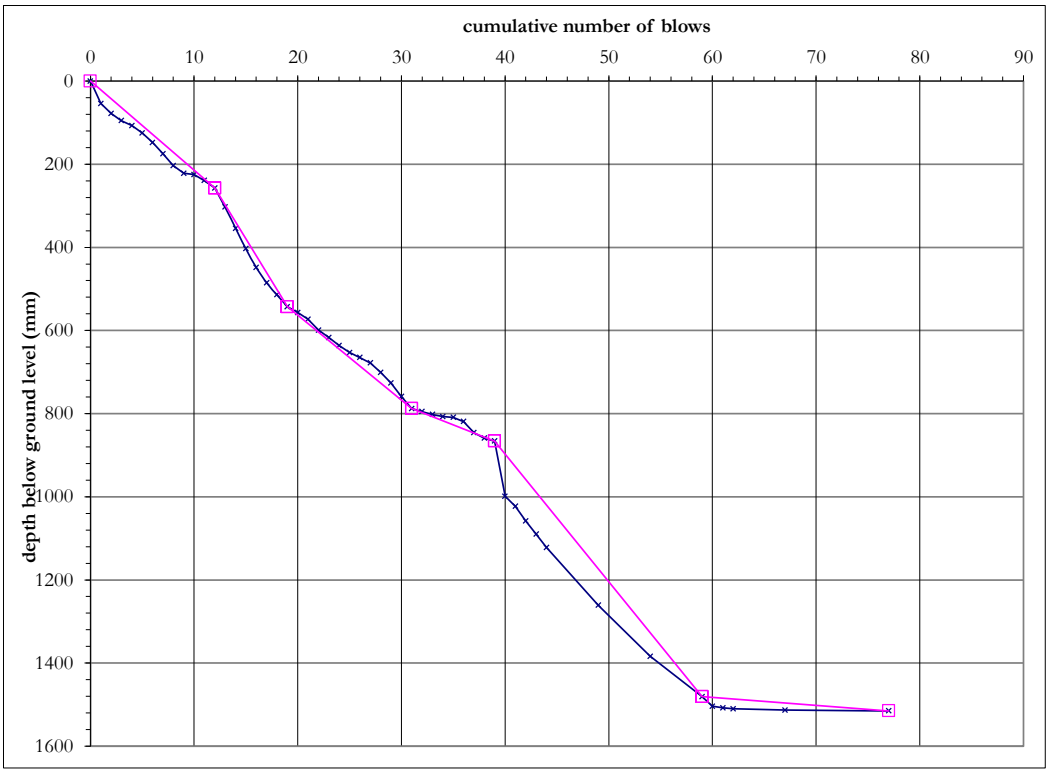
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Strabane |

| | |
|---|---|
| **Test Number** | CBR 042 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 25/05/2021 |
| **Weather** | Cloudy |

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

| Surface preparation | Description of surface material at test depth |
|---|---|
| N/A | Railway bed |




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 21 | 12 |
| 257 | | |
| 257 | 41 | 6 |
| 543 | | |
| 543 | 20 | 12 |
| 788 | | |
| 788 | 9.8 | 27 |
| 866 | | |
| 866 | 31 | 8.1 |
| 1481 | | |
| 1481 | 1.9 | >100 |
| 1515 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 6<br>Max: >100 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

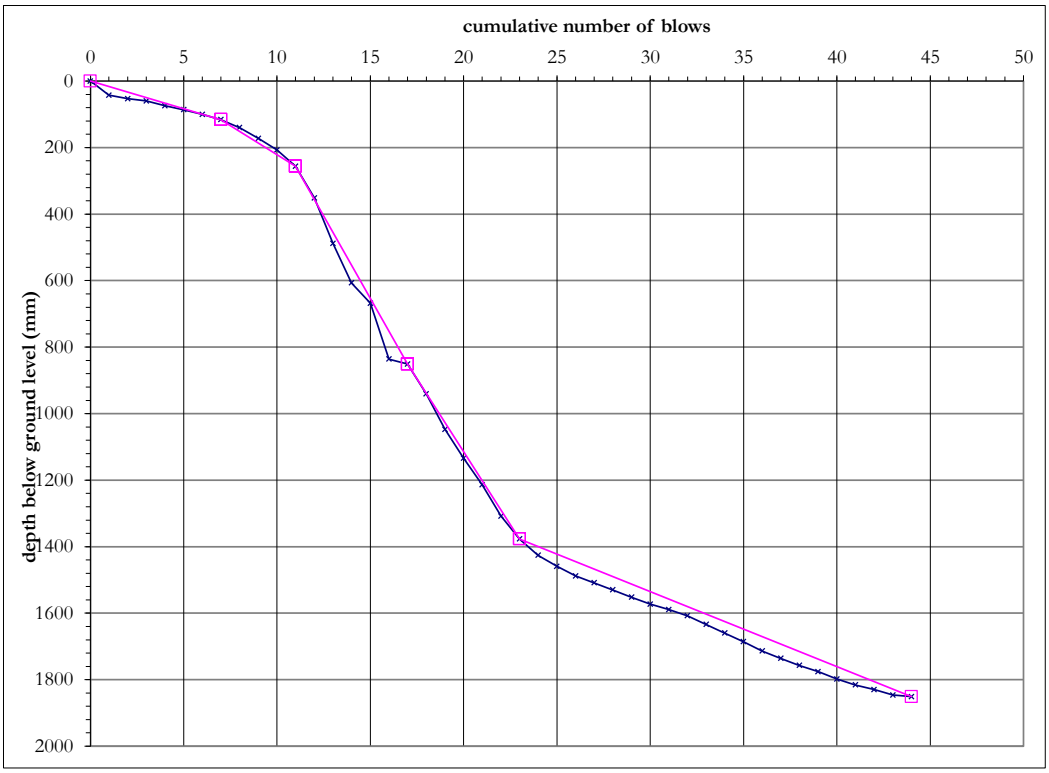
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Strabane |

| | |
|---|---|
| **Test Number** | CBR 043 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 26/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 17 | 16 |
| 116 | | |
| | | |
| 116 | 35 | 7 |
| 256 | | |
| | | |
| 256 | 99 | 2.3 |
| 851 | | |
| | | |
| 851 | 88 | 2.7 |
| 1377 | | |
| | | |
| 1377 | 23 | 11 |
| 1851 | | |
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|---|---|---|
| **CBR Range** | Min: 2.3<br>Max: 16 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

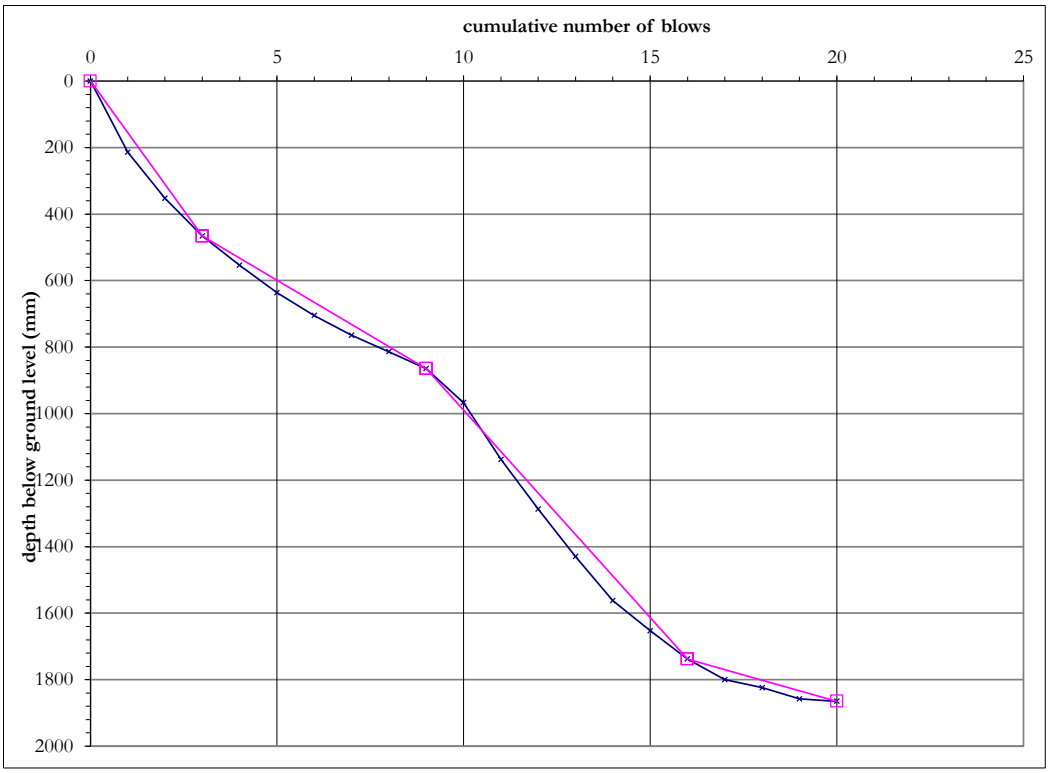
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Strabane |

| | |
|---|---|
| **Test Number** | CBR 044 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 26/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 155 | 1.5 |
| 466 | | |
| | | |
| 466 | 67 | 3.6 |
| 865 | | |
| | | |
| 865 | 125 | 1.8 |
| 1738 | | |
| | | |
| 1738 | 32 | 7.8 |
| 1865 | | |
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| CBR Range | | |
|---|---|---|
| | Min: 1.5<br>Max: 7.8 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

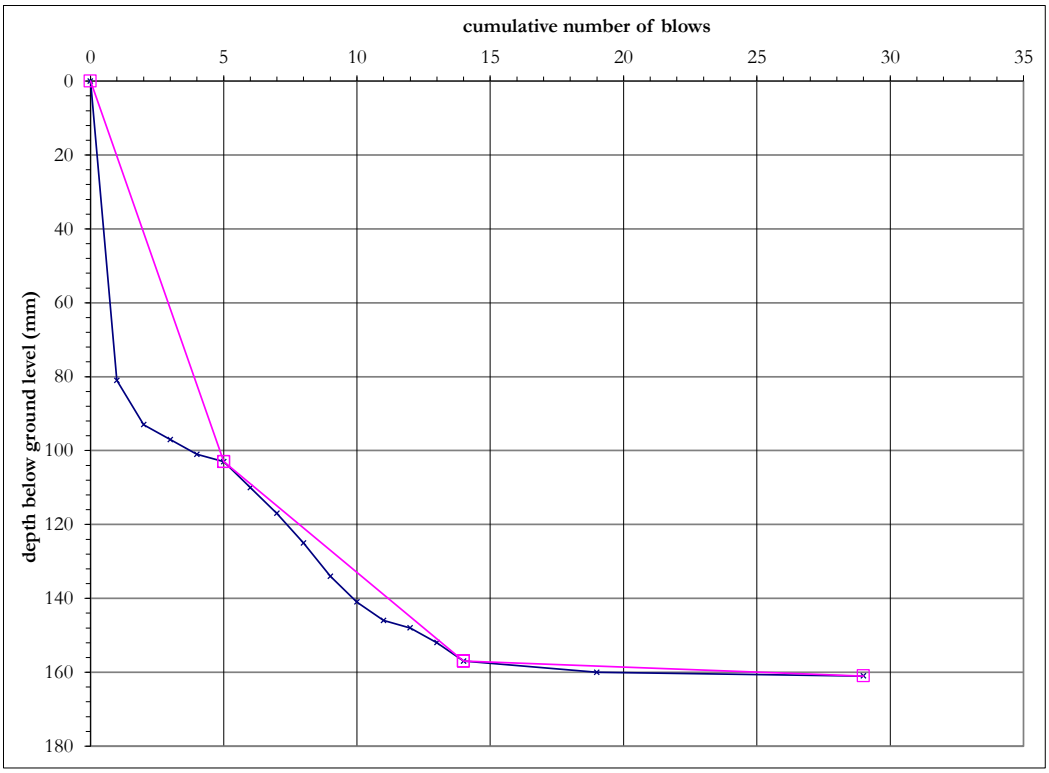
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Strabane |

| | |
|---|---|
| **Test Number** | CBR 045 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 25/05/2021 |
| **Weather** | Cloudy |

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

| Surface preparation | Description of surface material at test depth |
|---|---|
| N/A | Railway bed |




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 21 | 12 |
| 103 | | |
| | | |
| 103 | 6 | 45 |
| 157 | | |
| | | |
| 157 | 0.3 | >100 |
| 161 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 12<br>Max: >100 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

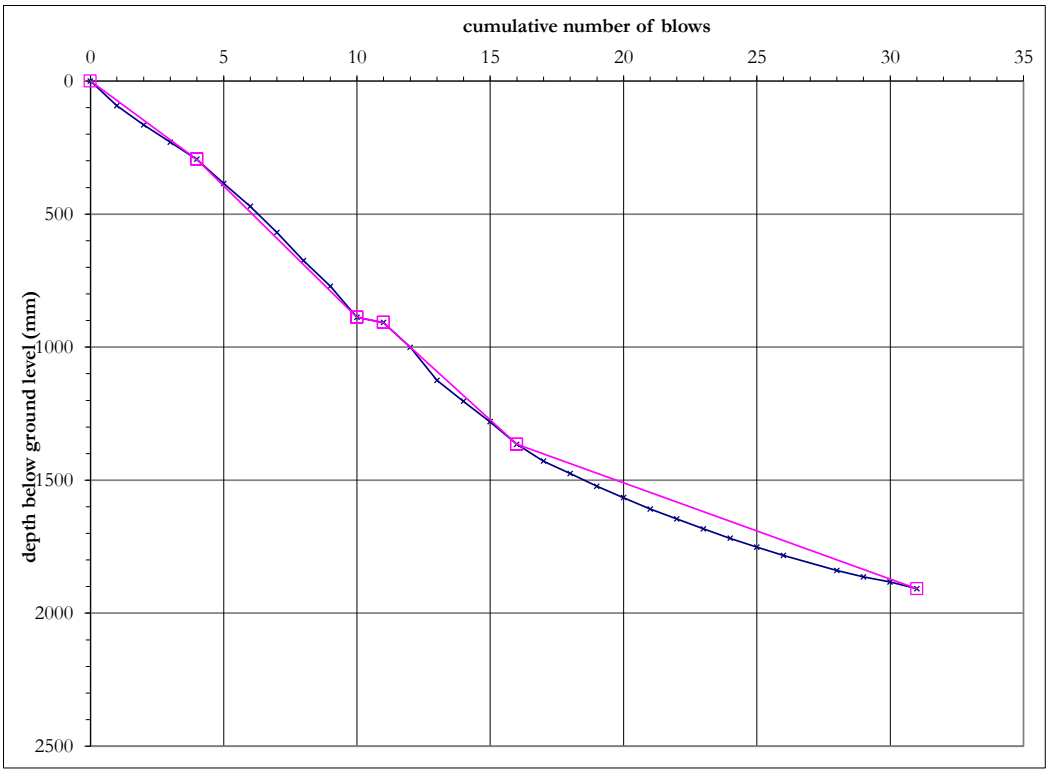
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Strabane |

| | |
|---|---|
| **Test Number** | CBR 046 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 26/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 74 | 3.2 |
| 294 | | |
| 294 | 99 | 2.3 |
| 888 | | |
| 888 | 20 | 13 |
| 908 | | |
| 908 | 92 | 2.5 |
| 1366 | | |
| 1366 | 36 | 6.8 |
| 1908 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 2.3<br>Max: 13 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

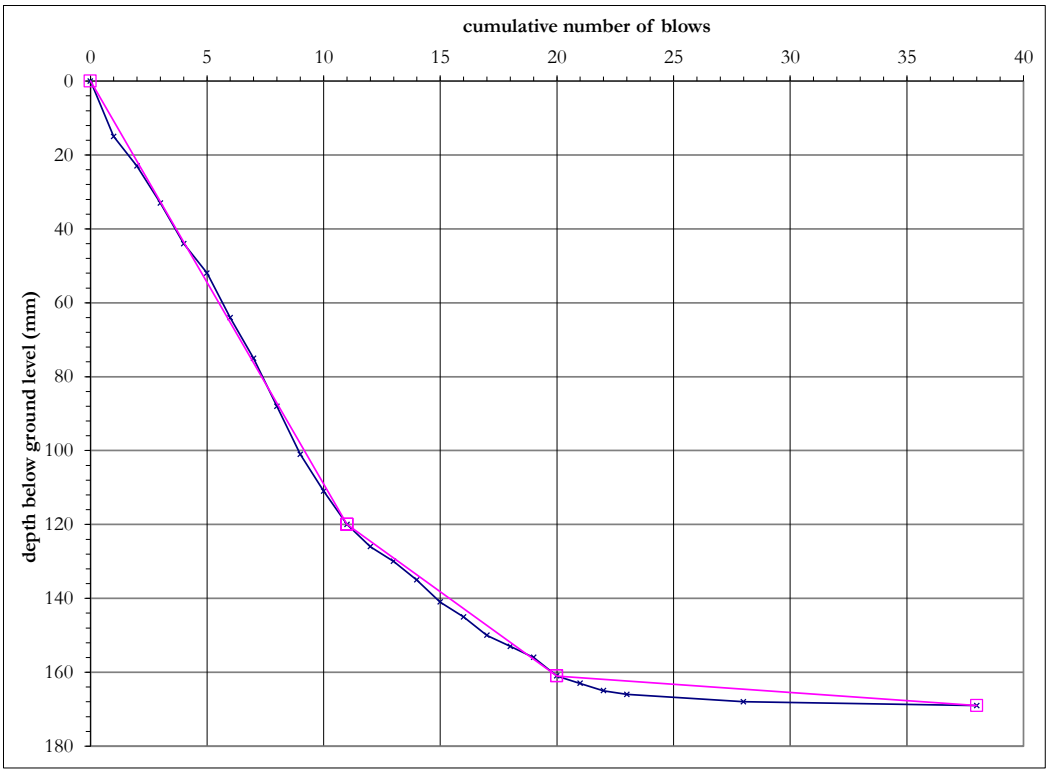
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Strabane |

| | |
|---|---|
| **Test Number** | CBR 047 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 25/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 11 | 24 |
| 120 | | |
| | | |
| 120 | 4.6 | 61 |
| 161 | | |
| | | |
| 161 | 0.4 | >100 |
| 169 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 24<br>Max: >100 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

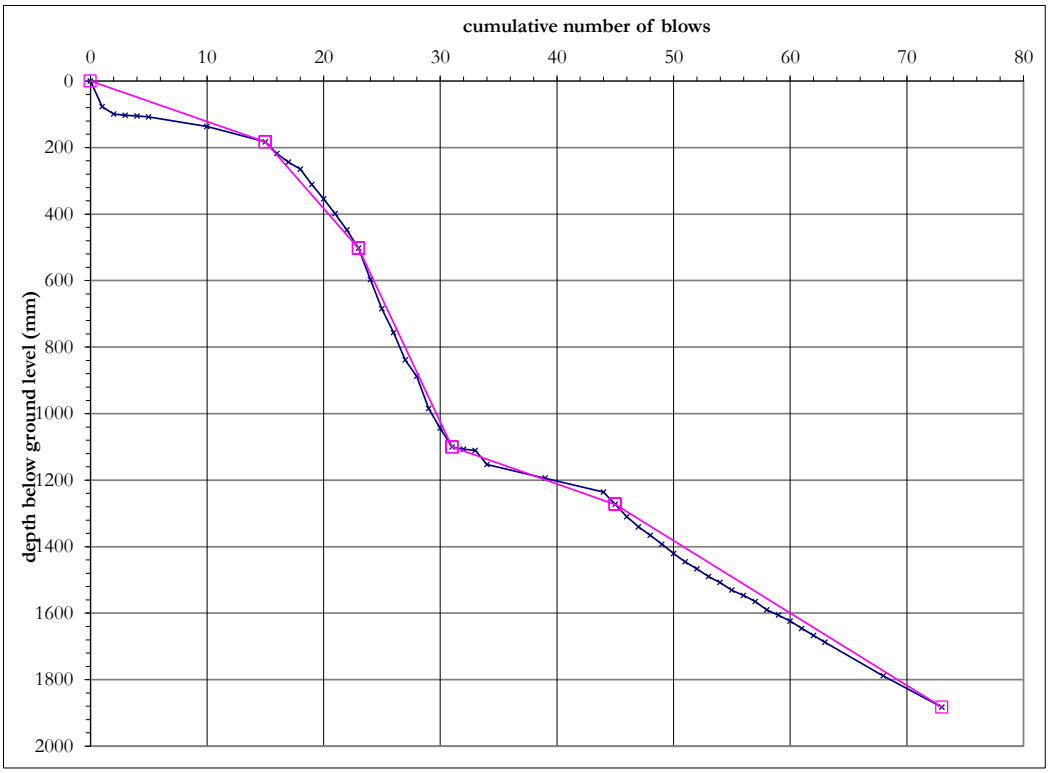
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Strabane |

| | |
|---|---|
| **Test Number** | CBR 048 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 26/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 12 | 21 |
| 183 | | |
| 183 | 40 | 6.1 |
| 503 | | |
| 503 | 75 | 3.2 |
| 1100 | | |
| 1100 | 12 | 21 |
| 1273 | | |
| 1273 | 22 | 12 |
| 1883 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 3.2<br>Max: 21 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

UKAS TESTING 10122

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

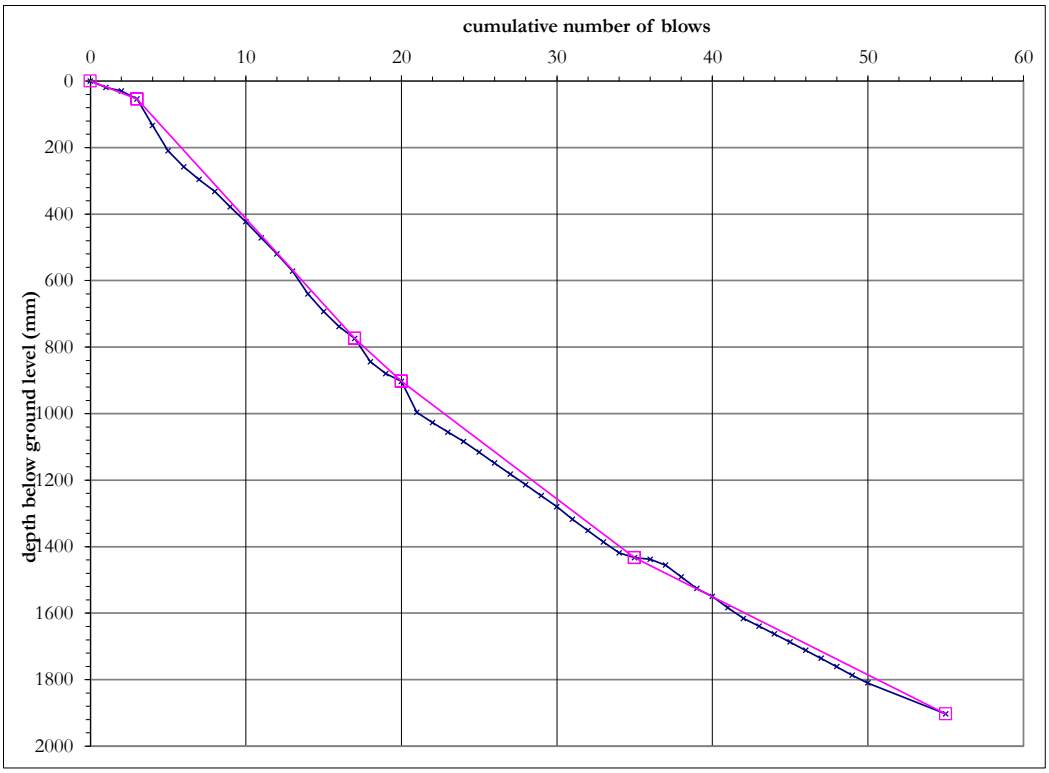
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Strabane |

| | |
|---|---|
| **Test Number** | CBR 049 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 26/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 18 | 14 |
| 54 | | |
| | | |
| 54 | 51 | 4.7 |
| 774 | | |
| | | |
| 774 | 43 | 5.7 |
| 903 | | |
| | | |
| 903 | 35 | 7 |
| 1433 | | |
| | | |
| 1433 | 24 | 11 |
| 1903 | | |
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|---|---|---|
| **CBR Range** | Min: 4.7<br>Max: 14 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

UKAS TESTING 10122

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

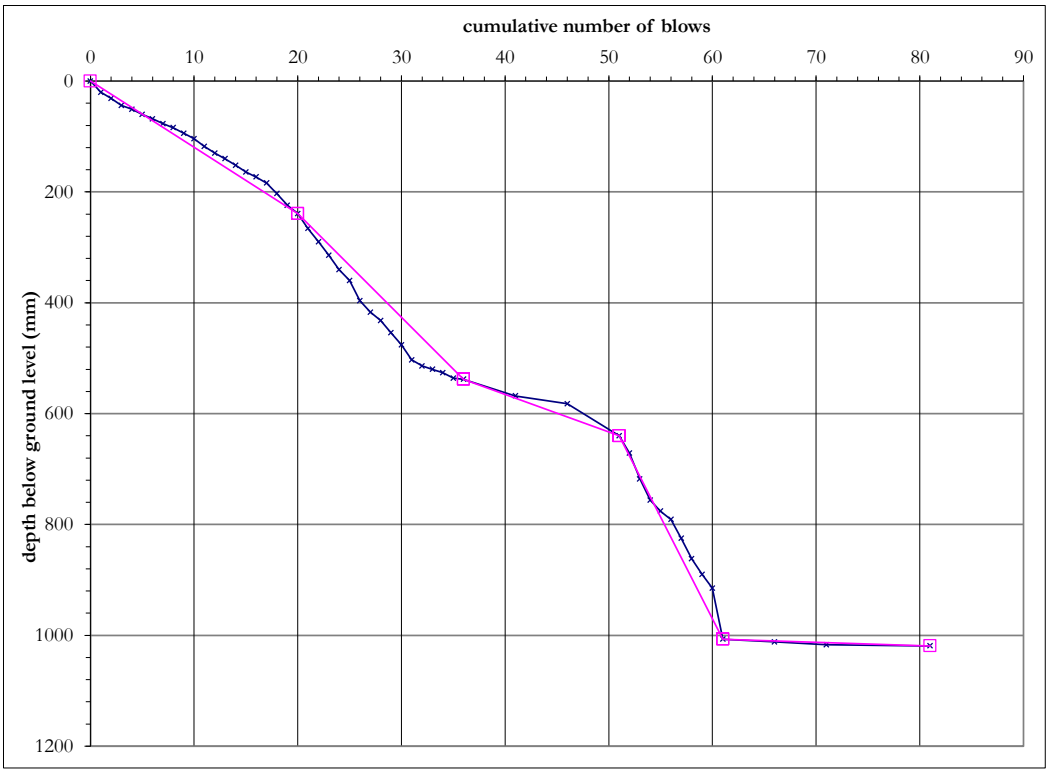
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Strabane |

| | |
|---|---|
| **Test Number** | CBR 051 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 26/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 12 | 22 |
| 239 | | |
| 239 | 19 | 14 |
| 538 | | |
| 538 | 6.8 | 40 |
| 640 | | |
| 640 | 37 | 6.7 |
| 1007 | | |
| 1007 | 0.6 | >100 |
| 1019 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 6.7<br>Max: >100 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

UKAS TESTING 10122

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

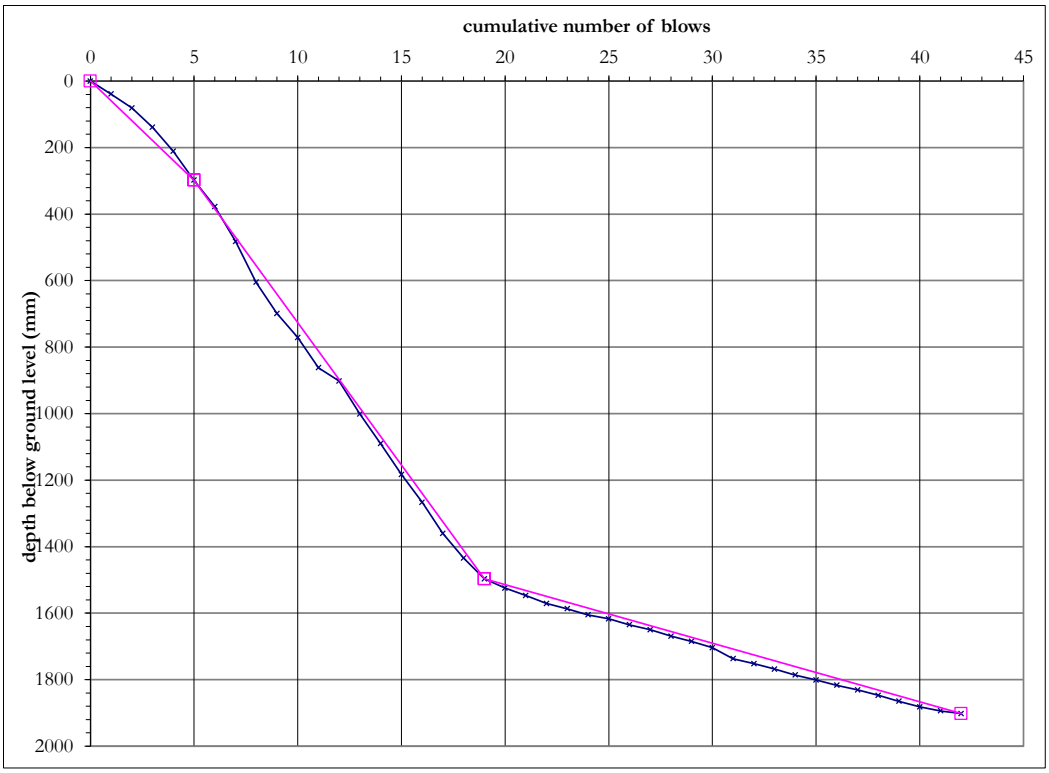
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Strabane |

| | |
|---|---|
| **Test Number** | CBR 052 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 26/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 60 | 4 |
| 298 | | |
| | | |
| 298 | 86 | 2.7 |
| 1497 | | |
| | | |
| 1497 | 18 | 15 |
| 1902 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 2.7<br>Max: 15 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Strabane |

| | |
|---|---|
| **Test Number** | CBR 053 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 13/07/2021 |
| **Weather** | Overcast |

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

| Surface preparation | Description of surface material at test depth |
|---|---|
| Grass | TOPSOIL |




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 111 | 2.1 |
| 334 | | |
| | | |
| 334 | 55 | 4.4 |
| 882 | | |
| | | |
| 882 | 67 | 3.5 |
| 1150 | | |
| | | |
| 1150 | 42 | 5.8 |
| 1827 | | |
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| **CBR Range** | Min: 2.1<br>Max: 5.8 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | July 2021 |

UKAS TESTING 10122

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

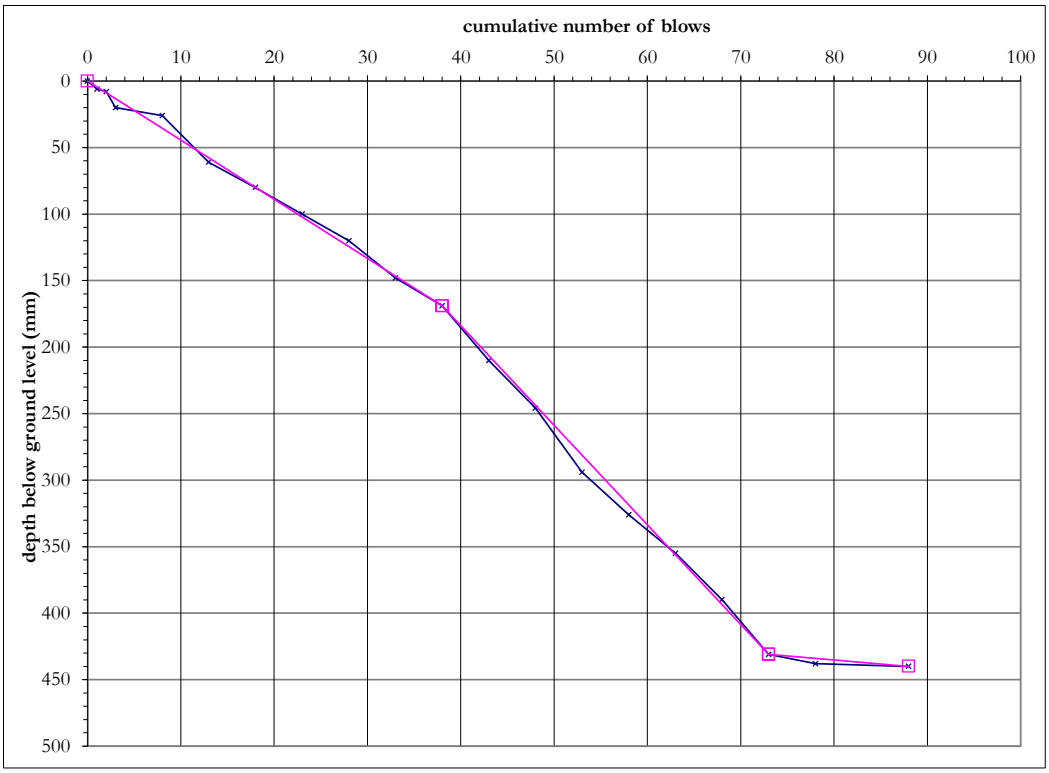
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Strabane |

| | |
|---|---|
| **Test Number** | CBR 054 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 26/05/2021 |
| **Weather** | Cloudy |

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

| Surface preparation | Description of surface material at test depth |
|---|---|
| N/A | Railway bed |




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 4.4 | 62 |
| 169 | | |
| | | |
| 169 | 7.5 | 36 |
| 431 | | |
| | | |
| 431 | 0.6 | >100 |
| 440 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 36<br>Max: >100 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

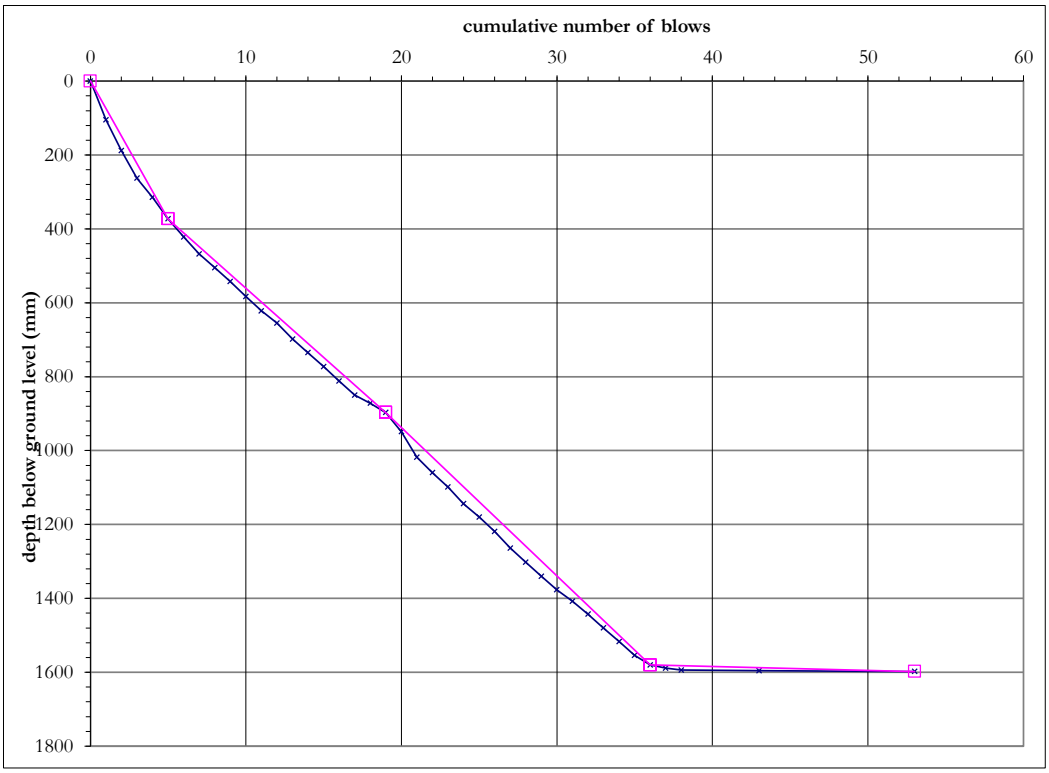
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Strabane |

| | |
|---|---|
| **Test Number** | CBR 055 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 13/07/2021 |
| **Weather** | Sunny |

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

| Surface preparation | Description of surface material at test depth |
|---|---|
| Grass | TOPSOIL |




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 75 | 3.2 |
| 373 | | |
| 373 | 37 | 6.6 |
| 897 | | |
| 897 | 40 | 6.1 |
| 1580 | | |
| 1580 | 1.1 | >100 |
| 1598 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 3.2<br>Max: >100 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | July 2021 |

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

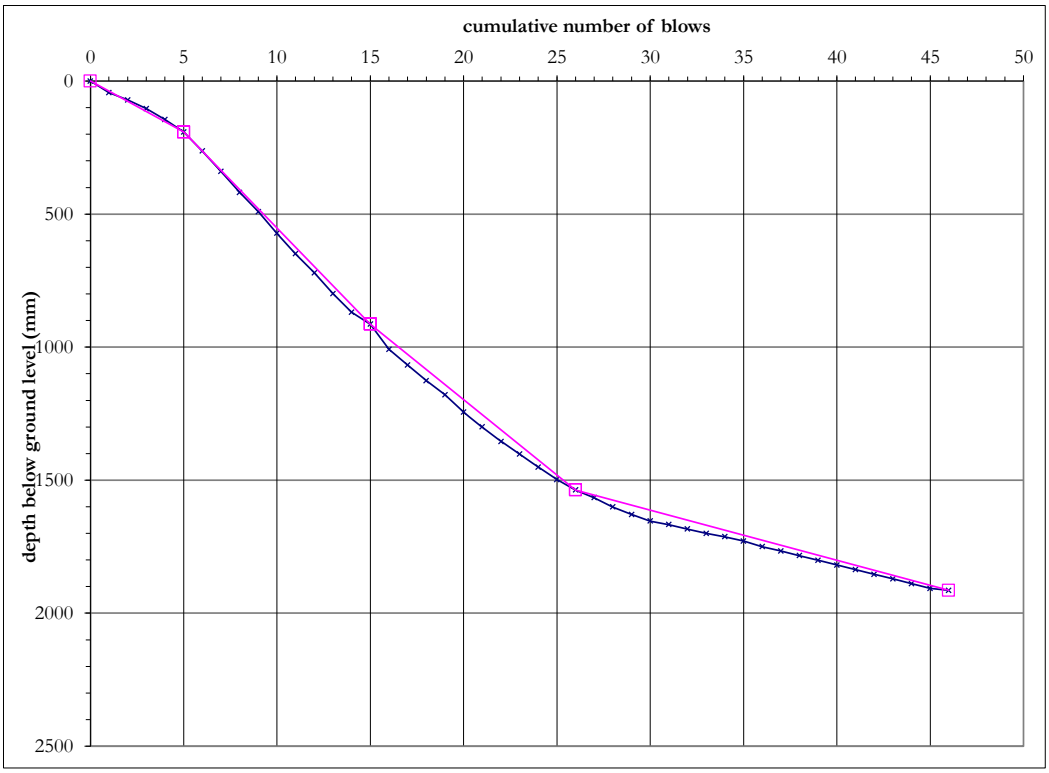
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Strabane |

| | |
|---|---|
| **Test Number** | CBR 056 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 26/05/2021 |
| **Weather** | Cloudy |

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

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




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 38 | 6.4 |
| 191 | | |
| 191 | 72 | 3.3 |
| 914 | | |
| 914 | 57 | 4.2 |
| 1537 | | |
| 1537 | 19 | 14 |
| 1914 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 3.3<br>Max: 14 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

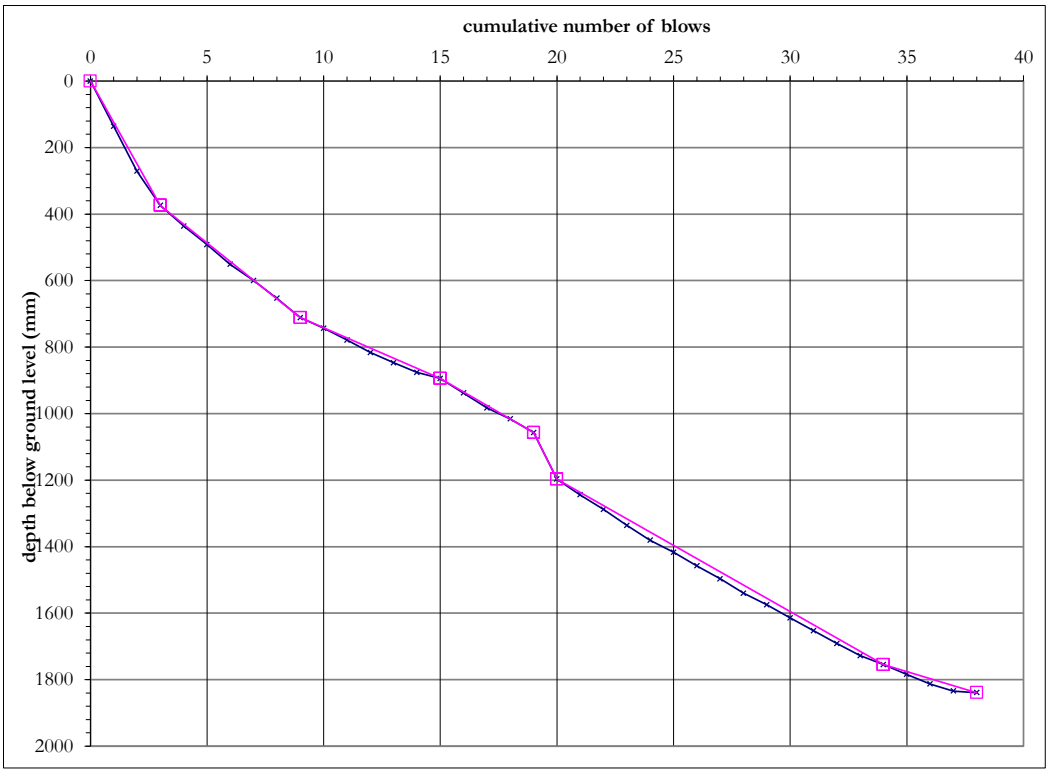
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Strabane |

| | |
|---|---|
| **Test Number** | CBR 057 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 13/07/2021 |
| **Weather** | Cloudy |

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

| Surface preparation | Description of surface material at test depth |
|---|---|
| Grass | TOPSOIL |




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 125 | 1.8 |
| 374 | | |
| 374 | 56 | 4.3 |
| 711 | | |
| 711 | 31 | 8.1 |
| 894 | | |
| 894 | 41 | 6 |
| 1057 | | |
| 1057 | 140 | 1.6 |
| 1197 | | |
| 1197 | 40 | 6.1 |
| 1755 | | |
| 1755 | 21 | 12 |
| 1839 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 1.6<br>Max: 12 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | July 2021 |

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

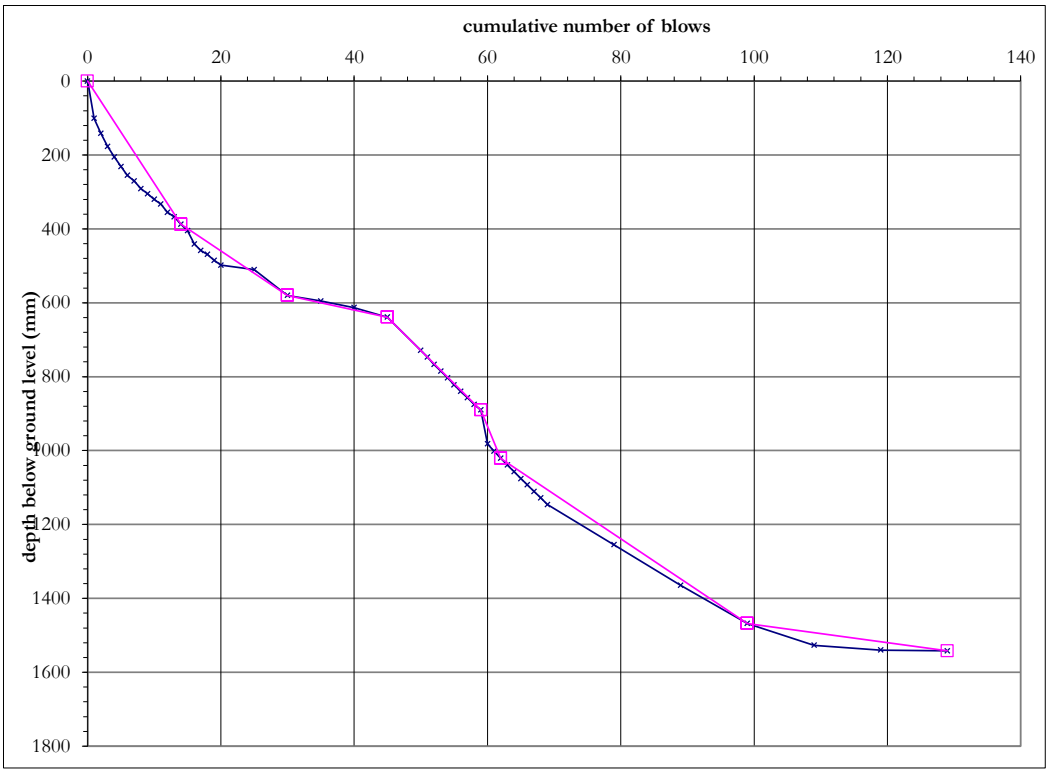
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Strabane |

| | |
|---|---|
| **Test Number** | CBR 058 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 26/05/2021 |
| **Weather** | Cloudy |

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

| Surface preparation | Description of surface material at test depth |
|---|---|
| N/A | Railway bed |




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 28 | 9 |
| 387 | | |
| 387 | 12 | 22 |
| 580 | | |
| 580 | 3.9 | 71 |
| 639 | | |
| 639 | 18 | 14 |
| 890 | | |
| 890 | 44 | 5.6 |
| 1021 | | |
| 1021 | 12 | 22 |
| 1468 | | |
| 1468 | 2.5 | >100 |
| 1542 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 5.6<br>Max: >100 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

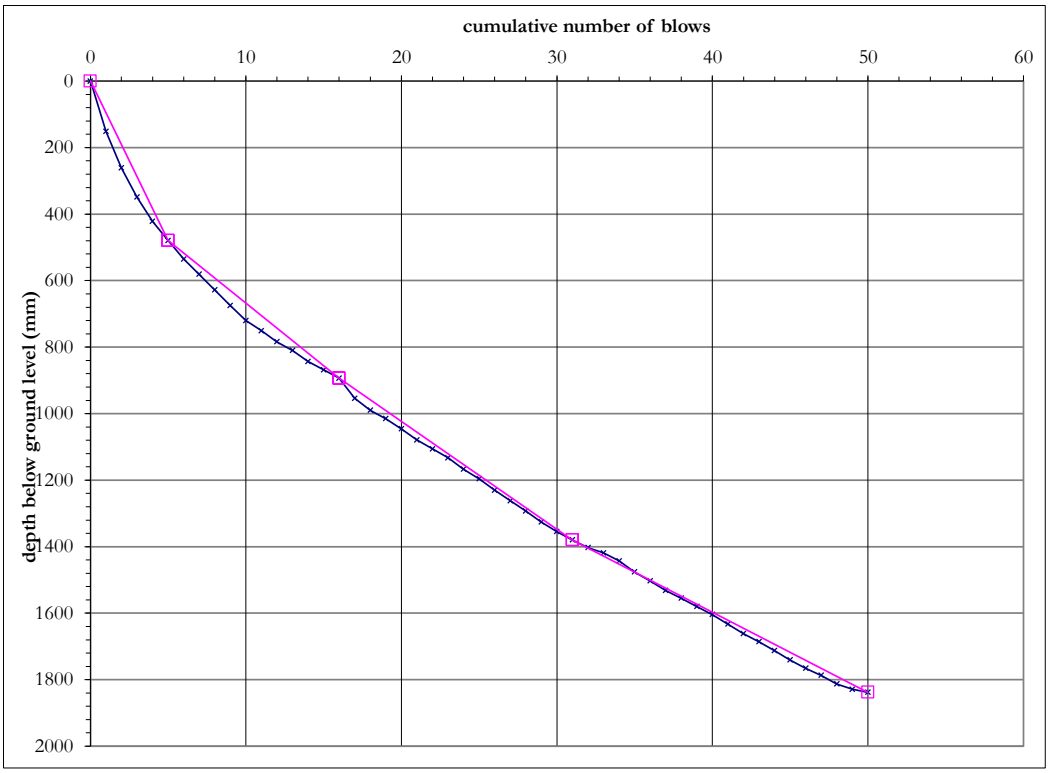
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Strabane |

| | |
|---|---|
| **Test Number** | CBR 059 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 13/07/2021 |
| **Weather** | Cloudy |

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

| Surface preparation | Description of surface material at test depth |
|---|---|
| Grass | TOPSOIL |




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 96 | 2.4 |
| 479 | | |
| 479 | 38 | 6.5 |
| 893 | | |
| 893 | 32 | 7.6 |
| 1380 | | |
| 1380 | 24 | 10 |
| 1838 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 2.4<br>Max: 10 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | July 2021 |

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Strabane |

| | |
|---|---|
| **Test Number** | INFIL 005 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 20/05/2021 |
| **Weather** | Showers |

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

| Surface preparation | Description of surface material at test depth |
|---|---|
| Grass | TOPSOIL |




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 23 | 11 |
| 136 | | |
| | | |
| 136 | 17 | 15 |
| 473 | | |
| | | |
| 473 | 44 | 5.5 |
| 824 | | |
| | | |
| 824 | 33 | 7.4 |
| 1492 | | |
| | | |
| 1492 | 22 | 11 |
| 1824 | | |
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| | | |
|---|---|---|
| **CBR Range** | Min: 5.5<br>Max: 15 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | June 2021 |

UKAS TESTING 10122

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

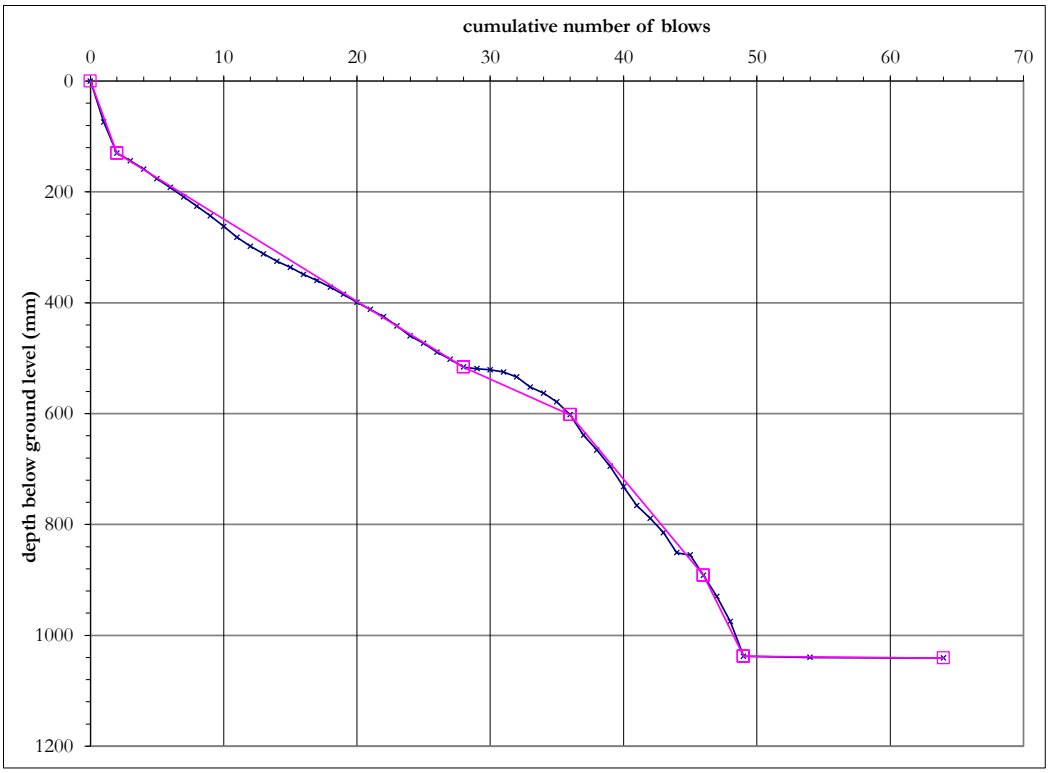
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Strabane |

| | |
|---|---|
| **Test Number** | INFIL 006 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 13/07/2021 |
| **Weather** | Sunny |

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

| Surface preparation | Description of surface material at test depth |
|---|---|
| Grass | TOPSOIL |




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 65 | 3.7 |
| 130 | | |
| 130 | 15 | 17 |
| 516 | | |
| 516 | 11 | 25 |
| 602 | | |
| 602 | 29 | 8.6 |
| 892 | | |
| 892 | 49 | 5 |
| 1038 | | |
| 1038 | 0.2 | >100 |
| 1041 | | |

| | | |
|---|---|---|
| **CBR Range** | Min: 3.7<br>Max: >100 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | July 2021 |

# Dynamic Cone Penetrometer (DCP) test results and estimated CBR

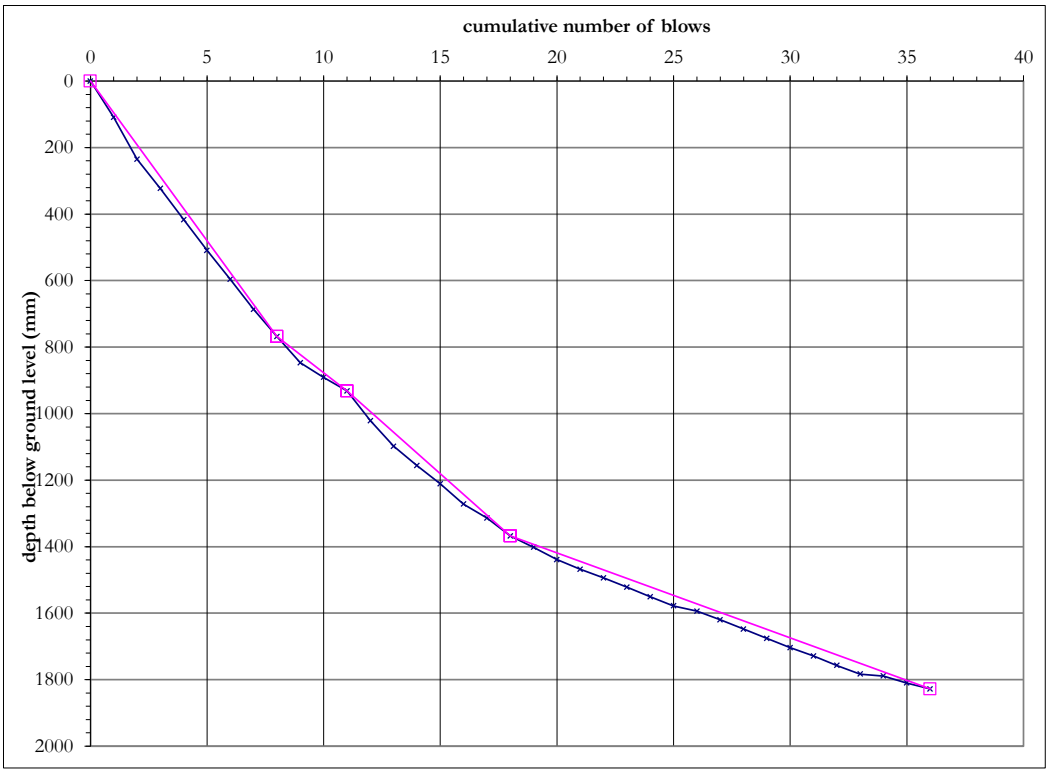
| | |
|---|---|
| **Project Number** | 21-0553 |
| **Project Name** | Riverine Community Park, Lifford |
| **Site Location** | Strabane |

| | |
|---|---|
| **Test Number** | INFIL 007 |
| **Depth bgl (m)** | 0.00 |

| | |
|---|---|
| **Date Tested** | 13/07/2021 |
| **Weather** | Sunny |

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

| Surface preparation | Description of surface material at test depth |
|---|---|
| Grass | TOPSOIL |




| top / base of layer (mm) | mm/ blow | CBR (%) |
|---|---|---|
| 0 | 96 | 2.4 |
| 768 | | |
| | | |
| 768 | 55 | 4.4 |
| 932 | | |
| | | |
| 932 | 62 | 3.8 |
| 1368 | | |
| | | |
| 1368 | 26 | 9.8 |
| 1828 | | |
| | | |
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| | | |
|---|---|---|
| **CBR Range** | Min: 2.4<br>Max: 9.8 | The selection of layers is based on visual interpretation of the data.<br>The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;<br>variation in moisture content or other factors may affect the insitu value. |

| | |
|---|---|
| **Deviation(s) from standard procedure** | None |

| | |
|---|---|
| **Observations and comments** | |

| Approved Name and Appointment | | |
|---|---|---|
| Darren O'Mahony<br>Director | | July 2021 |

UKAS TESTING 10122

CAUSEWAY GEOTECH

# APPENDIX F

# GROUNDWATER MONITORING RECORDS

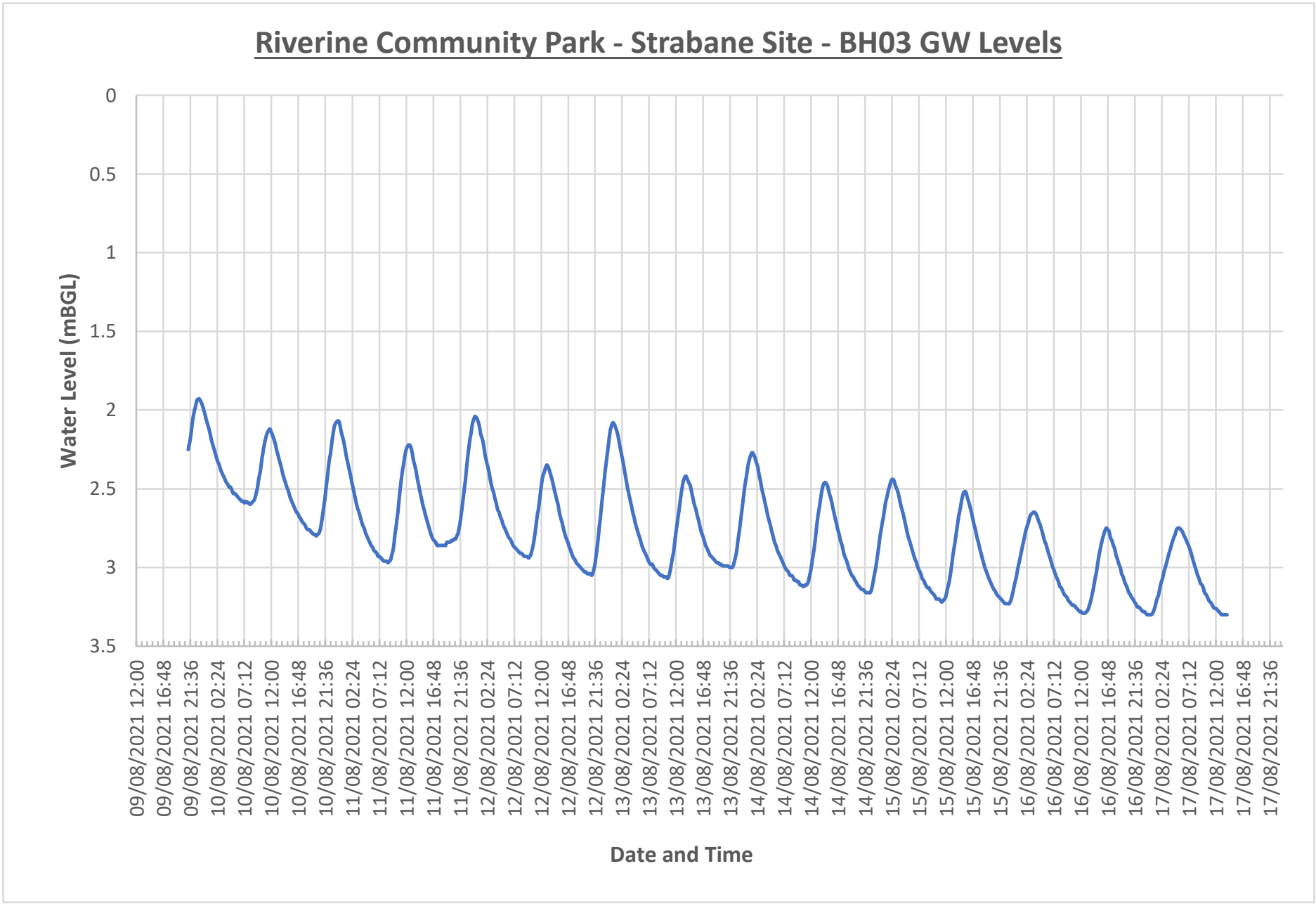


**Job No: 21-0553B**

**Job Name: Riverine Community Park, Lifford - Site Investigation**

**Strabane Site Ground Water Monitoring Results**

| EH No: | Depth to base at end of fieldwork (mbgl) | Water Level (mbgl) | | | |
|---|---|---|---|---|---|
| | | ROUND 1 13.07.2021 | ROUND 2 27.07.2021 | ROUND 3 09.08.2021 | ROUND 4 17.08.2021 |
| BH03 (rz 7.00-10.00mbgl) | 10.00m | 2.71m | 2.43m | 2.25m | 3.30m |


Riverine Community Park - Strabane Site - BH03 GW Levels
Water Level (mBGL)
0
0.5
1
1.5
2
2.5
3
3.5
09/08/2021 12:00
09/08/2021 16:48
09/08/2021 21:36
10/08/2021 02:24
10/08/2021 07:12
10/08/2021 12:00
10/08/2021 16:48
10/08/2021 21:36
11/08/2021 02:24
11/08/2021 07:12
11/08/2021 12:00
11/08/2021 16:48
11/08/2021 21:36
12/08/2021 02:24
12/08/2021 07:12
12/08/2021 12:00
12/08/2021 16:48
12/08/2021 21:36
13/08/2021 02:24
13/08/2021 07:12
13/08/2021 12:00
13/08/2021 16:48
13/08/2021 21:36
14/08/2021 02:24
14/08/2021 07:12
14/08/2021 12:00
14/08/2021 16:48
14/08/2021 21:36
15/08/2021 02:24
15/08/2021 07:12
15/08/2021 12:00
15/08/2021 16:48
15/08/2021 21:36
16/08/2021 02:24
16/08/2021 07:12
16/08/2021 12:00
16/08/2021 16:48
16/08/2021 21:36
17/08/2021 02:24
17/08/2021 07:12
17/08/2021 12:00
17/08/2021 16:48
17/08/2021 21:36
Date and Time

CAUSEWAY GEOTECH

# APPENDIX G

# GEOTECHNICAL LABORATORY TEST RESULTS



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

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

www.causewaygeotech.com

**SOIL AND ROCK SAMPLE ANALYSIS**
**LABORATORY TEST REPORT**

9 August 2021

| | |
|---|---|
| **Project Name:** | Riverine Community Park, Strabane Site |
| **Project No.:** | 21-0553B |
| **Client:** | Derry City and Strabane District Council |
| **Engineer:** | McAdam Design Ltd |

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.

Stephen Watson

Laboratory Manager

Signed for and on behalf of Causeway Geotech Ltd



SCS ISO 9001 CERTIFIED
SCS ISO 14001 CERTIFIED
SCS ISO 45001 CERTIFIED
UKAS MANAGEMENT SYSTEMS 9235
UKAS TESTING 10122
AGS
BRITISH DRILLING ASSOCIATION

**Project Name:** Riverine Community Park, Strabane Site

**Report Reference:** Schedule 1

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

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

| Material tested | Type of test/Properties measured/Range of measurement | Standard specifications | No. of results included in the report |
|---|---|---|---|
| SOIL | Moisture Content of Soil | BS 1377-2: 1990: Cl 3.2 | 2 |
| SOIL | Liquid and Plastic Limits of soil-1 point cone penetrometer method | BS 1377-2: 1990: Cl 4.4, 5.3 & 5.4 | 2 |
| SOIL | Particle size distribution - wet sieving | BS 1377-2: 1990: Cl 9.2 | 4 |
| SOIL | Particle size distribution - sedimentation hydrometer method | BS 1377-2: 1990: Cl 9.5 | 2 |
| SOIL | Consolidation properties in oedometer - Using 5 pressures (up to 5 days total duration) | BS 1377-5: 1990: Cl 3: 1 | 1 |
| SOIL | Undrained shear strength – triaxial compression without measurement of pore pressure (loads from 0.12 to 24 kN) | BS 1377-7: 1990: Cl 8 | |
| SOIL | Direct Shear Test using 60mm Small Shearbox (up to 3 days) | BS EN ISO 17892-10:2018 | 2 |
| | Extra over days (more than initial 3 days) | | 1 |

## SUB-CONTRACTED TESTS

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

| Material tested | Type of test/Properties measured/Range of measurement | Standard specifications | No. of results included in the report |
|---|---|---|---|
| SOIL – Subcontracted to Eurofins Chemtest Ltd *(UKAS 2183)* | BRE Test - Suite A | | 2 |
| SOIL – Subcontracted to Eurofins Chemtest Ltd *(UKAS 2183)* | BRE Test - Suite C | | 1 |

# Summary of Classification Test Results

| Project No. | Project Name |
|---|---|
| 21-0553B | Riverine Community Park, Lifford |

| Hole No. | Sample | | | | Soil Description | Density bulk | Density dry | w | Passing 425µm | LL | PL | PI | Particle density | Casagrande Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ref | Top | Base | Type | | Mg/m3 | | % | % | % | % | % | Mg/m3 | |
| BH03 | 3 | 0.50 | | D | Brown silty fine to coarse SAND. | | | 22.0 | 96 | 29 -1pt | NP | | | |
| BH03 | 13 | 2.00 | | D | Brown slightly sandy clayey SILT. | | | 56.0 | 99 | 57 -1pt | 36 | 21 | | MH |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | | |

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

LAB 01R Version 4

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 | |

Date Printed

08/06/2021 00:00

Approved By

Stephen.Watson

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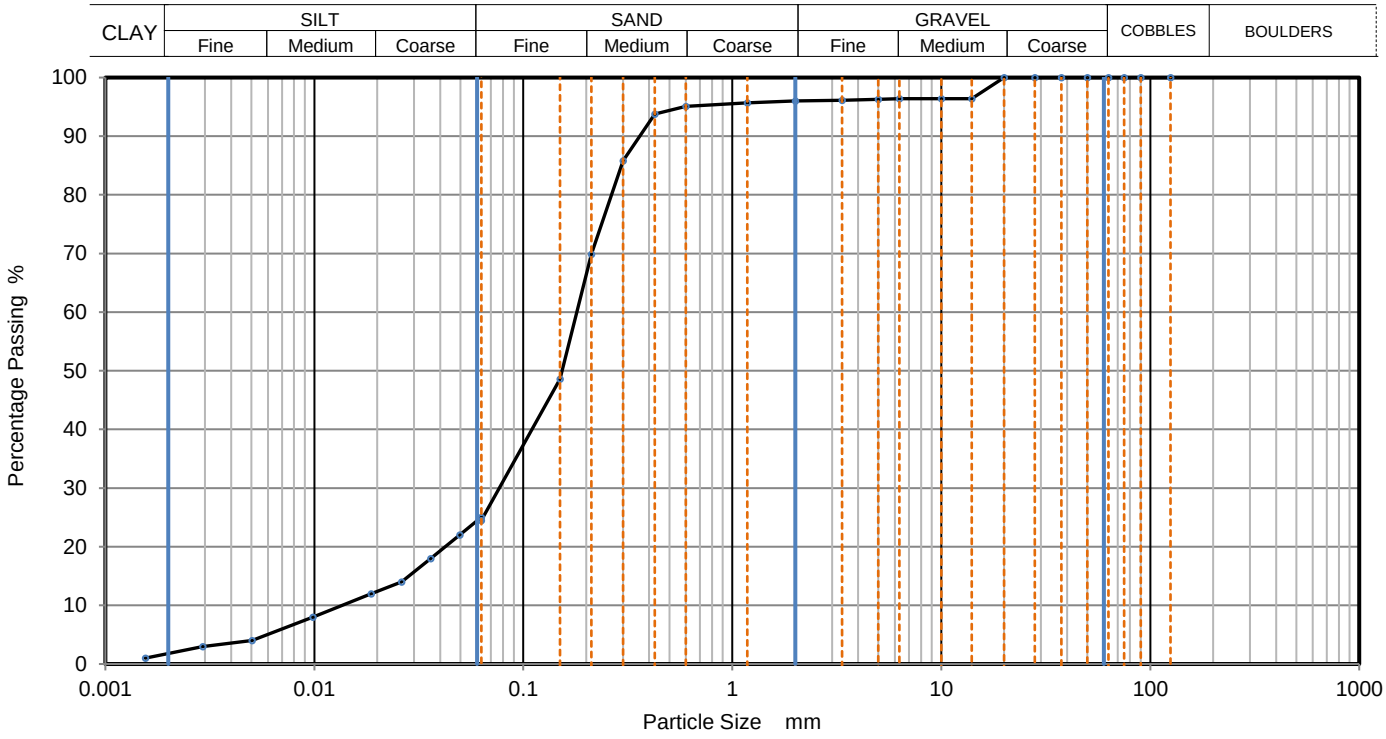
| CAUSEWAY GEOTECH | PARTICLE SIZE DISTRIBUTION | | | | Job Ref | 21-0553 |
|---|---|---|---|---|---|---|
| | | | | | Borehole/Pit No. | BH03 |
| Site Name | Riverine Community Park, Lifford | | | | Sample No. | 1 |
| Soil Description | Brown silty fine to coarse SAND. | | | | Depth, m | 0.50 |
| Specimen Reference | 2 | Specimen Depth | 0.5 | m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clauses 9.2 and 9.5 | | | | KeyLAB ID | Caus2021070619 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | 0.06300 | 25 |
| 90 | 100 | 0.04971 | 22 |
| 75 | 100 | 0.03603 | 18 |
| 63 | 100 | 0.02609 | 14 |
| 50 | 100 | 0.01866 | 12 |
| 37.5 | 100 | 0.00985 | 8 |
| 28 | 100 | 0.00503 | 4 |
| 20 | 100 | 0.00292 | 3 |
| 14 | 96 | 0.00155 | 1 |
| 10 | 96 | | |
| 6.3 | 96 | | |
| 5 | 96 | | |
| 3.35 | 96 | | |
| 2 | 96 | | |
| 1.18 | 96 | | |
| 0.6 | 95 | Particle density | (assumed) |
| 0.425 | 94 | 2.65 | Mg/m3 |
| 0.3 | 86 | | |
| 0.212 | 70 | | |
| 0.15 | 49 | | |
| 0.063 | 25 | | |

| Dry Mass of sample, g | 214 |
|---|---|

| Sample Proportions | % dry mass |
|---|---|
| Cobbles | 0.0 |
| Gravel | 4.0 |
| Sand | 71.5 |
| Silt | 22.7 |
| Clay | 1.8 |

| Grading Analysis | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 0.181 |
| D30 | mm | 0.0768 |
| D10 | mm | 0.0131 |
| Uniformity Coefficient | | 14 |
| Curvature Coefficient | | 2.5 |

Remarks

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

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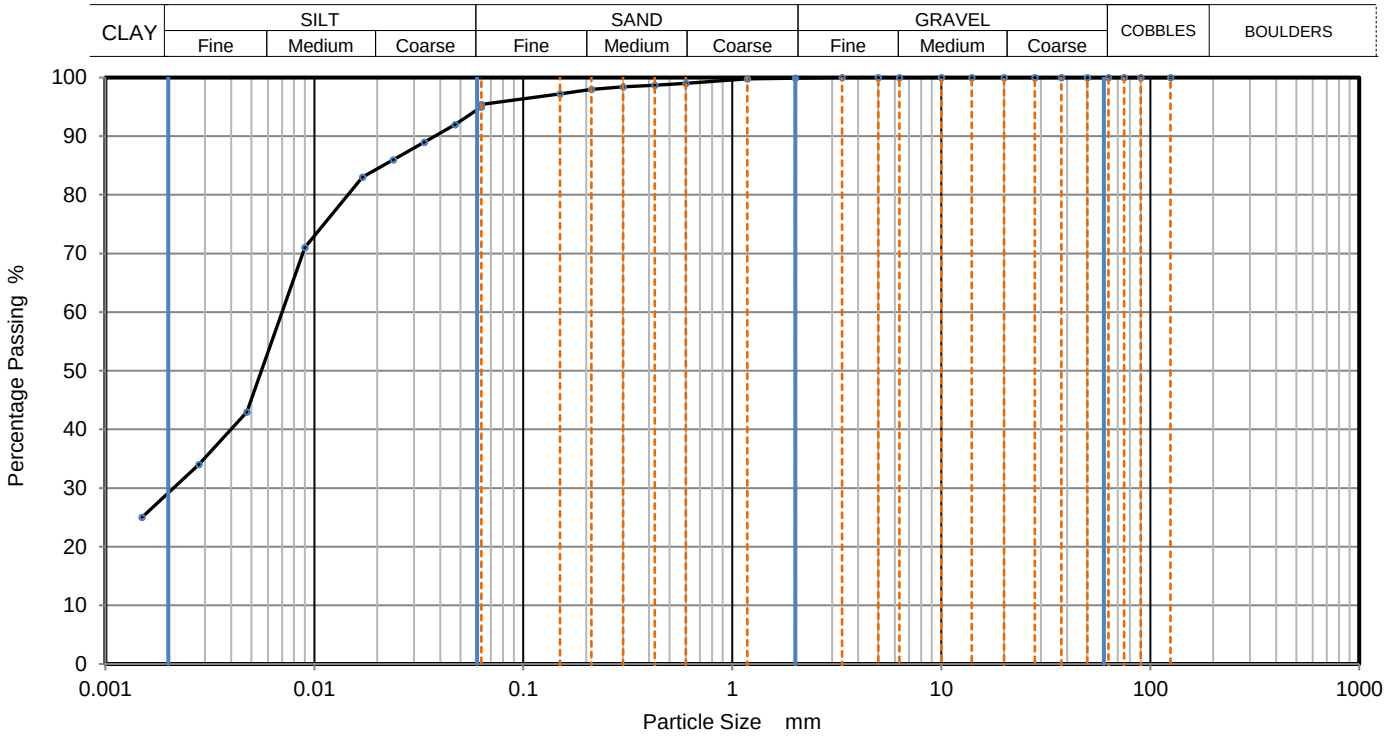
| | | | | | |
|---|---|---|---|---|---|
| CAUSEWAY GEOTECH | **PARTICLE SIZE DISTRIBUTION** | | | Job Ref | **21-0553** |
| | | | | Borehole/Pit No. | BH03 |
| Site Name | Riverine Community Park, Lifford | | | Sample No. | 5 |
| Soil Description | Brown slightly sandy clayey SILT. | | | Depth, m | 2.00 |
| Specimen Reference | 2 | Specimen Depth | 2 m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clauses 9.2 and 9.5 | | | KeyLAB ID | Caus2021070620 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | 0.06290 | 95 |
| 90 | 100 | 0.04711 | 92 |
| 75 | 100 | 0.03355 | 89 |
| 63 | 100 | 0.02389 | 86 |
| 50 | 100 | 0.01701 | 83 |
| 37.5 | 100 | 0.00902 | 71 |
| 28 | 100 | 0.00476 | 43 |
| 20 | 100 | 0.00280 | 34 |
| 14 | 100 | 0.00150 | 25 |
| 10 | 100 | | |
| 6.3 | 100 | | |
| 5 | 100 | | |
| 3.35 | 100 | | |
| 2 | 100 | | |
| 1.18 | 100 | | |
| 0.6 | 99 | Particle density | (assumed) |
| 0.425 | 99 | 2.65 | Mg/m3 |
| 0.3 | 98 | | |
| 0.212 | 98 | | |
| 0.15 | 97 | | |
| 0.063 | 95 | | |

| | |
|---|---|
| Dry Mass of sample, g | 208 |

| **Sample Proportions** | % dry mass |
|---|---|
| Cobbles | 0.0 |
| Gravel | 0.1 |
| Sand | 4.5 |
| Silt | 66.5 |
| Clay | 28.9 |

| **Grading Analysis** | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 0.00703 |
| D30 | mm | 0.00215 |
| D10 | mm | |
| Uniformity Coefficient | | |
| Curvature Coefficient | | |

Remarks

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

| |
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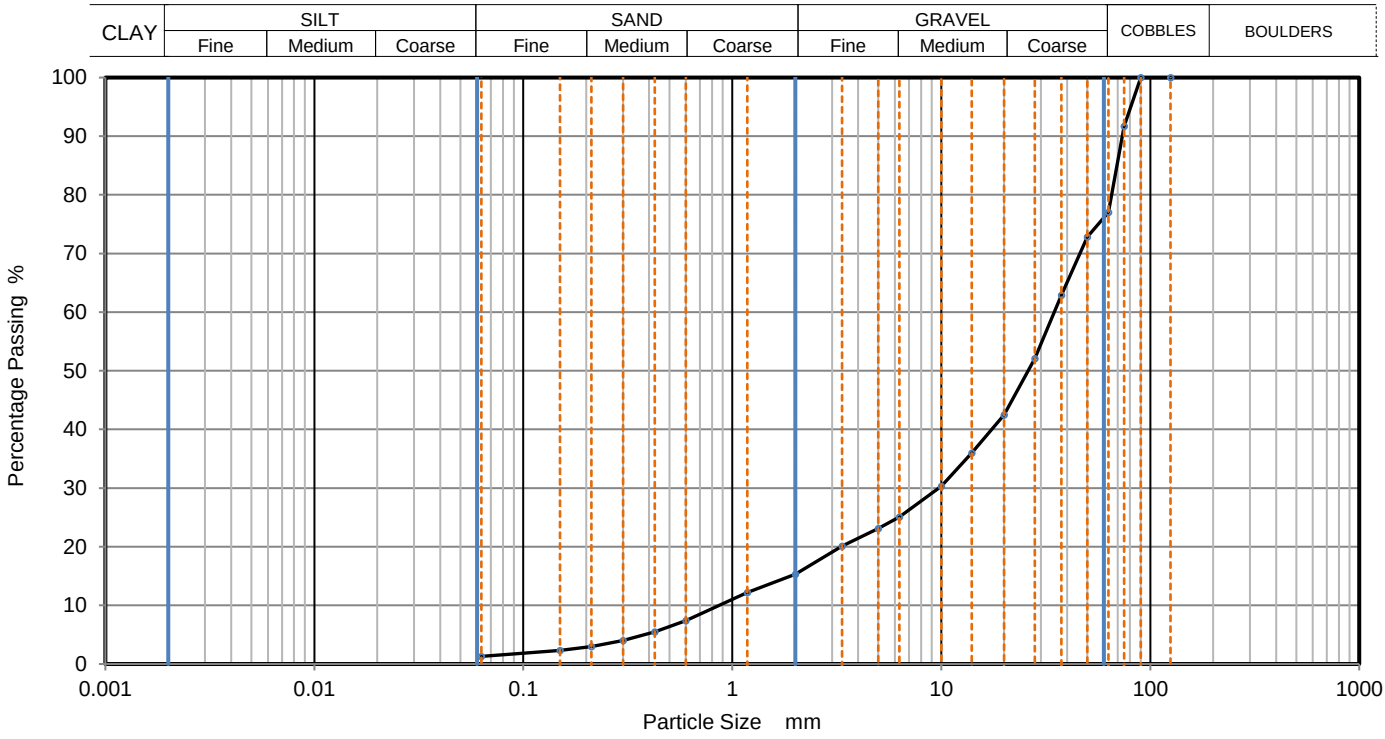
| | | | | | |
|---|---|---|---|---|---|
| CAUSEWAY GEOTECH | **PARTICLE SIZE DISTRIBUTION** | | | Job Ref | **21-0553** |
| | | | | Borehole/Pit No. | BH03 |
| Site Name | Riverine Community Park, Lifford | | | Sample No. | 7 |
| Soil Description | Greyish brown sandy subangular fine to coarse GRAVEL. | | | Depth, m | 4.00 |
| Specimen Reference | 3 | Specimen Depth | 4 m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clause 9.2 | | | KeyLAB ID | Caus2021070623 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | | |
| 90 | 100 | | |
| 75 | 92 | | |
| 63 | 77 | | |
| 50 | 73 | | |
| 37.5 | 63 | | |
| 28 | 52 | | |
| 20 | 43 | | |
| 14 | 36 | | |
| 10 | 30 | | |
| 6.3 | 25 | | |
| 5 | 23 | | |
| 3.35 | 20 | | |
| 2 | 15 | | |
| 1.18 | 12 | | |
| 0.6 | 7 | | |
| 0.425 | 6 | | |
| 0.3 | 4 | | |
| 0.212 | 3 | | |
| 0.15 | 2 | | |
| 0.063 | 1 | | |

| | |
|---|---|
| Dry Mass of sample, g | 16012 |

| **Sample Proportions** | % dry mass |
|---|---|
| Cobbles | 23.0 |
| Gravel | 61.7 |
| Sand | 14.0 |
| | |
| Fines <0.063mm | 1.0 |

| **Grading Analysis** | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 34.6 |
| D30 | mm | 9.74 |
| D10 | mm | 0.867 |
| Uniformity Coefficient | | 40 |
| Curvature Coefficient | | 3.2 |

Remarks

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

| |
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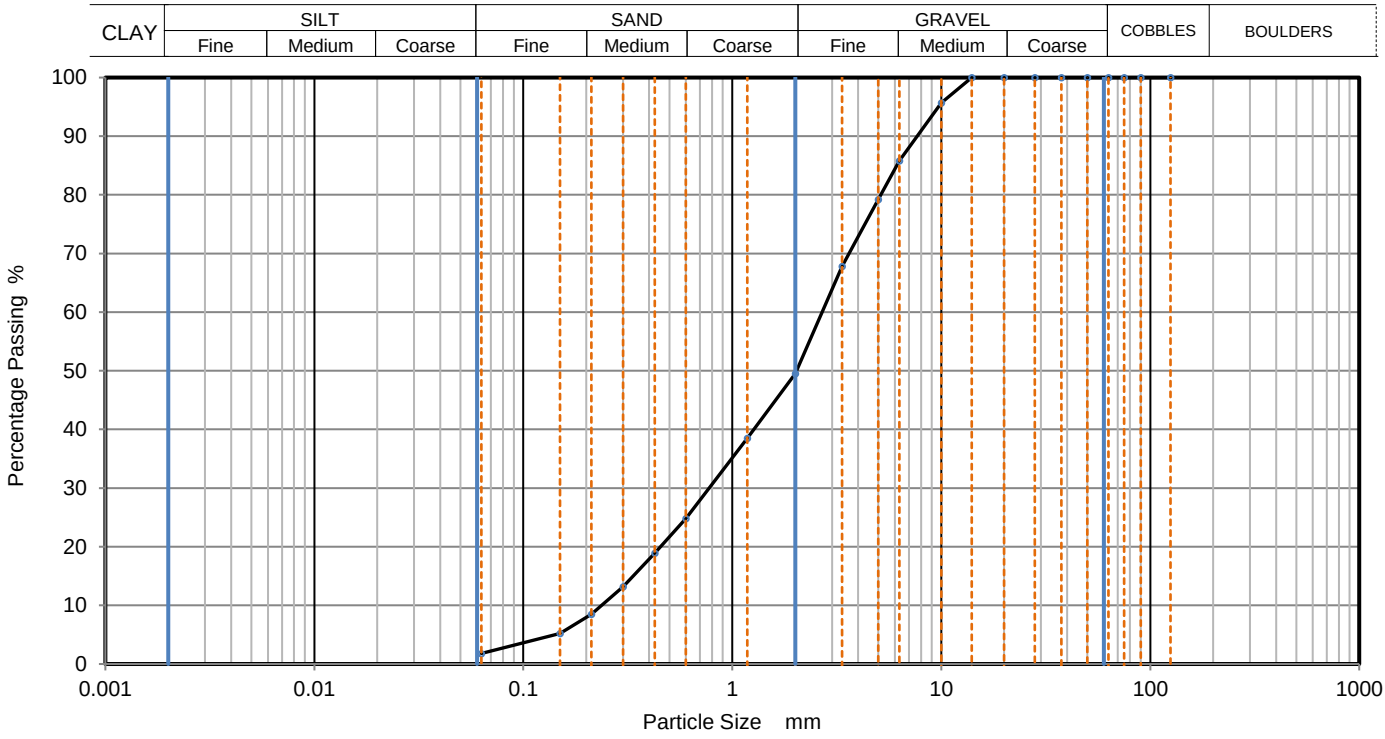
| CAUSEWAY GEOTECH | PARTICLE SIZE DISTRIBUTION | | | | Job Ref | 21-0553 |
|---|---|---|---|---|---|---|
| | | | | | Borehole/Pit No. | BH03 |
| Site Name | Riverine Community Park, Lifford | | | | Sample No. | 11 |
| Soil Description | Greyish brown gravelly fine to coarse SAND. | | | | Depth, m | 9.00 |
| Specimen Reference | 3 | Specimen Depth | 9 | m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clause 9.2 | | | | KeyLAB ID | Caus2021070625 |




| 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 | 100 | | |
| 10 | 96 | | |
| 6.3 | 86 | | |
| 5 | 79 | | |
| 3.35 | 68 | | |
| 2 | 50 | | |
| 1.18 | 39 | | |
| 0.6 | 25 | | |
| 0.425 | 19 | | |
| 0.3 | 13 | | |
| 0.212 | 9 | | |
| 0.15 | 5 | | |
| 0.063 | 2 | | |

| Dry Mass of sample, g | 1117 |
|---|---|

| Sample Proportions | % dry mass |
|---|---|
| Cobbles | 0.0 |
| Gravel | 50.5 |
| Sand | 47.7 |
| | |
| Fines <0.063mm | 2.0 |

| Grading Analysis | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 2.69 |
| D30 | mm | 0.775 |
| D10 | mm | 0.237 |
| Uniformity Coefficient | | 11 |
| Curvature Coefficient | | 0.94 |

Remarks

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

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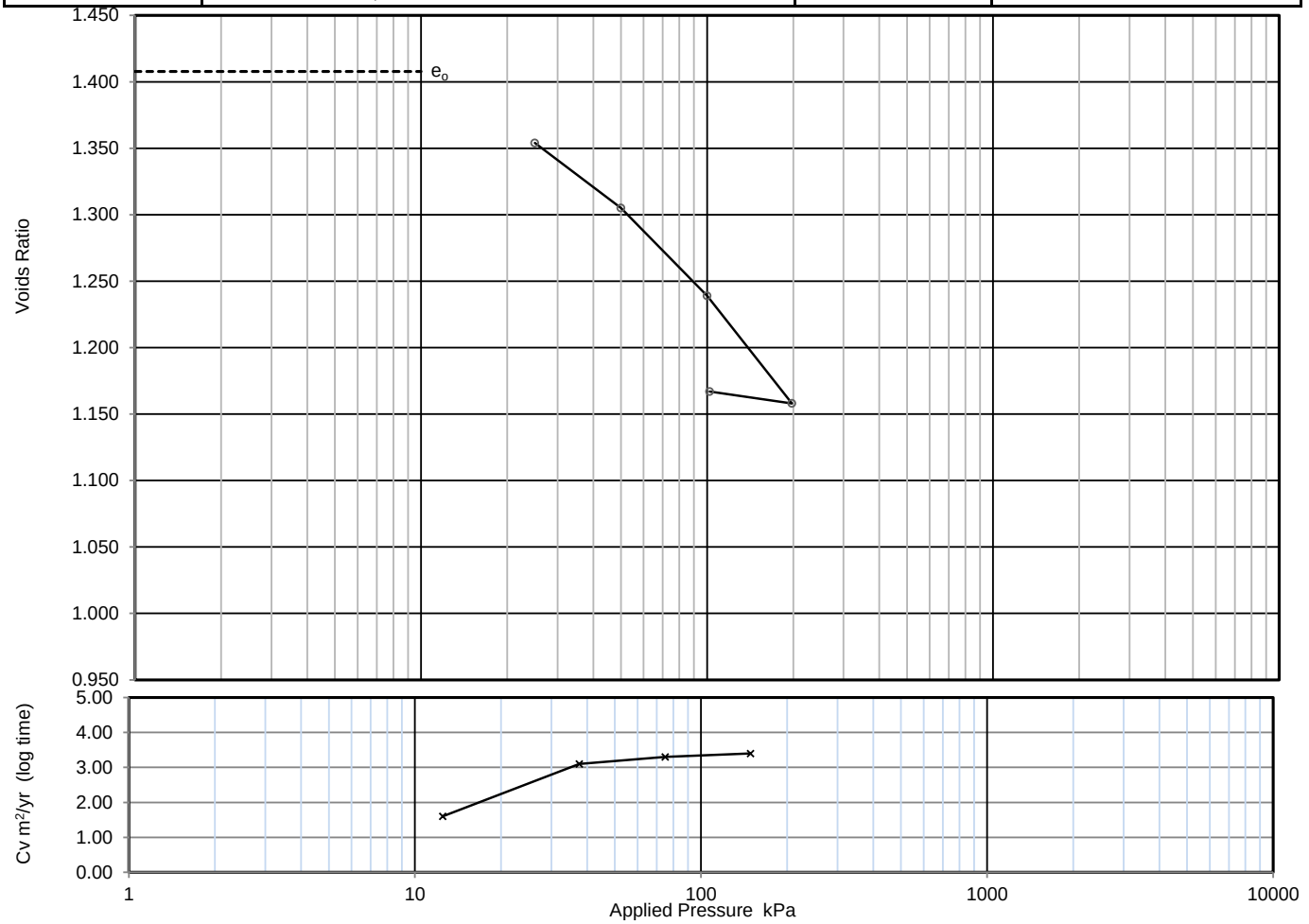
| CAUSEWAY GEOTECH | ONE DIMENSIONAL CONSOLIDATION TEST<br>BS1377:Part 5:1990, clause 3 | | | | Job Ref | 21-0553 |
|---|---|---|---|---|---|---|
| | | | | | Borehole/Pit No. | BH03 |
| Site Name | Riverine Community Park, Lifford | | | | Sample No. | 21 |
| Soil Description | Brown slightly sandy clayey SILT. | | | | Depth | 2 |
| Specimen Reference | 3 | Specimen Depth | 2.05 | m | Sample Type | UT |
| Specimen Description | Brown slightly sandy clayey SILT. | | | | KeyLAB ID | Caus2021070622 |
| Test Method | BS1377:Part 5:1990, clause 3 | | | | Date started | 27/07/2021 |




| Applied Pressure kPa | Voids ratio | Mv m2/MN | Cv ( t50, log ) m2/yr | Cv ( t90, root ) m2/yr | Csec |
|---|---|---|---|---|---|
| 0.0 | 1.408 | - | - | - | - |
| 25 | 1.354 | 0.89 | 1.6 | 2 | 0.0022 |
| 50 | 1.305 | 0.84 | 3.1 | 14 | 0.0014 |
| 100 | 1.239 | 0.57 | 3.3 | 33 | 0.0016 |
| 198 | 1.158 | 0.37 | 3.4 | 8.2 | 0.0026 |
| 102 | 1.167 | 0.04 | | | |

Preparation

Index tests Liquid limit % Plastic limit %

Particle density assumed 2.65 Mg/m3

| Specimen details | Initial | Final | |
|---|---|---|---|
| Diameter | 75.00 | - | mm |
| Height | 19.90 | 17.91 | mm |
| Moisture Content | 55.5 | 49.0 | % |
| Bulk density | 1.71 | 1.82 | Mg/m3 |
| Dry density | 1.10 | 1.22 | Mg/m3 |
| Voids Ratio | 1.408 | 1.167 | |
| Saturation | 104 | 111 | % |
| Average temperature for test | | | oC |
| Swelling Pressure | | | kPa |
| Settlement on saturation | | | % |

Remarks

Final values should be used with caution

Cv plotted at mid point of load increments

Cv corrected to 20oC

Approved

Stephen.Watson

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06/08/2021 16:04

LAB 13R Version 4

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| Direct Shear Test BS EN ISO 17892-10:2018 | | | | | |
|---|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | | |
| Location Number | BH03 | Sample Reference | | B7 | |
| Depth (m) | 4.00 | Sample Submerged? | | Yes | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | | 2.65 | Assumed |
| Description | Greyish brown sandy subangular fine to coarse GRAVEL. | | | | |
| Sample Preparation | Sample is recompacted using material passing 2mm test sieve | | | | |

| Stage | 1 | 2 | 3 |
|---|---|---|---|
| **Initial Conditions** | | | |
| Height (mm) | 20.0 | 20.0 | 20.0 |
| Diameter (mm) | 60.0 | 60.0 | 60.0 |
| Water Content (%) | 7.9 | 7.9 | 7.9 |
| Bulk Density (Mg/m$^3$) | 1.69 | 1.71 | 1.72 |
| Dry Density (Mg/m$^3$) | 1.57 | 1.59 | 1.59 |
| Voids Ratio | 0.691 | 0.668 | 0.663 |
| **Consolidation** | | | |
| Normal Pressure (kPa) | 40 | 80 | 160 |
| Vertical Displacement (mm) | 0.435 | 0.160 | 0.448 |
| **Shearing** | | | |
| Rate of Strain (mm/min) | 0.600 | 0.600 | 0.600 |
| Peak Shear Stress (kPa) | 49.3 | 78.2 | 144.0 |
| Hoz Displacement (mm) | 10.2 | 10.2 | 10.2 |
| Hoz Displacement at Peak Shear Stress (mm) | 2.463 | 2.163 | 4.023 |
| **Final Conditions** | | | |
| Water Content (%) | 22.0 | 21.0 | 22.0 |
| Dry Density (Mg/m$^3$) | 1.58 | 1.58 | 1.67 |
| Voids Ratio | 0.690 | 0.662 | 0.609 |

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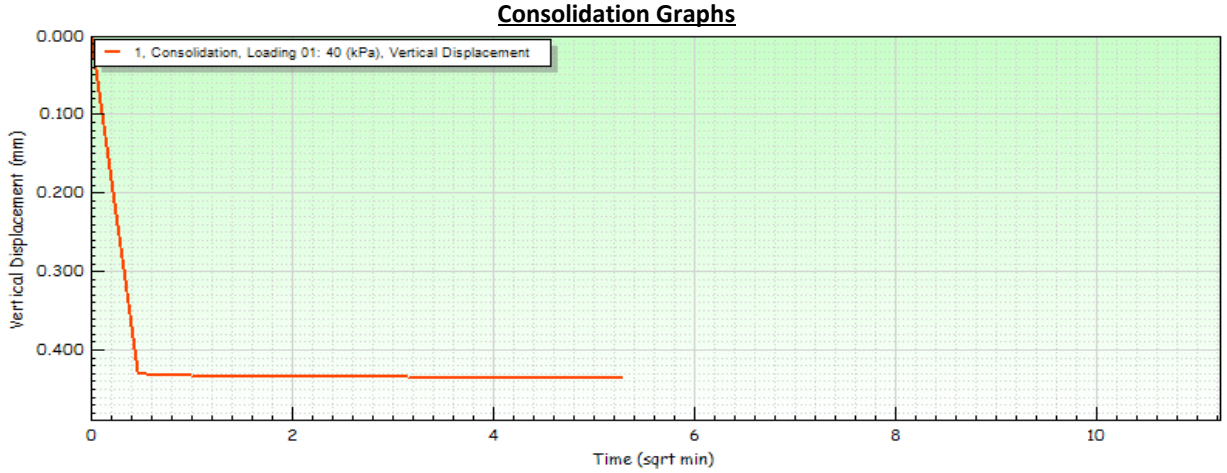
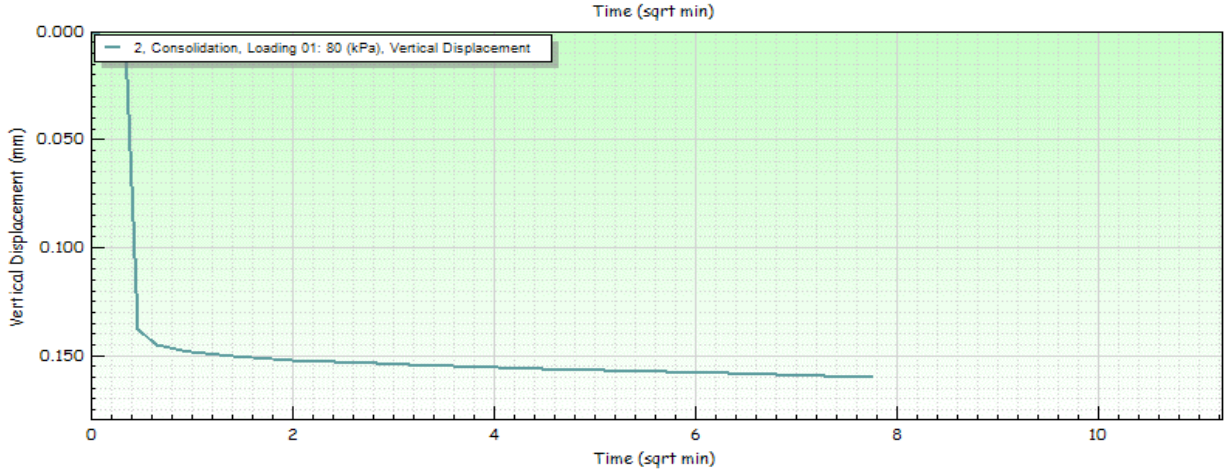
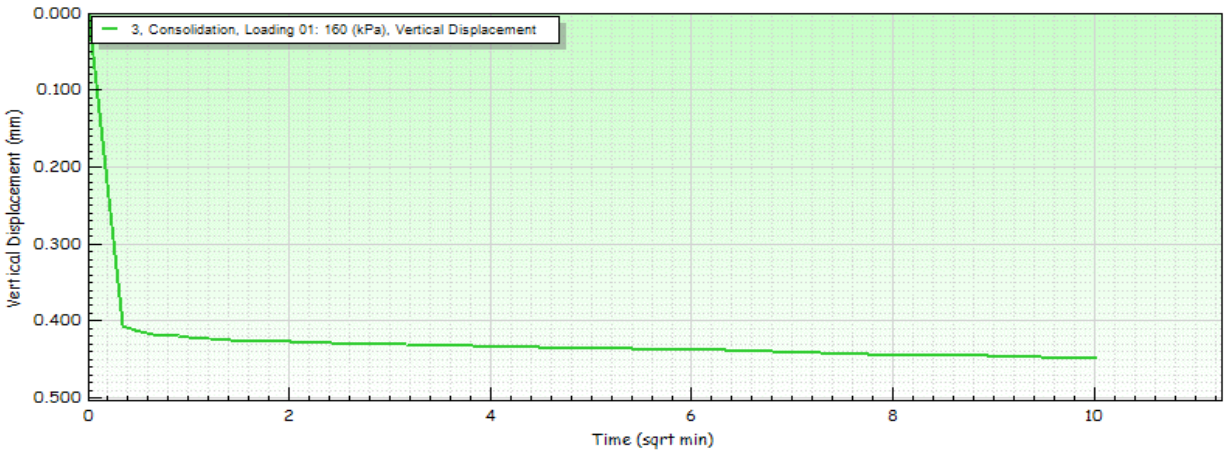
| Direct Shear Test BS EN ISO 17892-10:2018 | | | | |
|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | |
| Location Number | BH03 | Sample Reference | B7 | |
| Depth (m) | 4.00 | Sample Submerged? | Yes | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | 2.65 | Assumed |

**Consolidation Graphs**

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|---|---|---|
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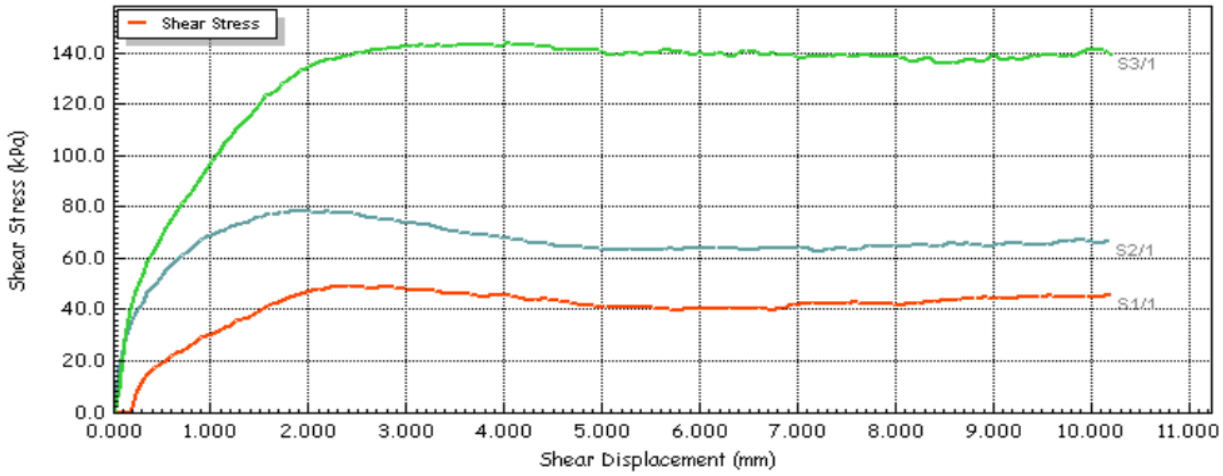
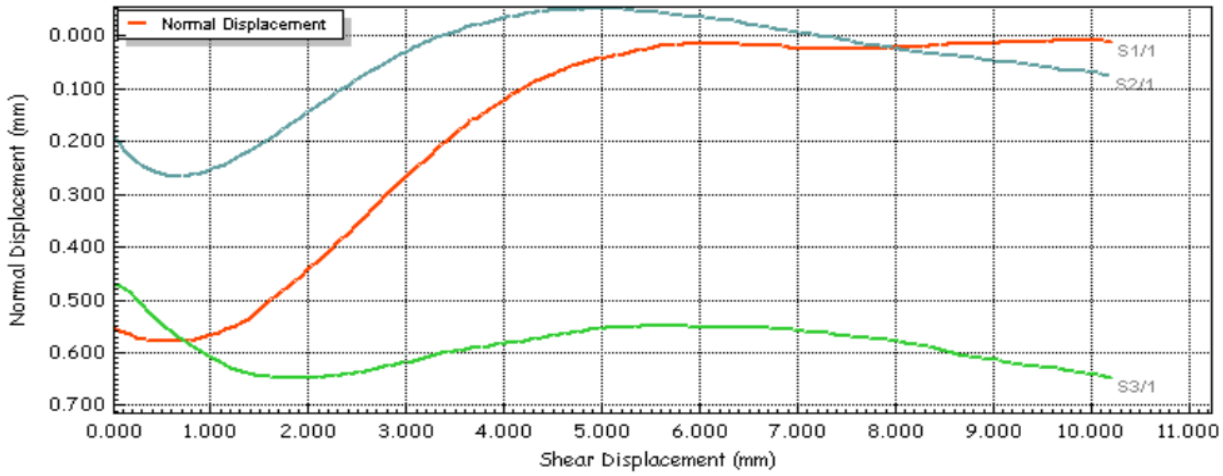
Lab Sheet Reference : LAB25R - Version 3

| Direct Shear Test BS EN ISO 17892-10:2018 | | | | |
|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | |
| Location Number | BH03 | Sample Reference | B7 | |
| Depth (m) | 4.00 | Sample Submerged? | Yes | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | 2.65 | Assumed |

**Shear Stage**

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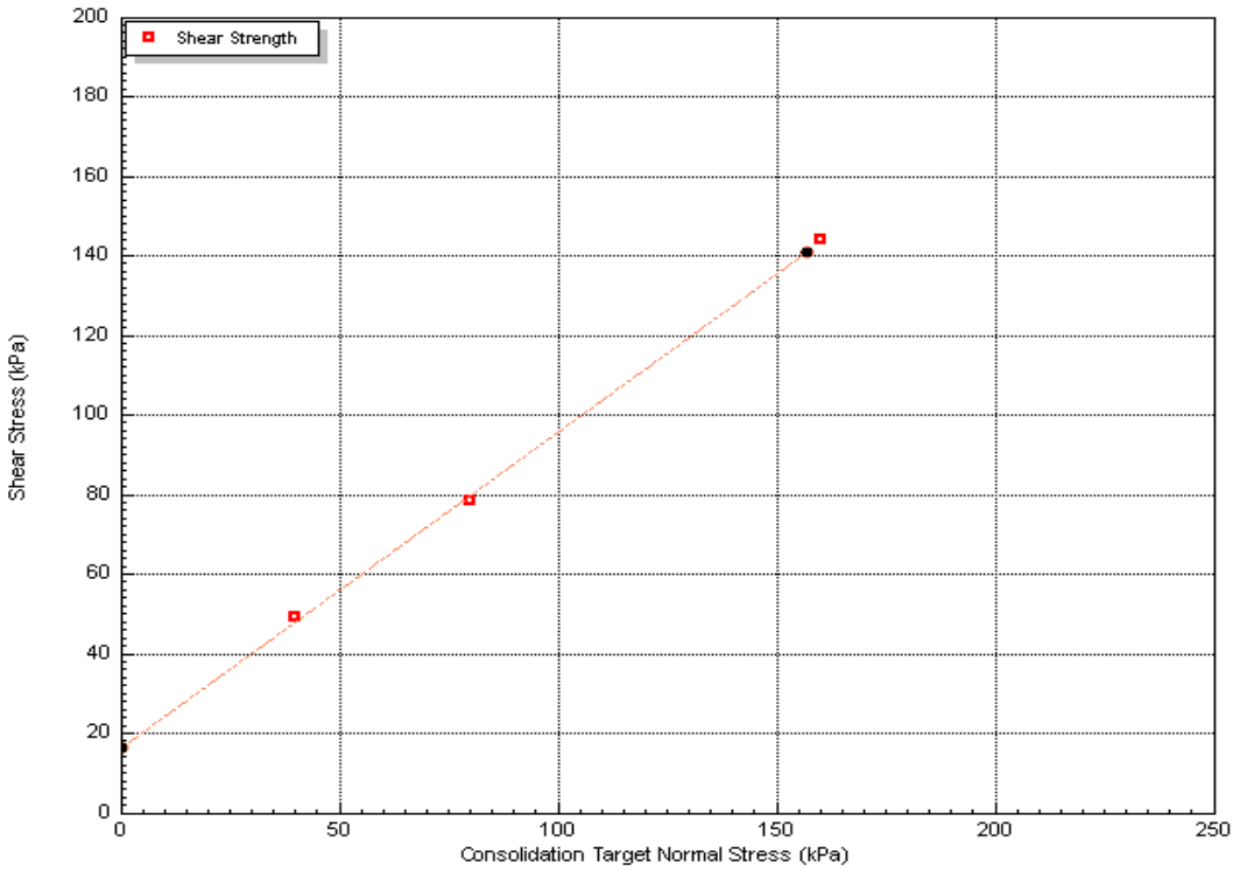
| Direct Shear Test BS EN ISO 17892-10:2018 | | | | |
|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | |
| Location Number | BH03 | Sample Reference | B7 | |
| Depth (m) | 4.00 | Sample Submerged? | 4 | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | 2.65 | Assumed |

| Stage | 1 | 2 | 3 |
|---|---|---|---|
| **Envelope Failure Results** | | | |
| Apparent Cohesion (kPa) | 16 | | |
| Angle of Shearing Resistance (°) | 38.5 | | |




| | Tested | Approved |
|---|---|---|
| UKAS TESTING 10122 / CAUSEWAY GEOTECH | Aaron Nutt | Joseph Nicholl |

Lab Sheet Reference : LAB25R - Version 3

| Direct Shear Test BS EN ISO 17892-10:2018 | | | | | |
|---|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | | |
| Location Number | BH03 | Sample Reference | | B11 | |
| Depth (m) | 9.00 | Sample Submerged? | | Yes | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | | 2.65 | Assumed |
| Description | Compact grey fine to coarse SAND | | | | |
| Sample Preparation | Sample is recompacted using material passing 2mm test sieve | | | | |

| Stage | 1 | 2 | 3 |
|---|---|---|---|
| **Initial Conditions** | | | |
| Height (mm) | 20.0 | 20.0 | 20.0 |
| Diameter (mm) | 60.0 | 60.0 | 60.0 |
| Water Content (%) | 15.0 | 15.0 | 15.0 |
| Bulk Density (Mg/m$^3$) | 1.86 | 1.86 | 1.90 |
| Dry Density (Mg/m$^3$) | 1.62 | 1.62 | 1.65 |
| Voids Ratio | 0.638 | 0.637 | 0.605 |
| **Consolidation** | | | |
| Normal Pressure (kPa) | 90 | 180 | 360 |
| Vertical Displacement (mm) | 0.381 | 0.411 | 0.770 |
| **Shearing** | | | |
| Rate of Strain (mm/min) | 0.600 | 0.600 | 0.600 |
| Peak Shear Stress (kPa) | 89.8 | 163.7 | 298.5 |
| Hoz Displacement (mm) | 10.2 | 10.2 | 10.2 |
| Hoz Displacement at Peak Shear Stress (mm) | 10.200 | 2.577 | 2.463 |
| **Final Conditions** | | | |
| Water Content (%) | 18.0 | 19.0 | 18.0 |
| Dry Density (Mg/m$^3$) | 1.67 | 1.69 | 1.79 |
| Voids Ratio | 0.630 | 0.610 | 0.529 |

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CAUSEWAY GEOTECH

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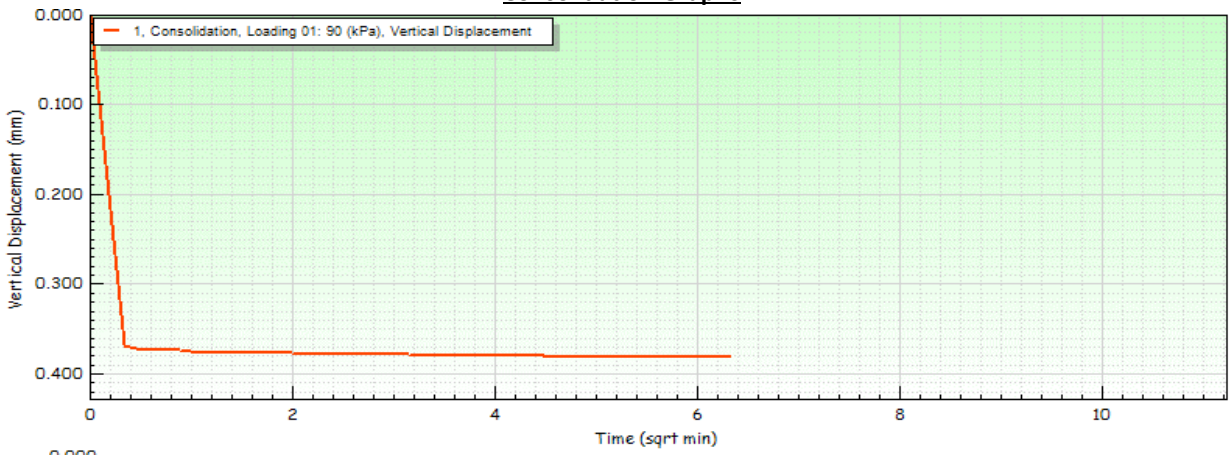
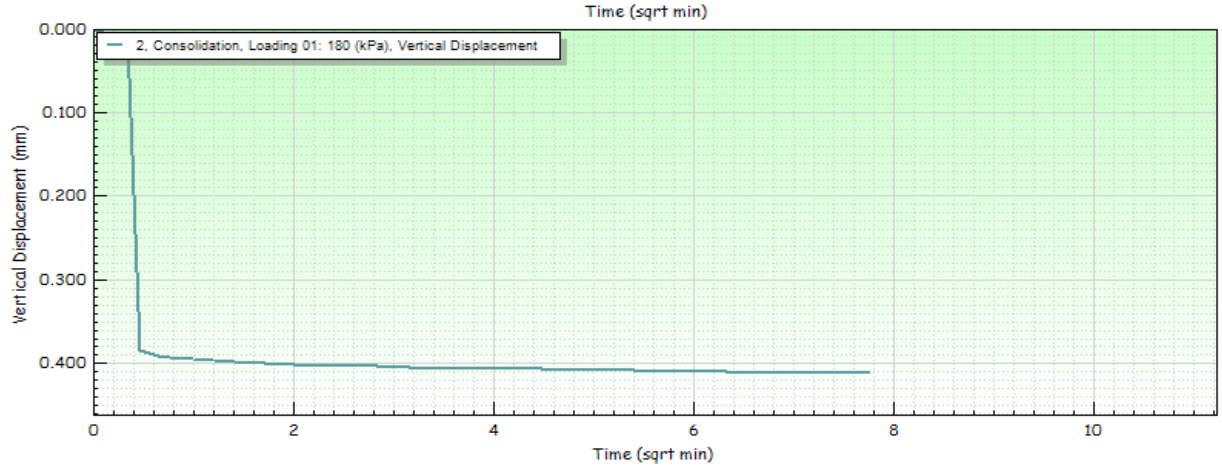
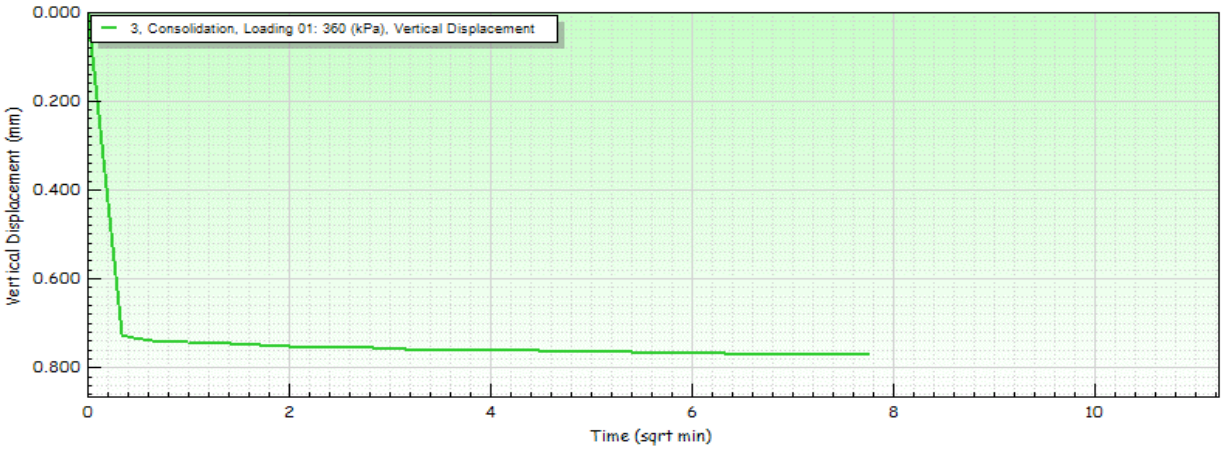
| Direct Shear Test BS EN ISO 17892-10:2018 | | | | |
|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | |
| Location Number | BH03 | Sample Reference | B11 | |
| Depth (m) | 9.00 | Sample Submerged? | Yes | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | 2.65 | Assumed |

**Consolidation Graphs**



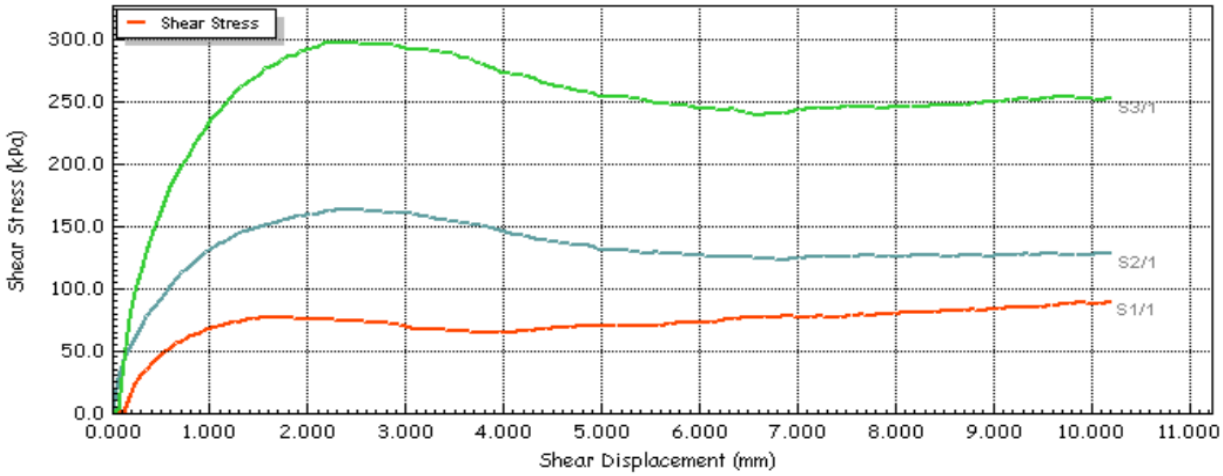



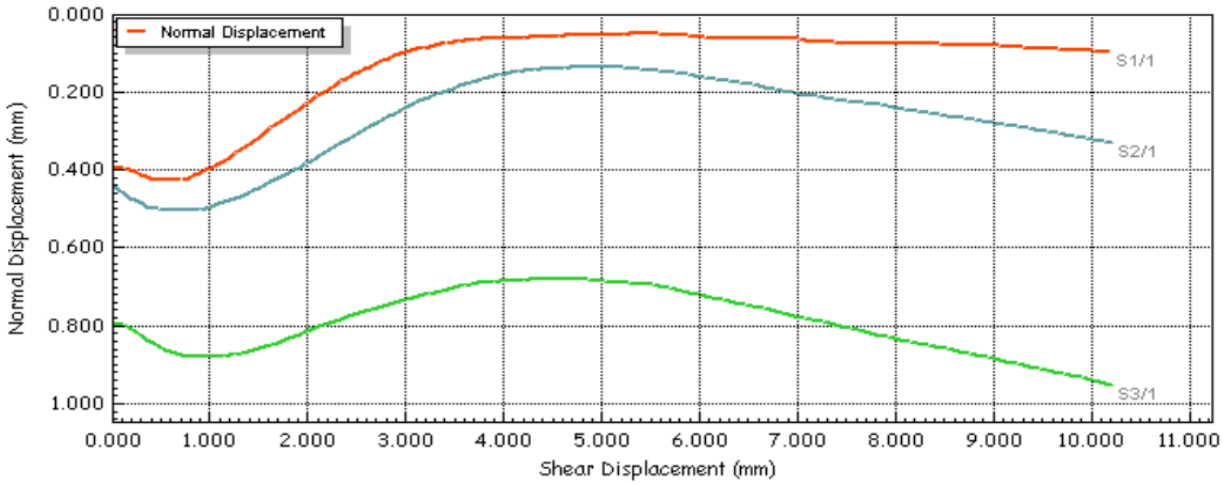

| | Tested | Approved |
|---|---|---|
| UKAS TESTING 10122 / CAUSEWAY GEOTECH | Aaron Nutt | Joseph Nicholl |

Lab Sheet Reference : LAB25R - Version 3

| Direct Shear Test BS EN ISO 17892-10:2018 | | | | |
|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | |
| Location Number | BH03 | Sample Reference | B11 | |
| Depth (m) | 9.00 | Sample Submerged? | Yes | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | 2.65 | Assumed |

**Shear Stage**



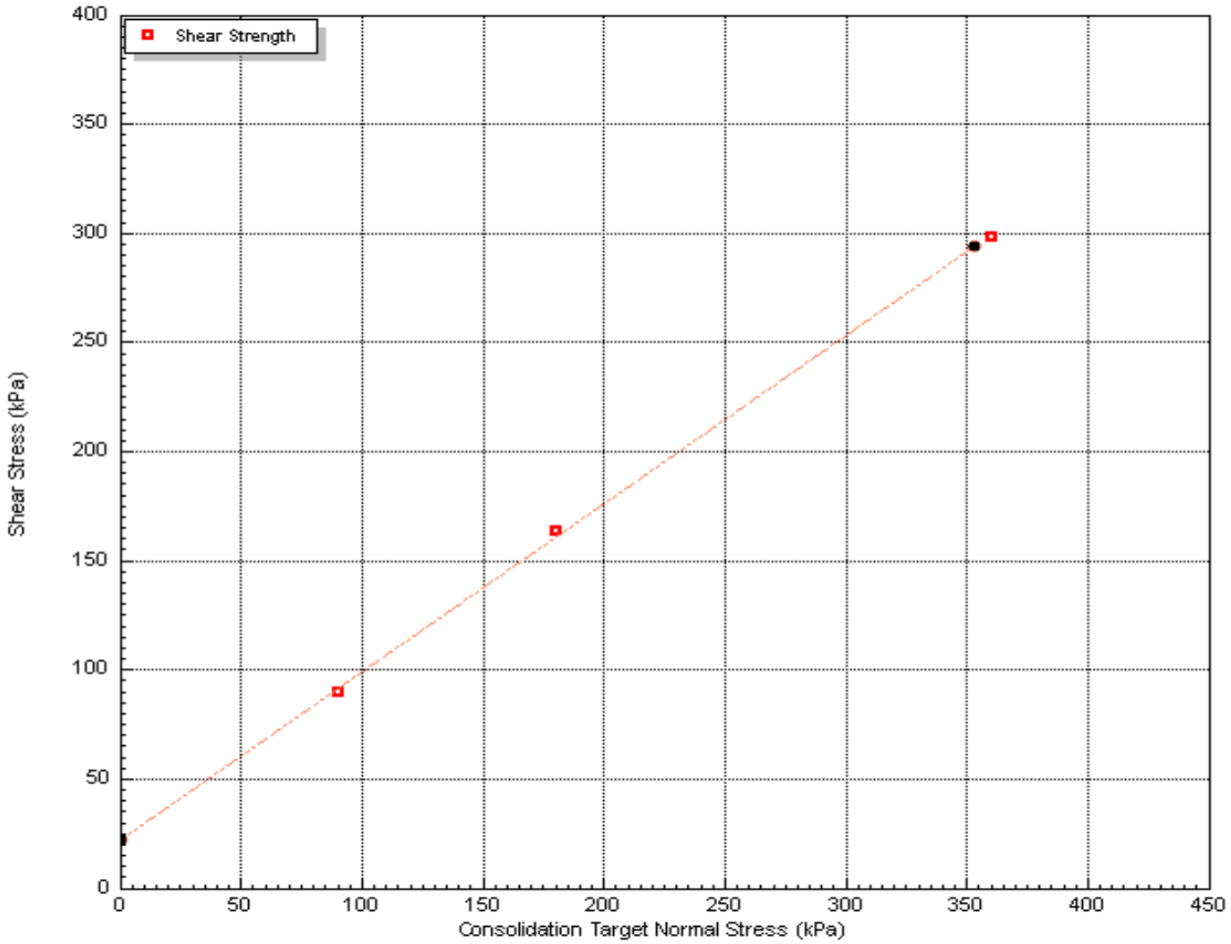




| | Tested | Approved |
|---|---|---|
| UKAS TESTING 10122 / CAUSEWAY GEOTECH | Aaron Nutt | Joseph Nicholl |

Lab Sheet Reference : LAB25R - Version 3

| Direct Shear Test BS EN ISO 17892-10:2018 | | | | |
|---|---|---|---|---|
| Project Number | 21-0553 | Project | Riverine Community Park | |
| Location Number | BH03 | Sample Reference | B11 | |
| Depth (m) | 9.00 | Sample Submerged? | 4 | ~~No~~ |
| Sample Type | B | Particle Density (Mg/m$^3$) | 2.65 | Assumed |

| Stage | 1 | 2 | 3 |
|---|---|---|---|
| **Envelope Failure Results** | | | |
| Apparent Cohesion (kPa) | 22 | | |
| Angle of Shearing Resistance (°) | 37.5 | | |




| | Tested | Approved |
|---|---|---|
| UKAS TESTING 10122 / CAUSEWAY GEOTECH | Aaron Nutt | Joseph Nicholl |

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

# Final Report

| | |
|---|---|
| **Report No.:** | 21-25664-1 |
| **Initial Date of Issue:** | 30-Jul-2021 |
| **Client** | Causeway Geotech Ltd |
| **Client Address:** | 8 Drumahiskey Road<br>Balnamore<br>Ballymoney<br>County Antrim<br>BT53 7QL |
| **Contact(s):** | Carin Cornwall<br>Colm Hurley<br>Darren O'Mahony<br>Gabriella Horan<br>Joe Gervin<br>John Cameron<br>Lucy Newland<br>Martin Gardiner<br>Matthew Gilbert<br>Michelle Gaffney<br>Neil Haggan<br>Paul Dunlop<br>Sean Ross<br>Stephen Franey<br>Stephen Watson<br>Stuart Abraham<br>Thomas McAllist |
| **Project** | 21-0553 Riverine Community Park, Lifford |

| | | | |
|---|---|---|---|
| **Quotation No.:** | | **Date Received:** | 26-Jul-2021 |
| **Order No.:** | | **Date Instructed:** | 26-Jul-2021 |
| **No. of Samples:** | 25 | | |
| **Turnaround (Wkdays):** | 7 | **Results Due:** | 03-Aug-2021 |
| **Date Approved:** | 30-Jul-2021 | | |

**Approved By:**



**Details:** Glynn Harvey, Technical Manager

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

# Results - Soil

**Project: 21-0553 Riverine Community Park, Lifford**

| **Client: Causeway Geotech Ltd** | | | **Chemtest Job No.:** | | 21-25664 | 21-25664 | 21-25664 | 21-25664 | 21-25664 | 21-25664 | 21-25664 | 21-25664 | 21-25664 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Quotation No.: | | | **Chemtest Sample ID.:** | | 1247932 | 1247933 | 1247934 | 1247935 | 1247936 | 1247937 | 1247938 | 1247939 | 1247940 |
| Order No.: | | | Client Sample Ref.: | | 10 | 14 | 20 | 3 | 15 | 19 | 10 | 13 | 16 |
| | | | Sample Location: | | BH02 | BH02 | BH02 | BH03 | BH03 | BH03 | BH05 | BH05 | BH05 |
| | | | Sample Type: | | SOIL | SOIL | SOIL | SOIL | SOIL | SOIL | SOIL | SOIL | SOIL |
| | | | Top Depth (m): | | 1.0 | 5.0 | 10.5 | 0.5 | 4.0 | 9.0 | 1.0 | 4.0 | 7.5 |
| | | | Date Sampled: | | 23-Jul-2021 | 23-Jul-2021 | 23-Jul-2021 | 23-Jul-2021 | 23-Jul-2021 | 23-Jul-2021 | 23-Jul-2021 | 23-Jul-2021 | 23-Jul-2021 |
| **Determinand** | **Accred.** | **SOP** | **Units** | **LOD** | | | | | | | | | |
| Moisture | N | 2030 | % | 0.020 | | | | 20 | 7.1 | 8.5 | | | |
| Soil Colour | N | 2040 | | N/A | | | | Brown | Grey | Grey | | | |
| Other Material | N | 2040 | | N/A | | | | Stones | Stones | Stones | | | |
| Soil Texture | N | 2040 | | N/A | | | | Sand | Sand | Sand | | | |
| pH (2.5:1) | N | 2010 | | 4.0 | | | | 8.0 | < 4.0 | 5.4 | | | |
| Magnesium (Water Soluble) | N | 2120 | g/l | 0.010 | | | | < 0.010 | | | | | |
| Sulphate (2:1 Water Soluble) as SO4 | M | 2120 | g/l | 0.010 | | | | < 0.010 | 1.5 | 0.17 | | | |
| Chloride (Water Soluble) | M | 2220 | g/l | 0.010 | | | | 0.032 | | | | | |
| Nitrate (Water Soluble) | N | 2220 | g/l | 0.010 | | | | < 0.010 | | | | | |

# Test Methods

| SOP | Title | Parameters included | Method summary |
|---|---|---|---|
| 2010 | pH Value of Soils | pH | pH Meter |
| 2030 | Moisture and Stone Content of Soils(Requirement of MCERTS) | Moisture content | Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C. |
| 2040 | Soil Description(Requirement of MCERTS) | Soil description | As received soil is described based upon BS5930 |
| 2120 | Water Soluble Boron, Sulphate, Magnesium & Chromium | Boron; Sulphate; Magnesium; Chromium | Aqueous extraction / ICP-OES |
| 2220 | Water soluble Chloride in Soils | Chloride | Aqueous extraction and measuremernt by 'Aquakem 600' Discrete Analyser using ferric nitrate / mercuric thiocyanate. |

## Report Information

**Key**

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

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

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

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

**Sample Deviation Codes**

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

**Sample Retention and Disposal**

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

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

# LABORATORY RESTRICTION REPORT

| | | | |
|---|---|---|---|
| Project Reference | 21-0553B | To | Neil Haggan |
| Project Name | Riverine Community Park, Strabane Site | Position | Project Manager |
| TR reference | 21-0553B / G01 | From | Joseph Nicholl |
| | | Position | Laboratory Quality 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 | | | |
| BH03 | 21 | 2.00 | UT | UU Triaxial | Sample slumped on extrusion | CANCEL TEST |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
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| | | | | | | |

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

| Laboratory Signature | Project Manager Signature |
|---|---|
| Joseph Nicholl | Neil Haggan |
| Date | Date |
| 27 July 2021 | 27 July 2021 |

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NI: +44 (0)28 276 66640
Registered in Northern Ireland.
Company Number: NI610766

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

www.causewaygeotech.com

**SOIL AND ROCK SAMPLE ANALYSIS**
**LABORATORY TEST REPORT**

9 August 2021

| | |
|---|---|
| **Project Name:** | Riverine Community Park, Strabane Site |
| **Project No.:** | 21-0553B |
| **Client:** | Derry City and Strabane District Council |
| **Engineer:** | McAdam Design Ltd |

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.

Stephen Watson

Laboratory Manager

Signed for and on behalf of Causeway Geotech Ltd



SCS ISO 9001 CERTIFIED
SCS ISO 14001 CERTIFIED
SCS ISO 45001 CERTIFIED
UKAS MANAGEMENT SYSTEMS 9235
UKAS TESTING 10122
AGS
BRITISH DRILLING ASSOCIATION

**Project Name:** Riverine Community Park, Strabane Site

**Report Reference:** Schedule 2

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

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

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

## SUB-CONTRACTED TESTS

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

| Material tested | Type of test/Properties measured/Range of measurement | Standard specifications | No. of results included in the report |
|---|---|---|---|
| SOIL – Subcontracted to Eurofins Chemtest Ltd *(UKAS 2183)* | BRE Test - Suite A | | |
| SOIL – Subcontracted to Eurofins Chemtest Ltd *(UKAS 2183)* | BRE Test - Suite C | | 1 |

# Summary of Classification Test Results

| Project No. | Project Name |
|---|---|
| 21-0553 | Riverine Community Park, Lifford |

| Hole No. | Sample | | | | Soil Description | Density bulk | Density dry | *w* | Passing 425µm | LL | PL | PI | Particle density | Casagrande Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ref | Top | Base | Type | | Mg/m3 | | % | % | % | % | % | Mg/m3 | |
| INFIL 005 | 3 | 1.60 | | B | Brown slightly sandy slightly gravelly clayey SILT. | | | 71.0 | 98 | 53 -1pt | 35 | 18 | | MH |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | | |

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

LAB 01R Version 4

Key

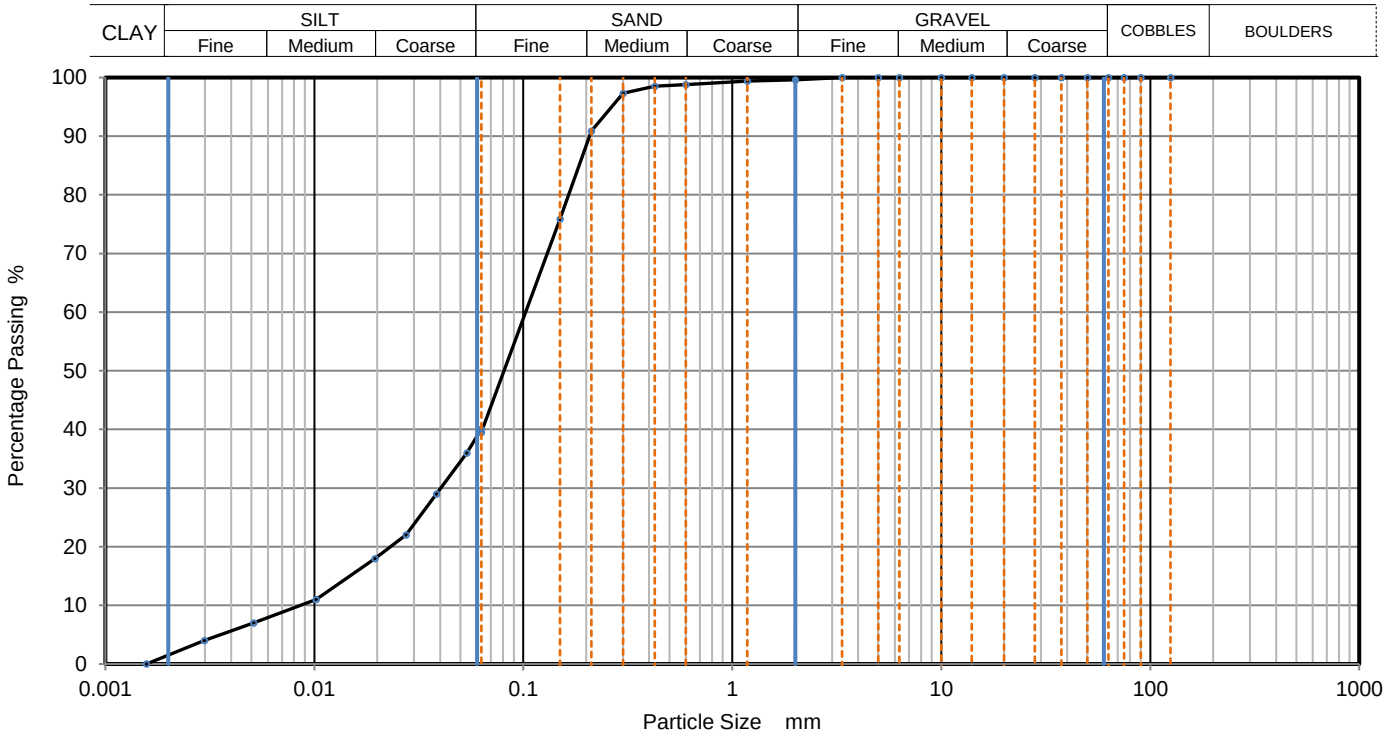
| | | |
|---|---|---|
| Density test | Liquid Limit | Particle density |
| Linear measurement unless : | 4pt cone unless : | sp - small pyknometer |
| wd - water displacement | cas - Casagrande method | gj - gas jar |
| wi - immersion in water | 1pt - single point test | |

Date Printed: 08/09/2021 00:00

Approved By: Stephen.Watson

UKAS TESTING 10122

| | | | | | |
|---|---|---|---|---|---|
| CAUSEWAY GEOTECH | **PARTICLE SIZE DISTRIBUTION** | | | Job Ref | **21-0553** |
| | | | | Borehole/Pit No. | INFIL 005 |
| Site Name | Riverine Community Park, Lifford | | | Sample No. | 2 |
| Soil Description | Brown sandy slightly gravelly silty fine to coarse SAND. | | | Depth, m | 1.00 |
| Specimen Reference | 2 | Specimen Depth | 1 m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clauses 9.2 and 9.5 | | | KeyLAB ID | Caus2021070682 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | 0.06300 | 40 |
| 90 | 100 | 0.05375 | 36 |
| 75 | 100 | 0.03843 | 29 |
| 63 | 100 | 0.02747 | 22 |
| 50 | 100 | 0.01953 | 18 |
| 37.5 | 100 | 0.01019 | 11 |
| 28 | 100 | 0.00512 | 7 |
| 20 | 100 | 0.00297 | 4 |
| 14 | 100 | 0.00157 | 0 |
| 10 | 100 | | |
| 6.3 | 100 | | |
| 5 | 100 | | |
| 3.35 | 100 | | |
| 2 | 100 | | |
| 1.18 | 99 | | |
| 0.6 | 99 | Particle density | (assumed) |
| 0.425 | 99 | 2.65 | Mg/m3 |
| 0.3 | 97 | | |
| 0.212 | 91 | | |
| 0.15 | 76 | | |
| 0.063 | 40 | | |

| | |
|---|---|
| Dry Mass of sample, g | 208 |

| **Sample Proportions** | % dry mass |
|---|---|
| Cobbles | 0.0 |
| Gravel | 0.4 |
| Sand | 60.1 |
| Silt | 38.1 |
| Clay | 1.4 |

| **Grading Analysis** | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 0.103 |
| D30 | mm | 0.0408 |
| D10 | mm | 0.00879 |
| Uniformity Coefficient | | 12 |
| Curvature Coefficient | | 1.8 |

Remarks

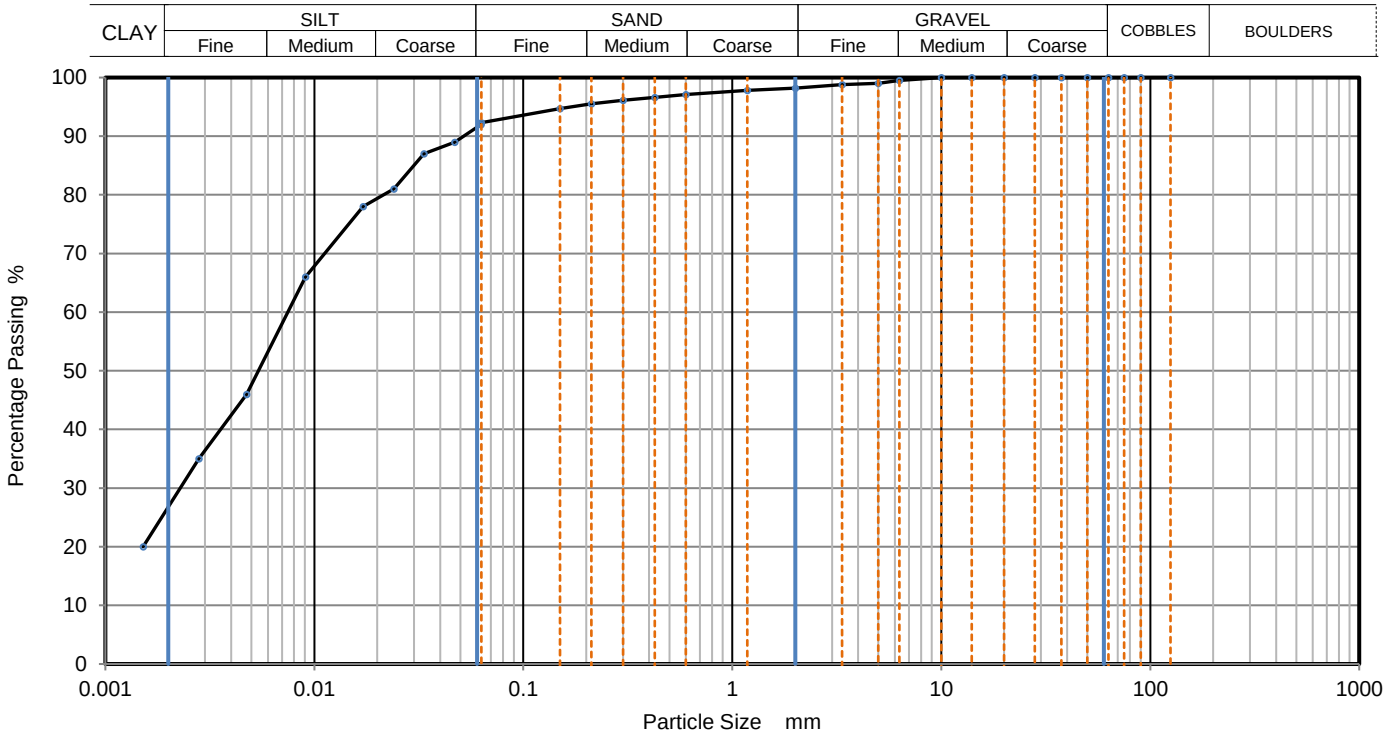
Preparation and testing in accordance with BS1377-2 :1990 unless noted below

| |
|---|
| Approved |
| Stephen.Watson |



UKAS TESTING 10122

| CAUSEWAY GEOTECH | PARTICLE SIZE DISTRIBUTION | | | | Job Ref | 21-0553 |
|---|---|---|---|---|---|---|
| | | | | | Borehole/Pit No. | INFIL 005 |
| Site Name | Riverine Community Park, Lifford | | | | Sample No. | 3 |
| Soil Description | Brown slightly sandy slightly gravelly clayey SILT. | | | | Depth, m | 1.60 |
| Specimen Reference | 4 | Specimen Depth | 1.6 | m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clauses 9.2 and 9.5 | | | | KeyLAB ID | Caus2021070683 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | 0.06276 | 92 |
| 90 | 100 | 0.04701 | 89 |
| 75 | 100 | 0.03349 | 87 |
| 63 | 100 | 0.02402 | 81 |
| 50 | 100 | 0.01710 | 78 |
| 37.5 | 100 | 0.00907 | 66 |
| 28 | 100 | 0.00474 | 46 |
| 20 | 100 | 0.00280 | 35 |
| 14 | 100 | 0.00152 | 20 |
| 10 | 100 | | |
| 6.3 | 100 | | |
| 5 | 99 | | |
| 3.35 | 99 | | |
| 2 | 98 | | |
| 1.18 | 98 | | |
| 0.6 | 97 | Particle density | (assumed) |
| 0.425 | 97 | 2.65 | Mg/m3 |
| 0.3 | 96 | | |
| 0.212 | 96 | | |
| 0.15 | 95 | | |
| 0.063 | 92 | | |

| Dry Mass of sample, g | 210 |
|---|---|

| Sample Proportions | % dry mass |
|---|---|
| Cobbles | 0.0 |
| Gravel | 1.8 |
| Sand | 5.9 |
| Silt | 65.6 |
| Clay | 26.7 |

| Grading Analysis | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 0.0074 |
| D30 | mm | 0.0023 |
| D10 | mm | |
| Uniformity Coefficient | | |
| Curvature Coefficient | | |

Remarks

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

| Approved |
|---|
| Stephen.Watson |

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

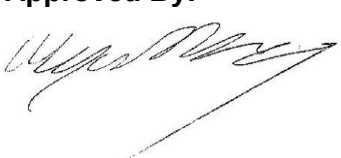
UKAS TESTING
2183

# Final Report

| | |
|---|---|
| **Report No.:** | 21-23652-1 |
| **Initial Date of Issue:** | 15-Jul-2021 |
| **Client** | Causeway Geotech Ltd |
| **Client Address:** | 8 Drumahiskey Road<br>Balnamore<br>Ballymoney<br>County Antrim<br>BT53 7QL |
| **Contact(s):** | Carin Cornwall<br>Colm Hurley<br>Darren O'Mahony<br>Gabriella Horan<br>Joe Gervin<br>John Cameron<br>Lucy Newland<br>Martin Gardiner<br>Matthew Gilbert<br>Michelle Gaffney<br>Neil Haggan<br>Paul Dunlop<br>Sean Ross<br>Stephen Franey<br>Stephen Watson<br>Stuart Abraham<br>Thomas McAllist |
| **Project** | 21-0553 Riverine Community Park, Lifford |

| | | | |
|---|---|---|---|
| **Quotation No.:** | | **Date Received:** | 09-Jul-2021 |
| **Order No.:** | | **Date Instructed:** | 09-Jul-2021 |
| **No. of Samples:** | 5 | | |
| **Turnaround (Wkdays):** | 7 | **Results Due:** | 19-Jul-2021 |
| **Date Approved:** | 15-Jul-2021 | | |

**Approved By:**



**Details:** Glynn Harvey, Technical Manager

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

# Results - Soil

**Project: 21-0553 Riverine Community Park, Lifford**

| **Client: Causeway Geotech Ltd** | | | **Chemtest Job No.:** | | 21-23652 | 21-23652 | 21-23652 | 21-23652 | 21-23652 |
|---|---|---|---|---|---|---|---|---|---|
| Quotation No.: | | | **Chemtest Sample ID.:** | | 1237620 | 1237621 | 1237622 | 1237623 | 1237624 |
| Order No.: | | | Client Sample Ref.: | | 2 | 2 | 1 | 2 | 1 |
| | | | Sample Location: | | INFIL 001 | INFIL 002 | INFIL 003 | INFIL 004 | INFIL 005 |
| | | | Sample Type: | | SOIL | SOIL | SOIL | SOIL | SOIL |
| | | | Top Depth (m): | | 1.50 | 1.50 | 0.50 | 1.50 | 0.50 |
| | | | Date Sampled: | | 08-Jul-2021 | 08-Jul-2021 | 08-Jul-2021 | 08-Jul-2021 | 08-Jul-2021 |
| **Determinand** | **Accred.** | **SOP** | **Units** | **LOD** | | | | | |
| Moisture | N | 2030 | % | 0.020 | | | | | 12 |
| pH (2.5:1) | N | 2010 | | 4.0 | | | | | 8.3 |
| Magnesium (Water Soluble) | N | 2120 | g/l | 0.010 | | | | | < 0.010 |
| Sulphate (2:1 Water Soluble) as SO4 | U | 2120 | g/l | 0.010 | | | | | 0.013 |
| Chloride (Water Soluble) | U | 2220 | g/l | 0.010 | | | | | < 0.010 |
| Nitrate (Water Soluble) | N | 2220 | g/l | 0.010 | | | | | < 0.010 |

# Test Methods

| SOP | Title | Parameters included | Method summary |
|---|---|---|---|
| 2010 | pH Value of Soils | pH | pH Meter |
| 2030 | Moisture and Stone Content of Soils(Requirement of MCERTS) | Moisture content | Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C. |
| 2040 | Soil Description(Requirement of MCERTS) | Soil description | As received soil is described based upon BS5930 |
| 2120 | Water Soluble Boron, Sulphate, Magnesium & Chromium | Boron; Sulphate; Magnesium; Chromium | Aqueous extraction / ICP-OES |
| 2220 | Water soluble Chloride in Soils | Chloride | Aqueous extraction and measuremernt by 'Aquakem 600' Discrete Analyser using ferric nitrate / mercuric thiocyanate. |

## 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" |
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| LOD | Limit of detection |

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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**

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

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

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Company Number: 633786

www.causewaygeotech.com

**SOIL AND ROCK SAMPLE ANALYSIS**
**LABORATORY TEST REPORT**

9 August 2021

| | |
|---|---|
| **Project Name:** | Riverine Community Park, Strabane Site |
| **Project No.:** | 21-0553B |
| **Client:** | Derry City and Strabane District Council |
| **Engineer:** | McAdam Design Ltd |

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.

Stephen Watson

Laboratory Manager

Signed for and on behalf of Causeway Geotech Ltd



SCS ISO 9001 CERTIFIED
SCS ISO 14001 CERTIFIED
SCS ISO 45001 CERTIFIED
UKAS MANAGEMENT SYSTEMS 9235
UKAS TESTING 10122
AGS
BRITISH DRILLING ASSOCIATION

**Project Name:** Riverine Community Park, Strabane Site

**Report Reference:** Schedule 3

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

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

| Material tested | Type of test/Properties measured/Range of measurement | Standard specifications | No. of results included in the report |
|---|---|---|---|
| SOIL | Moisture Content of Soil | BS 1377-2: 1990: Cl 3.2 | 4 |
| SOIL | Liquid and Plastic Limits of soil-1 point cone penetrometer method | BS 1377-2: 1990: Cl 4.4, 5.3 & 5.4 | 2 |
| SOIL | Particle size distribution - wet sieving | BS 1377-2: 1990: Cl 9.2 | 3 |
| SOIL | Particle size distribution - sedimentation hydrometer method | BS 1377-2: 1990: Cl 9.5 | 3 |

## SUB-CONTRACTED TESTS

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

| Material tested | Type of test/Properties measured/Range of measurement | Standard specifications | No. of results included in the report |
|---|---|---|---|
| SOIL – Subcontracted to Eurofins Chemtest Ltd *(UKAS 2183)* | BRE Test - Suite A | | 1 |
| SOIL – Subcontracted to Eurofins Chemtest Ltd *(UKAS 2183)* | BRE Test - Suite C | | 1 |
| SOIL – Subcontracted to Eurofins Chemtest Ltd (UKAS 2183) | Organic Matter | | 1 |

# Summary of Classification Test Results

| Project No. | Project Name |
|---|---|
| 21-0553 | Riverine Community Park, Lifford |

| Hole No. | Sample | | | | Soil Description | Density bulk | Density dry | w | Passing 425µm | LL | PL | PI | Particle density | Casagrande Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ref | Top | Base | Type | | Mg/m3 | | % | % | % | % | % | Mg/m3 | |
| INFIL 006 | 2 | 1.50 | | B | Grey gravelly silty fine to coarse SAND. | | | 37.0 | | | | | | |
| INFIL 006 | 3 | 1.90 | | B | Grey sandy organic clayey SILT. | | | 122.0 | 96 | 71 -1pt | 47 | 24 | | MV |
| INFIL 007 | 1 | 0.50 | | B | Dark brown pseudo-fibrous PEAT | | | 353.0 | | | | | | |
| INFIL 007 | 2 | 1.50 | | B | Dark brown slightly sandy organic clayey SILT. | | | 90.0 | 97 | 74 -1pt | 39 | 35 | | MV |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |

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

LAB 01R Version 4

Key

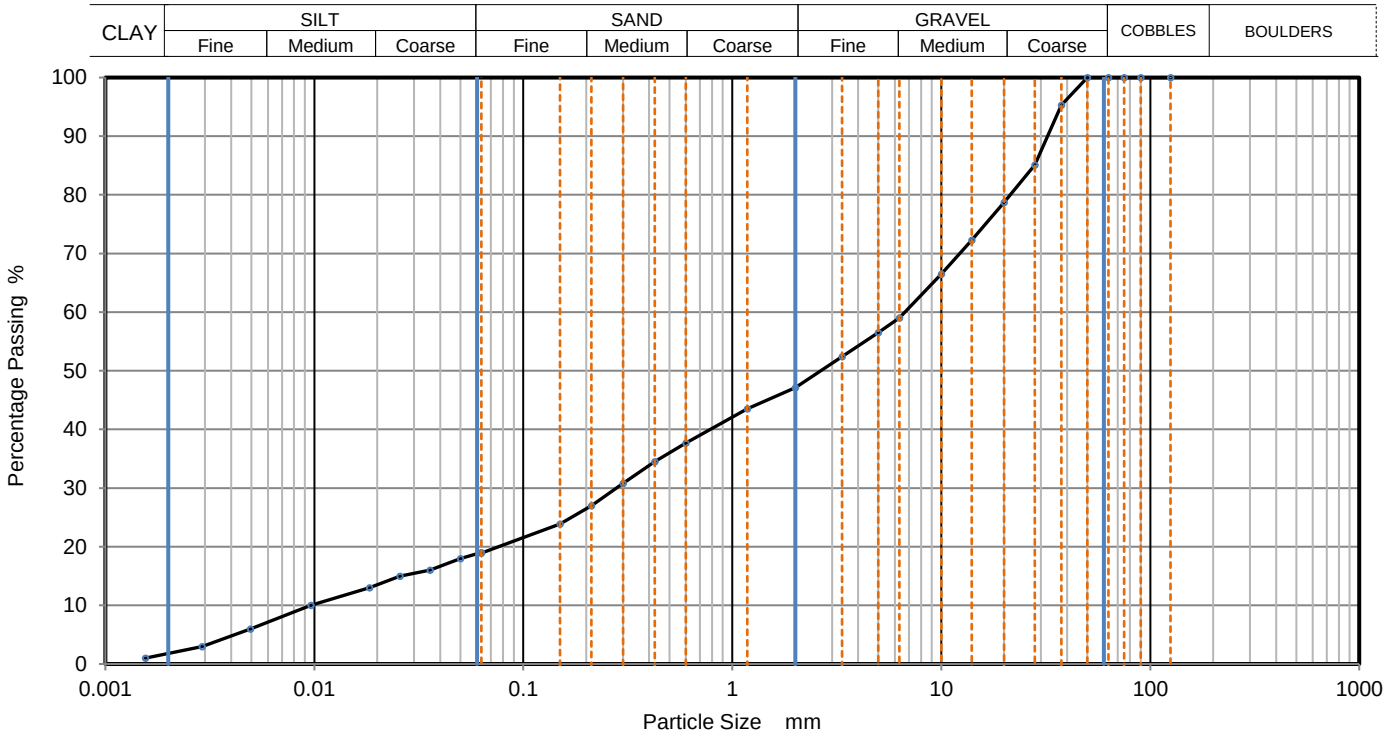
| | | |
|---|---|---|
| Density test | Liquid Limit | Particle density |
| Linear measurement unless : | 4pt cone unless : | sp - small pyknometer |
| wd - water displacement | cas - Casagrande method | gj - gas jar |
| wi - immersion in water | 1pt - single point test | |

Date Printed: 08/09/2021 00:00

Approved By: Stephen.Watson

UKAS TESTING 10122

| | | | | | |
|---|---|---|---|---|---|
| CAUSEWAY GEOTECH | **PARTICLE SIZE DISTRIBUTION** | | | Job Ref | **21-0553** |
| | | | | Borehole/Pit No. | INFIL 006 |
| Site Name | Riverine Community Park, Lifford | | | Sample No. | 2 |
| Soil Description | Grey gravelly silty fine to coarse SAND. | | | Depth, m | 1.50 |
| Specimen Reference | 4 | Specimen Depth | 1.5 m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clauses 9.2 and 9.5 | | | KeyLAB ID | Caus202107260 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | 0.06300 | 19 |
| 90 | 100 | 0.05002 | 18 |
| 75 | 100 | 0.03581 | 16 |
| 63 | 100 | 0.02563 | 15 |
| 50 | 100 | 0.01834 | 13 |
| 37.5 | 95 | 0.00964 | 10 |
| 28 | 85 | 0.00495 | 6 |
| 20 | 79 | 0.00290 | 3 |
| 14 | 72 | 0.00155 | 1 |
| 10 | 67 | | |
| 6.3 | 59 | | |
| 5 | 57 | | |
| 3.35 | 52 | | |
| 2 | 47 | | |
| 1.18 | 44 | | |
| 0.6 | 38 | Particle density | (assumed) |
| 0.425 | 35 | 2.65 | Mg/m3 |
| 0.3 | 31 | | |
| 0.212 | 27 | | |
| 0.15 | 24 | | |
| 0.063 | 19 | | |

| Dry Mass of sample, g | 2408 |
|---|---|

| **Sample Proportions** | % dry mass |
|---|---|
| Cobbles | 0.0 |
| Gravel | 52.9 |
| Sand | 28.2 |
| Silt | 17.0 |
| Clay | 1.9 |

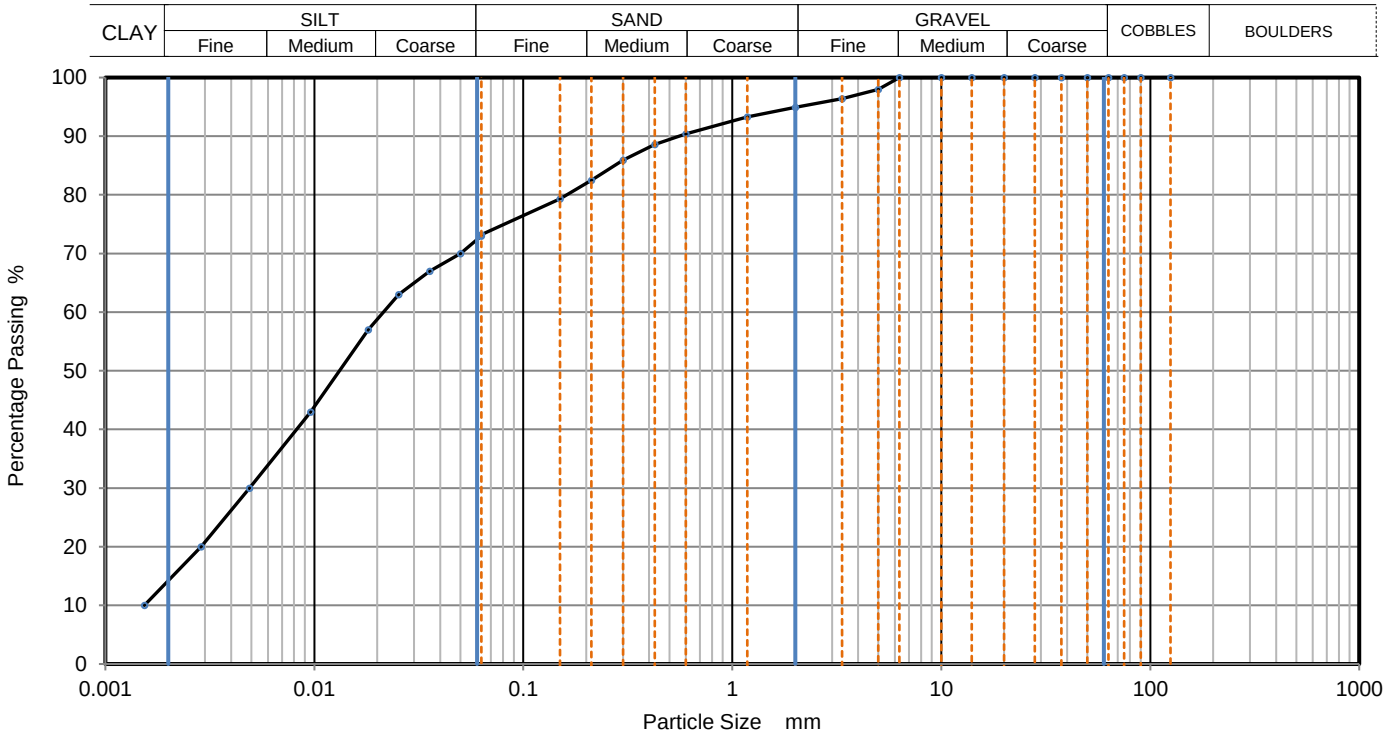
| **Grading Analysis** | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 6.68 |
| D30 | mm | 0.278 |
| D10 | mm | 0.00919 |
| Uniformity Coefficient | | 730 |
| Curvature Coefficient | | 1.3 |

Remarks

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

| Approved |
|---|
| Stephen.Watson |

| CAUSEWAY GEOTECH | PARTICLE SIZE DISTRIBUTION | | | | Job Ref | 21-0553 |
|---|---|---|---|---|---|---|
| | | | | | Borehole/Pit No. | INFIL 006 |
| Site Name | Riverine Community Park, Lifford | | | | Sample No. | 3 |
| Soil Description | Grey sandy organic clayey SILT. | | | | Depth, m | 1.90 |
| Specimen Reference | 5 | Specimen Depth | 1.9 | m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clauses 9.2 and 9.5 | | | | KeyLAB ID | Caus202107261 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | 0.06300 | 73 |
| 90 | 100 | 0.05002 | 70 |
| 75 | 100 | 0.03559 | 67 |
| 63 | 100 | 0.02532 | 63 |
| 50 | 100 | 0.01813 | 57 |
| 37.5 | 100 | 0.00958 | 43 |
| 28 | 100 | 0.00490 | 30 |
| 20 | 100 | 0.00287 | 20 |
| 14 | 100 | 0.00154 | 10 |
| 10 | 100 | | |
| 6.3 | 100 | | |
| 5 | 98 | | |
| 3.35 | 96 | | |
| 2 | 95 | | |
| 1.18 | 93 | | |
| 0.6 | 90 | Particle density | (assumed) |
| 0.425 | 89 | 2.65 | Mg/m3 |
| 0.3 | 86 | | |
| 0.212 | 83 | | |
| 0.15 | 79 | | |
| 0.063 | 73 | | |

| Dry Mass of sample, g | 205 |
|---|---|

| Sample Proportions | % dry mass |
|---|---|
| Cobbles | 0.0 |
| Gravel | 5.1 |
| Sand | 21.8 |
| Silt | 58.9 |
| Clay | 14.2 |

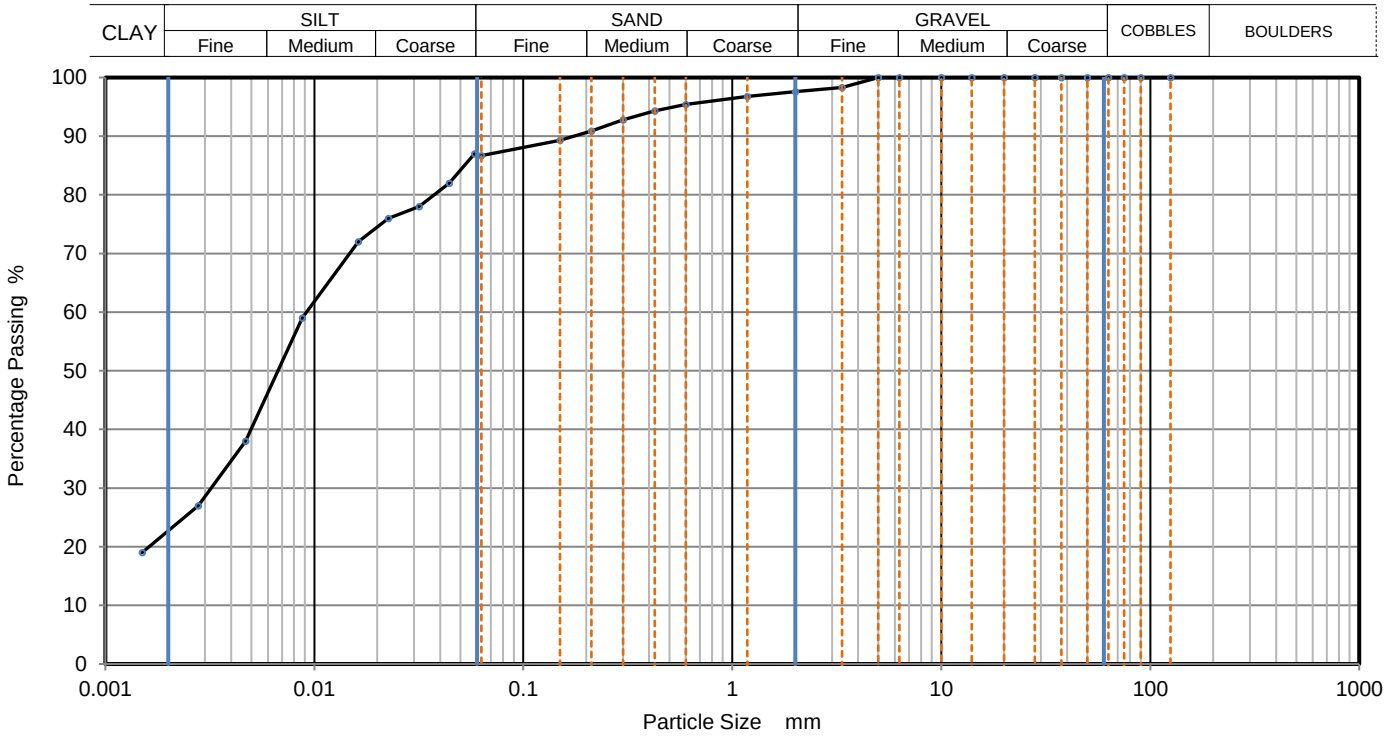
| Grading Analysis | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 0.0215 |
| D30 | mm | 0.00491 |
| D10 | mm | 0.00154 |
| Uniformity Coefficient | | 14 |
| Curvature Coefficient | | 0.73 |

Remarks

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

| Approved |
|---|
| Stephen.Watson |

| | | | | | |
|---|---|---|---|---|---|
| CAUSEWAY GEOTECH | **PARTICLE SIZE DISTRIBUTION** | | | Job Ref | **21-0553** |
| | | | | Borehole/Pit No. | INFIL 007 |
| Site Name | Riverine Community Park, Lifford | | | Sample No. | 2 |
| Soil Description | Dark brown slightly sandy organic clayey SILT. | | | Depth, m | 1.50 |
| Specimen Reference | 5 | Specimen Depth | 1.5 m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clauses 9.2 and 9.5 | | | KeyLAB ID | Caus202107263 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | 0.05843 | 87 |
| 90 | 100 | 0.04418 | 82 |
| 75 | 100 | 0.03175 | 78 |
| 63 | 100 | 0.02263 | 76 |
| 50 | 100 | 0.01625 | 72 |
| 37.5 | 100 | 0.00877 | 59 |
| 28 | 100 | 0.00468 | 38 |
| 20 | 100 | 0.00278 | 27 |
| 14 | 100 | 0.00150 | 19 |
| 10 | 100 | | |
| 6.3 | 100 | | |
| 5 | 100 | | |
| 3.35 | 98 | | |
| 2 | 98 | | |
| 1.18 | 97 | | |
| 0.6 | 95 | Particle density | (assumed) |
| 0.425 | 94 | 2.65 | Mg/m3 |
| 0.3 | 93 | | |
| 0.212 | 91 | | |
| 0.15 | 89 | | |
| 0.063 | 87 | | |

| | |
|---|---|
| Dry Mass of sample, g | 203 |

| **Sample Proportions** | % dry mass |
|---|---|
| Cobbles | 0.0 |
| Gravel | 2.4 |
| Sand | 10.9 |
| Silt | 63.7 |
| Clay | 23.0 |

| **Grading Analysis** | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 0.00911 |
| D30 | mm | 0.00315 |
| D10 | mm | |
| Uniformity Coefficient | | |
| Curvature Coefficient | | |

Remarks

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

| |
|---|
| Approved |
| Stephen.Watson |

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

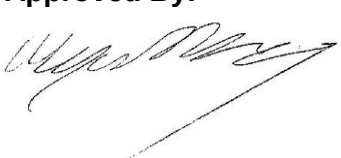
2183

# Final Report

| | |
|---|---|
| **Report No.:** | 21-26171-1 |
| **Initial Date of Issue:** | 06-Aug-2021 |
| **Client** | Causeway Geotech Ltd |
| **Client Address:** | 8 Drumahiskey Road<br>Balnamore<br>Ballymoney<br>County Antrim<br>BT53 7QL |
| **Contact(s):** | Carin Cornwall<br>Colm Hurley<br>Darren O'Mahony<br>Gabriella Horan<br>Joe Gervin<br>John Cameron<br>Lucy Newland<br>Martin Gardiner<br>Matthew Gilbert<br>Michelle Gaffney<br>Neil Haggan<br>Paul Dunlop<br>Sean Ross<br>Stephen Franey<br>Stephen Watson<br>Stuart Abraham<br>Thomas McAllist |
| **Project** | 21-0553 Riverine Community Park, Lifford |

| | | | |
|---|---|---|---|
| **Quotation No.:** | | **Date Received:** | 29-Jul-2021 |
| **Order No.:** | | **Date Instructed:** | 29-Jul-2021 |
| **No. of Samples:** | 3 | | |
| **Turnaround (Wkdays):** | 7 | **Results Due:** | 06-Aug-2021 |
| **Date Approved:** | 06-Aug-2021 | | |

**Approved By:**



**Details:** Glynn Harvey, Technical Manager

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

# Results - Soil

**Project: 21-0553 Riverine Community Park, Lifford**

| **Client: Causeway Geotech Ltd** | | | **Chemtest Job No.:** | | 21-26171 | 21-26171 | 21-26171 |
|---|---|---|---|---|---|---|---|
| Quotation No.: | | | **Chemtest Sample ID.:** | | 1250342 | 1250343 | 1250344 |
| Order No.: | | | Client Sample Ref.: | | 2 | 1 | 2 |
| | | | Sample Location: | | INFIL006 | INFIL007 | INFIL007 |
| | | | Sample Type: | | SOIL | SOIL | SOIL |
| | | | Top Depth (m): | | 1.5 | 0.5 | 1.5 |
| | | | Date Sampled: | | 28-Jul-2021 | 28-Jul-2021 | 28-Jul-2021 |
| **Determinand** | **Accred.** | **SOP** | **Units** | **LOD** | | | |
| Moisture | N | 2030 | % | 0.020 | 52 | 66 | 18 |
| pH (2.5:1) | N | 2010 | | 4.0 | < 4.0 | | 8.2 |
| Magnesium (Water Soluble) | N | 2120 | g/l | 0.010 | 0.028 | | |
| Sulphate (2:1 Water Soluble) as SO4 | U | 2120 | g/l | 0.010 | 0.36 | | 0.081 |
| Chloride (Water Soluble) | U | 2220 | g/l | 0.010 | 0.061 | | |
| Nitrate (Water Soluble) | N | 2220 | g/l | 0.010 | < 0.010 | | |
| Organic Matter | U | 2625 | % | 0.40 | | 35 | |

# Test Methods

| SOP | Title | Parameters included | Method summary |
|---|---|---|---|
| 2010 | pH Value of Soils | pH | pH Meter |
| 2030 | Moisture and Stone Content of Soils(Requirement of MCERTS) | Moisture content | Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C. |
| 2040 | Soil Description(Requirement of MCERTS) | Soil description | As received soil is described based upon BS5930 |
| 2120 | Water Soluble Boron, Sulphate, Magnesium & Chromium | Boron; Sulphate; Magnesium; Chromium | Aqueous extraction / ICP-OES |
| 2175 | Total Sulphur in Soils | Total Sulphur | Determined by high temperature combustion under oxygen, using an Eltra elemental analyser. |
| 2220 | Water soluble Chloride in Soils | Chloride | Aqueous extraction and measuremernt by 'Aquakem 600' Discrete Analyser using ferric nitrate / mercuric thiocyanate. |
| 2430 | Total Sulphate in soils | Total Sulphate | Acid digestion followed by determination of sulphate in extract by ICP-OES. |
| 2625 | Total Organic Carbon in Soils | Total organic Carbon (TOC) | Determined by high temperature combustion under oxygen, using an Eltra elemental analyser. |

## Report Information

**Key**

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

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

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

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

**Sample Deviation Codes**

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

**Sample Retention and Disposal**

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

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

CAUSEWAY GEOTECH

# APPENDIX H

# SPT HAMMER ENERGY MEASUREMENT REPORT



# SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

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

| | |
|---|---|
| SPT Hammer Ref: | 0199 |
| Test Date: | 27/02/2021 |
| Report Date: | 01/03/2021 |
| File Name: | 0199.spt |
| Test Operator: | NPB |

## Instrumented Rod Data

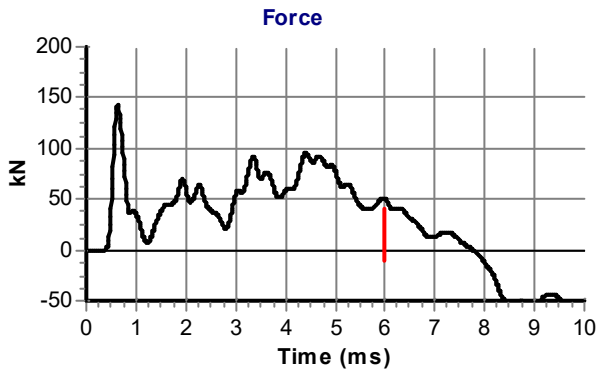
| | |
|---|---|
| Diameter $d_r$ (mm): | 54 |
| Wall Thickness $t_r$ (mm): | 6.3 |
| Assumed Modulus $E_a$ (GPa): | 208 |
| Accelerometer No.1: | 6458 |
| Accelerometer No.2: | 9607 |

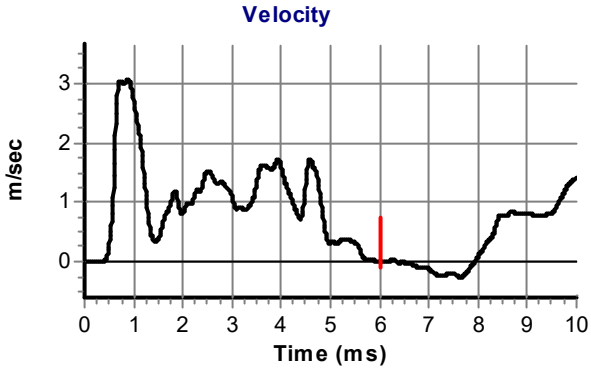
## SPT Hammer Information

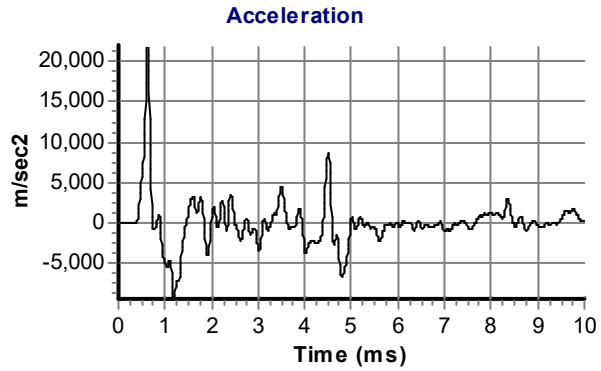
| | |
|---|---|
| Hammer Mass m (kg): | 63.5 |
| Falling Height h (mm): | 760 |
| SPT String Length L (m): | 11.0 |

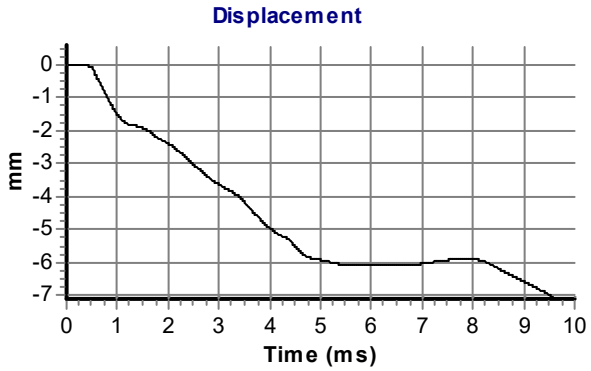
## Comments / Location

BALLYMONEY




## Calculations

| | |
|---|---|
| Area of Rod A (mm2): | 944 |
| Theoretical Energy $E_{theor}$ (J): | 473 |
| Measured Energy $E_{meas}$ (J): | 325 |

**Energy Ratio $E_r$ (%):** **69**

The recommended calibration interval is 12 months

Signed: N P Burrows

Title: Field Operations Manager

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# SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

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

| | |
|---|---|
| SPT Hammer Ref: | 0210 |
| Test Date: | 27/02/2021 |
| Report Date: | 01/03/2021 |
| File Name: | 0210.spt |
| Test Operator: | NPB |

**Instrumented Rod Data**

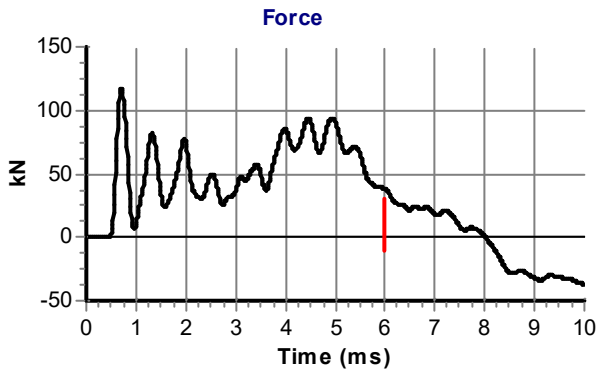
| | |
|---|---|
| Diameter $d_r$ (mm): | 54 |
| Wall Thickness $t_r$ (mm): | 6.3 |
| Assumed Modulus $E_a$ (GPa): | 208 |
| Accelerometer No.1: | 6458 |
| Accelerometer No.2: | 9607 |

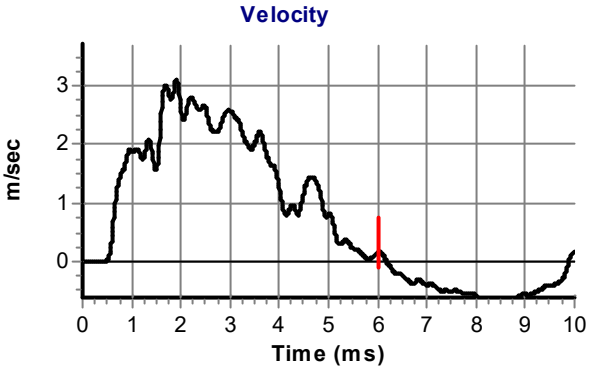
**SPT Hammer Information**

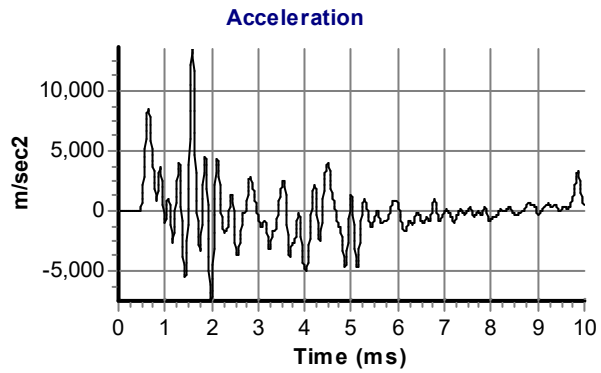
| | |
|---|---|
| Hammer Mass m (kg): | 63.5 |
| Falling Height h (mm): | 760 |
| SPT String Length L (m): | 11.0 |

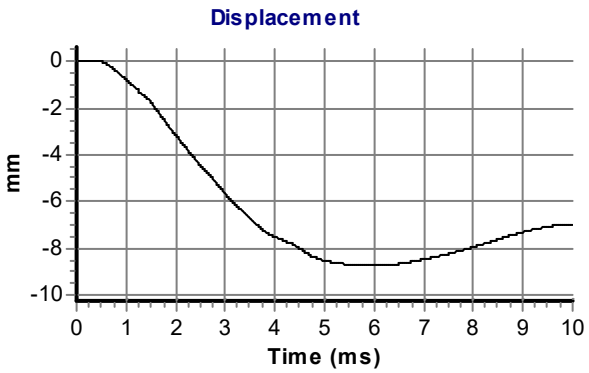
**Comments / Location**

BALLYMONEY




**Calculations**

| | |
|---|---|
| Area of Rod A (mm2): | 944 |
| Theoretical Energy $E_{theor}$ (J): | 473 |
| Measured Energy $E_{meas}$ (J): | 297 |

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

Signed: N P Burrows

Title: Field Operations Manager

The recommended calibration interval is 12 months

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## Appendix 9-9

### Piling Risk Assessment

**APPENDIX 9-9**

**Piling Risk Assessment**

**Riverine Development Scheme**

***Client:*** **McAdam**

**August 2021**

**MCL Consulting Ltd**

**Unit 5, Forty Eight North**

**Duncrue Street**

**Belfast**

**BT3 9BJ**

**028 9074 7766**

www.mclni.com

# CONTENTS


1.0 INTRODUCTION 1

1.1 Report Brief 1
1.2 Scope of Works 1

2.0 SITE ASSESSMENT 2

2.1 Key Details of Proposed Development 2
2.2 Previous Reporting 3
2.3 Land Contamination 3
2.4 Ground Conditions 3
2.5 Groundwater 4
2.6 Ground Gas, Lifford 5
2.7 Ground Gas, Strabane 6

3.0 PILING RISK CONSIDERATIONS 6

3.1 Bridge Landing Site, Strabane 6
3.2 Bridge Landing Site, Lifford 7
3.3 Environmental Hazard Identification 8

4.0 PILING DESIGN 9

5.0 SOURCE- PATHWAY- RECEPTOR SUMMARY 10

6.0 PILING RISK ASSESSMENT 10

7.0 CONCLUSION AND SUMMARY 15

# 1.0 INTRODUCTION

## 1.1 Report Brief

MCL Consulting Ltd was appointed by McAdam Design Ltd to undertake a Piling Risk Assessment for the proposed Riverine Community Park Development Scheme in Strabane-Lifford.

The development will comprise the creation of a new community park infrastructure with multi-purpose community facilities and amenities. The development will include: Construction of a pedestrian and cycle bridge approximately 115m in length between Lifford and Strabane; Construction of a single storey community resource building with a gross internal floor area 302m², for use as community space including office and café use; Provision of a multi-functional outdoor space and external stage area to accommodate circa 3000 persons; Creation of play areas, a river walk and river access; Construction of a 4 meter wide access road, and provided internally within the park; Construction of walkways and cycleways; Construction of a Maintenance Compound with welfare facilities, machinery and materials storage for Council operatives; Associated landscaping inclusive of the wetlands of the River Foyle; Provision of car parking; and all ancillary development, accommodation works including replacement Spectator Stand and site services.

## 1.2 Scope of Works

The following works were undertaken as part of this assessment;

- Review of site setting;
- Review of ground and groundwater conditions encountered at the site;
- Review of Conceptual Site Model (CSM);
- Discussion of geotechnical requirements;
- Undertaking of a Piling Risk Assessment.

The report further assesses the CSM developed in the previously completed PRA / GQRA, including a risk assessment in line with CIRIA 552 methodology. The report will then outline suitable working methods, relating to piling operations including controls for groundwater monitoring and management and outline further remedial measures (if required).

The report has been produced in line with the guidance presented in *"Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention. Environment Agency National Groundwater and Contaminated Land Centre Report NC/99/73 May 2001".*

The aim of this report is to determine risk to environmental receptors associated with the use of piles which may be utilised within the development.

# 2.0 SITE ASSESSMENT

## 2.1 Key Details of Proposed Development

The following key elements of the development are considered in this piling risk assessment:-

**Lifford**

- Bridge Abutment, Riverbank.
- Bridge Abutment, Flood Embankment.
- Construction and Deconstruction of Temporary Crane Platform and Working Platform, River Bed and River Margin.
- Construction and Deconstruction of Sheet Pile Wall as Temporary Flood Embankment during the works.
- Hub Building.
- Spectator Stand (within Accommodation Works).

**Strabane**

- Bridge Abutment, River Bank.

It is assumed that other elements of the development comprising Maintenance Depot (Geotechnical Report advises strip & pad for this 'store'), access roads, paths, landscaped areas in Lifford and in Strabane will not require piling to be undertaken for foundations so these have not been assessed in this Piling Rik Assessment report.

## 2.2 Previous Reporting

The site has been subject to contaminated land (PRA/GQRA) assessment and Geotechnical Assessment, as follows:-

- *MCL Preliminary Risk Assessment (Stage 1), Chapter 9* ***Appendix 9-5****;*
- *MCL Generic Quantitative Risk Assessment (Stage 2), Chapter 9* ***Appendix 9-5****;*
- *Report No. 21-0553A INTERP, Interpretative Geotechnical Report, Lifford, Chapter 9,* ***Appendix 9-7****).*
- *Report No. 21-0553B INTERP, Interpretative Geotechnical Report, Strabane, Chapter 9,* ***Appendix 9-8****.*

## 2.3 Land Contamination

**Lifford**

Investigation of the site identified some areas of made ground due to historical site reprofiling but no significant soil or groundwater contamination was identified across the site.

**Strabane**

Investigation of the site identified some areas of made ground due to historical use as railway land, two small areas of soil contamination and minor groundwater contamination of limited lateral extent.

## 2.4 Ground Conditions

The ground conditions observed during intrusive investigations are summarised in **Table 1**. The reader should refer to the Geotechnical Reports prepared by Causeway Geotech and the GQRA prepared by MCL Consulting for borehole logs and detailed descriptions of ground and groundwater conditions.

**Table 1 Ground Conditions at Sites where Piling is Likely**

| Location | Ground Conditions |
|---|---|
| Strabane Bridge Abutments | On top of Flood Embankment (anticipated)<br>0 – 3m Made ground, sandy gravel fill<br><br>Under flood Embankment (anticipated)<br>3.0 - 3.1m Silty sand Alluvium (dry)<br>3.1 – 20m+ Sands & Gravels (water strike 9mbgl) |
| Bridge Abutment, Lifford<br>River Margin, Lifford | On top of Flood Embankment (anticipated)<br>0 – 3m Made ground, sandy gravel fill<br><br>Under flood Embankment (anticipated)<br>3.0 – 4.0 m Silty sand Alluvium (dry)<br>4.0m – 20m+ Sands & Gravels (water strike 9mbgl) |
| Hub Building, Lifford | 0 – 0.2m Topsoil<br>0.2– 3.6m Organic-rich Clay and Sand Alluvium (dry)<br>3.6 – 20m+ Sands & Gravels (water strike 19mbgl) |

Given that the bridge landing sites will tie into exiting and or modified embankments, the upper few metres of the ground being piled through will be comprised of made ground. The made ground of the site embankments is typically re-worked natural materials similar to the local geology. No contamination was identified in the embankments during the site investigations.

## 2.5 Groundwater

The embankments at the bridge landing sites, being elevated elongate structures elevated above surrounding ground level, are anticipated to be devoid of any significant groundwater.

Some pore water was observed in the underlying alluvium in some areas of the site but not close to the bridge landing sites or at the proposed Hub Building site. Excavation depths for infrastructure at greater than 1.5m depth are likely to be at risk of exposure to the underlying groundwater system. This risk is dependent on the precise elevation of the ground. Rapid inflow of water is not expected at 1.5mbgl depths or at >0.5mAOD. However, ingress rates will be subject to the extent of an excavation and the excavation's connectivity to permeable horizons and the River Foyle.

Deeper water strikes were recorded in the sand & gravel during the geotechnical drilling works, at depths of between around 10mbgl and 19mbgl with evidence of a degree of confinement within this unit.

Groundwater can be described as two systems. An upper system in the Made Ground / Alluvium and lower system in the Gravel deposits which underlie the Alluvium. The lower system is in hydraulic continuity with the River Foyle and there is a direct hydraulic response to the daily tidal cycle.

There is no consistency to the water levels in the alluvium and Made Ground. Groundwater levels are static and randomly distributed at an elevation above that of the river and gravels. This random distribution is consistent with a generally overall lower permeability matrix that has no lateral continuity compared to that of the gravel deposits which are regionally extensive.

Groundwater in the Made Ground should be considered as a series of moisture bearing units, which yield small seepage volumes into the investigation holes and therefore are representative of a disconnected interstitial porewater solution of percolating infiltrating waters which have reached a permeability contrast. The infiltrating volume is minimal and is likely to be controlled by a seepage where moisture intercepts the topography. There is insufficient volume to be of any significance in the Made Ground.

## 2.6 Ground Gas, Lifford

The ground gas flux was established to be at the lowest risk classification – Characteristic Situation CS2 for Hub Building Location and CS1 for the rest of the site, and gas protection

measures consistent with this situation should be employed for all works adjacent to or within excavations as well as building foundation design should be incorporated.

No specific risk to ground or water is expected from the construction of foundations, below ground services and above ground level structures, such as road surfacing.

## 2.7 Ground Gas, Strabane

The GQRA (Chapter 9, **Appendix 9-6**) classified the presence of the gas in Strabane as Characteristic Situation CS1, the lowest risk classification under *Ciria C665; Assessing risks posed by hazardous ground gases to buildings*).

The ground gas itself is a product of microbial activity and soil moisture conditions in combination with the availability of organic matter within the ground. There is no significance to the gas in the ground, particularly as the highest methane concentrations are present under an impermeable surface in a location which will be converted to a meadow. The ground gas concentrations are otherwise consistent with expectations for low permeability materials in a biologically enriched environment, *i.e*. agricultural land, stagnant anoxic ponds and woodland.

# 3.0 PILING RISK CONSIDERATIONS

## 3.1 Bridge Landing Site, Strabane

The bridge will be supported by a footing tying into the riverside embankment and walkway.

Following detailed discussions with statutory bodies including NIEA NED and Loughs Agency, it was agreed that piles required at the Strabane Bridge Landing Sites would be completed using a CFA Piling Technique to minimise ground vibration. This approach was agreed in order to minimise the construction phase vibration impact to the River Foyle SAC a measure to protect migratory fish and other aquatic species in this stretch of river, and a badger sett located within the Strabane site.

## 3.2 Bridge Landing Sites, Lifford

The bridge will be supported by a footing located on the river margin and a second footing tying into the walkway embankment further inland.

Following detailed discussions with statutory bodies including NPWS and Loughs Agency, it was agreed that piles required at the Lifford Bridge Landing Sites (Riverbank and re-modelled flood embankment) would be completed using a CFA Piling Technique to minimise ground vibration. This approach was agreed in order to minimise the construction phase vibration impact to the River Foyle SAC a measure to protect migratory fish and other aquatic species in this stretch of river.

## 3.3 River Margin and In-River Works, Lifford

In addition to bridge abutments, where permanent CFA Piles will be used piled foundations may also need to be emplaced on land within the river margin beyond the flood embankment in proximity to the Bridge Abutment sites. Depending on the outcomes of the proposed Ground Investigation Works, this may be necessary to create a working platform for the assembly and lifting of the bridge, which will arrive to the site in sections requiring assembly on site. This platform will support the main crane used to lift the bridge into position, smaller crane(s) used to assist with the assembly of both the main crane and bridge and to store the assembled bridge before it is lifted into place. This platform structure and will be deconstructed once the bridge has been completed. If CFA piles, which are permanent and cannot be withdrawn, have been used as foundations for this structure, then these piles shall be cut down to 1m below ground level as part of the site restoration / landscaping works following completion of bridge construction.

A temporary crane pad, extending into the river channel, is required to be constructed to support the large crane used for the bridge lift. This pad must bear the weight of the crane whilst it is lifting the bridge, and will be of sufficient dimension to facilitate safe lifting of the bridge structure. The crane pad structure may involve piling through the riverbed to install a temporary peripheral coffer dam and / or piling through the riverbed under the crane footprint to provide a temporary foundation for the crane. The crane platform and any associated piles will be withdrawn and deconstructed once the bridge is completed.

A section of the existing flood embankment running alongside the riverbank may need to be temporarily realigned to provide a suitable working room for the bridge abutment piling and construction works. In order to retain flood protection during the construction phase it is necessary to construct a temporary sheet pile wall in place of the removed section of flood defence. This sheet pile will be withdrawn and deconstructed once the new permanent section of flood defence is in place.

Due to ecological constraints designed to protect aquatic species within the SAC, the piling methods deployed for the river margin platform, crane pad and in-river works must comprise a low-vibration method for both installation and withdrawal. The piling method must allow subsequent withdrawal of the piles.

## 3.4 Environmental Hazard Identification

Based upon an assessment of the site setting, the following possible hazards are identified with regards to the use of driven piles in the site;

- Creation of preferential pathways, through a one or more low permeability layers (an aquitard), to allow potential contamination of an underlying aquifer (Environment Agency Pollution Scenario 1);
- Creation of preferential pathways, through a one or more low permeability layers (an aquitard), to allow upward migration of soil gas or contaminant vapours to the surface (Environment Agency Pollution Scenario 2);
- Contaminated arisings being brought to the surface by piling work, with subsequent risks to site workers and site users, and the need for appropriate handling; (Environment Agency Pollution Scenario 3);
- The effects of aggressive ground conditions on materials used in piles (Environment Agency Pollution Scenario 4);
- Driving contaminated materials downwards into the aquifer during construction/installation (Environment Agency Pollution Scenario 5); and
- Concrete or grout contamination of groundwater and any nearby surface waters (Environment Agency Pollution Scenario 6).

# 4.0 PILING DESIGN

At the time of reporting the piling design works for the bridge landing sites have been outlined as requiring CFA Piling for ecological protection reasons. The piling design for the Hub Building and Spectator Stand will also be CFA Filing.

There are numerous types of piled foundations used in industry, however they generally fall under two main categories:

Driven pre-cast piles are one form of *Displacement Piling* where the pile is formed by displacing soil from the space to be occupied by the pile **without** the removal of soil to the ground surface. The dominant movement of soil is in a radial horizontal direction with limited vertical movement of soils downwards. This typically results in volume reduction/ densification of the soil around the pile and is considered to generally result in a reduction in permeability.

CFA (Continuous Flight Auger) piles fall within the *Non-Displacement Piling* category. This involves the extraction of soils and the subsequent replacement of the void created by the pile (typically through casting of concrete in-situ by pumping from the surface). Displacement of the soils around the pile is minimised and there is minimal radial or vertical soil movement or densification. This does involve the bringing of soil arisings to the surface. Typically, the void created does need temporary support through the use of temporary or permanent casings or use of bentonite. The use of these supports can sometimes cause some minimal displacement type effects on surround soils.

Silent piling or the 'press-in' technique is a non-dynamic method for the installation of steel sheet piles suited to ecologically sensitive construction sites. It utilises hydraulic rams to push the piles into the ground and is commonly marketed as 'silent piling', which is essentially vibration free.

## 5.0 SOURCE- PATHWAY- RECEPTOR SUMMARY

A summary of the relevant S-P-R linkages which occur or could develop due to piling is presented in **Table 2**.

**Table 2: S-P-R Linkages Summary, Riverine**

| Source | Pathway | Receptor |
|---|---|---|
| Contaminated soils in upper infill | Downward displacement around pile | Groundwater within lower aquifer units |
| | | Site workers/site users where brought to surface |
| Impacted shallow groundwater in upper infill/superficial deposits. | Downward vertical movement around pile and potential lateral movement to lough | Groundwater within lower superficial units |
| | | Nearby surface waters |
| Impacted shallow groundwater in underlying superficial deposits | Downward vertical movement around pile and potential lateral movement to lough | Groundwater within lower bedrock aquifer units |
| | | Nearest surface water (River Lagan) |
| Soil gas/vapours | Upward vertical migration around pile | Site workers and site users |

## 6.0 PILING RISK ASSESSMENT

The introduction of piles through the made ground and superficial deposits (mainly sandy alluvium and sand & gravel) to depth has the potential to create preferential pathways for the downward migration of contamination from the shallow groundwater into the sand & gravel, which is hydraulically linked to the River Foyle SAC.

Only CFA and Silent Driven Piles are considered in this risk assessment, since hammer-driven piles and other piling methods have been ruled out on the basis of vibration risk to ecology.

CFA Piling is a non-displacement 'bored' piling technique which extracts a core of soil and replaces it with concrete cast in-situ. CFA piles are constructed by rotating a hollow stem

continuous flight auger into the soil to a designed depth. Concrete or grout is pumped through the hollow stem, maintaining static head pressure, to fill the cylindrical cavity created as the auger is slowly removed. The reinforcement cage is placed through the freshly placed concrete.

CFA Piling is a low vibration method making it ideal for ecologically sensitive areas. The method enables piles to be formed in water-bearing strata, without the need for casing or bentonite. The pile is drilled and concreted in one continuous operation.

CFA Piles are considered to provide better protection for multi-layer aquifer systems than driven piles, since the in-situ casting creates a water-tight seal against the geology over the length of the pile.

Hydraulically driven 'Silent Piles' are considered a low / zero vibration method making it ideal for ecologically sensitive areas.

A summary of the risk assessment undertaken for the proposed piling works is presented in **Table 3**, with the risk classification based on the CIRIA 552 methodology.

**Table 3: CSM and Piling Risk Assessment, Riverine Development**

| Activity | Consequence | Consequence of Risk | Probability of Risk | Risk Classification | Comments |
|---|---|---|---|---|---|
| Silent Sheet Piles (Temporary Works) | Contaminated arisings from pile | Low-Moderate | Low due to uncontaminated nature of made ground | Low | With this piling method it not considered that there will any significant volume of arisings during installation or removal. |
| | Piles acting as pathways into lower aquifer units for shallower groundwater | Low due to insignificant volumes of shallow groundwater in alluvium | Low due to uncontaminated nature of made ground | Low | Sheet piles do not provide good protection from mixing of groundwater from different units, however, where the consequences of allowing this are insignificant, sheet piles may still be appropriate. The volume of shallow groundwater is minimal and its presence is sporadic. The risks of groundwater mixing is low, the consequences of groundwater mixing are insignificant. |
| | Movement of contaminated made ground / infill further down into natural ground | Low, no significant contamination present | Low | Low | No significant contamination detected in vicinity of proposed application. |
| | Creation of Hydraulic link to underlying groundwater system when used for in-river works | Low-Moderate | Moderate | Low | Surface water and groundwater are already hydraulically linked across the floor of the riverbed. Installation will only be temporary for a short period of time of a few months and will then be withdrawn restoring the pre-construction hydraulic conditions. The environmental risk of these works is therefore considered as Low. |
| | Contact with contaminated soil / groundwater by construction workers | Low | Low | Low | No significant contamination detected in vicinity of proposed hub building |
| | Upward migration of gas/ vapours from made-ground / natural degradation or organic material or contamination | Moderate | Low | Low | Gas protection measures consistent with CS2 situation should be employed for all works adjacent to or within excavations should be incorporated. |
| | Migration of concrete/grout | Low | Low | Low | No grout/concrete applied into ground in this method reducing risk of any off-site migration. |
| | Aggressive attack on pile structure | Low | Low | Low | Specific pile design will take into account site setting and ground and water quality |

| Activity | Consequence | Consequence of Risk | Probability of Risk | Risk Classification | Comments and Mitigation Measures |
|---|---|---|---|---|---|
| CFA Piles | Contaminated arisings from pile | Low no significant contamination present | Low | Low | Soil arisings will be produced using this method. Stockpiling of soils will be necessary in accordance with the oCEMP. Materials may have to be removed from the site or re-used on site. |
| | Piles acting as pathways into lower aquifer units for shallower contaminated groundwater | Low | Low | Low | Removal of soils can potentially lead to vertical migration of shallow groundwater to lower units, however the CFA piling technique do not provide an easy preferential pathway (5.2.1 EA Guidance) and will be temporary with subsequent concrete/grout emplacement integrating with surrounding soils as a seal. Surrounding ground is alluvium over sand and gravel which may already allow some vertical migration in places. There is insignificant volumes of shallow groundwater and occurrence is sporadic. The risks of groundwater mixing is low, the consequences of groundwater mixing are insignificant. |
| | Movement of contaminated made ground / infill further down into natural ground | Low | Low | Low | No significant soil contamination present. |
| | Contact with contaminated soil / groundwater by construction workers | Low | Low | Low | No significant groundwater contamination present. |
| | Upward migration of gas/vapours from made-ground/ contamination | Moderate | Low | Low | Gas protection measures consistent with CS2 situation should be employed for all works adjacent to or within excavations as well as building foundation design should be incorporated. |
| | Migration of concrete/grout | Low | Low | Low | Measures described in the oCEMP will be to minimise excessive grout use preventing escape of concrete dust and slurry. |
| | Aggressive attack on pile structure | Low | Low | Low | Specific pile design will take into account site setting and ground and water quality. |
| | Retention of piles under construction platform | Low | Low | Low | Although required on a temporary basis for the construction phase, CFA piles are difficult to remove subsequently. The piles will be retained and cut down to 1m below ground level to facilitate landscape / restoration of the area following completion of construction works at the bridge site. |

In addition to the mitigation measures comprising piling method selection outlined in Table 3, all in-river and river bank piling and piling works within the SAC must be undertaken between May and September as a means to protect aquatic fish species within the River Foyle, as per the seasonal constraints described below.

**Seasonal Constraints for Construction and Associated Works**

Seasonal Constraints for Construction and Associated Works

| | Jan | Feb | March | April | May | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| In-River Piling, Bridge Construction, In-river works, riverbank Works and piling within SAC | | | | | | | | | | | | |
| Tree and Shrub Clearance | | | | | | | | | | | | |
| JK Treatment | | | | | | | | Opt | Opt | Opt | | |
| Balsam Treatment | | | | Opt | Opt | | | | | | | |
| Hogweed Treatment | | | | Opt | Opt | Opt | | | | | | |

Opt : Optimal Period  Red: Exclusion Period  Green: Approved Period

# 7.0 CONCLUSION AND SUMMARY

Overall, the risk assessment has concluded a low risk associated with the use of permanently installed CFA piles as the foundation solution for the Hub Building, Spectator Stand and Construction Platform.

The use of CFA Piles at the bridge crossing sites has already been determined, prior to this assessment. However, the CFA piling solution would appear to be good practice and an appropriately conservative approach in terms of ensuring protection of groundwaters close to the baseflow recharge zone, the bridge landing sites being close to the River Foyle. The CFA Pile method, being a low vibration option, also provides adequate protection for ecological purposes.

The use of Silent sheet piles for other temporary works to the flood embankment and within the river channel, which will be withdrawn following completion of the bridge structure, meets all of the environmental objectives to minimise environmental impact.

If during the development works, new contamination or risks are encountered which have not previously been identified, works should cease, and the Planning Authority shall be notified immediately. This new contamination shall be fully investigated in accordance with

LCRM. In the event of unacceptable risks being identified, a remediation strategy shall be agreed with the Planning Authority in writing, and subsequently implemented and verified to its satisfaction.

If an alternative piling solution is considered at the detailed design stage, all piling methods must be low vibration during installation and removal (where necessary), and must offer similar degree of environmental protection to the piling solutions assessed at the planning stage.

Following consultation with Loughs Agency regarding concerns over impacts to migratory fish species particularly salmon, all in-river piling, river-bank piling and all piling works within the SAC in both Lifford and Strabane sites must be carried out between May and September.

**Report Prepared By:-**

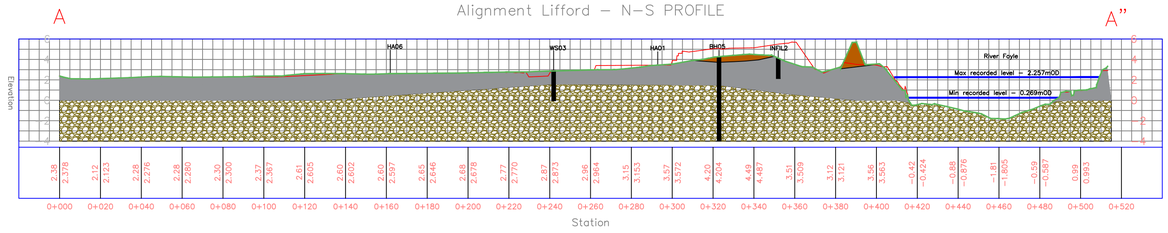
**David McLorinan BSc MSc CGeol CGeol MCIWM**

**Senior Hydrogeologist, Chartered Geologist, Chartered Waste Manager**

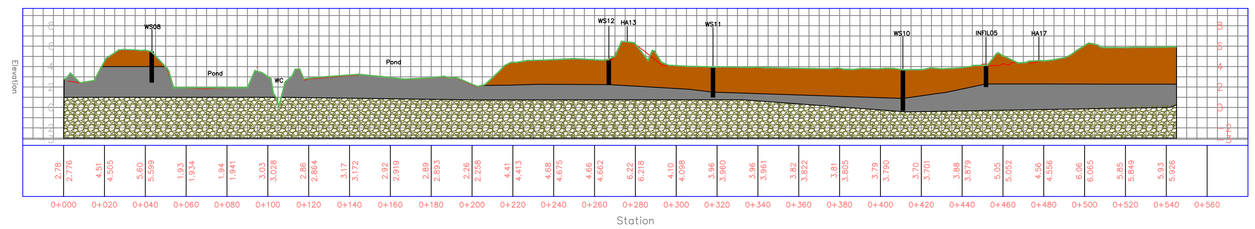
## Appendix 9-10

### Geological Cross Sections

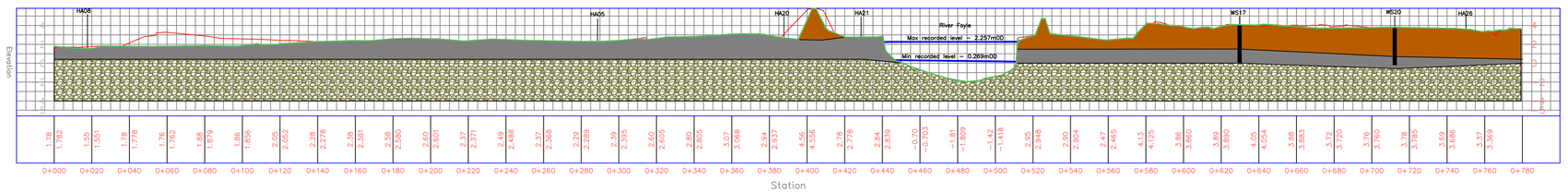
## Alignment Lifford – N–S PROFILE



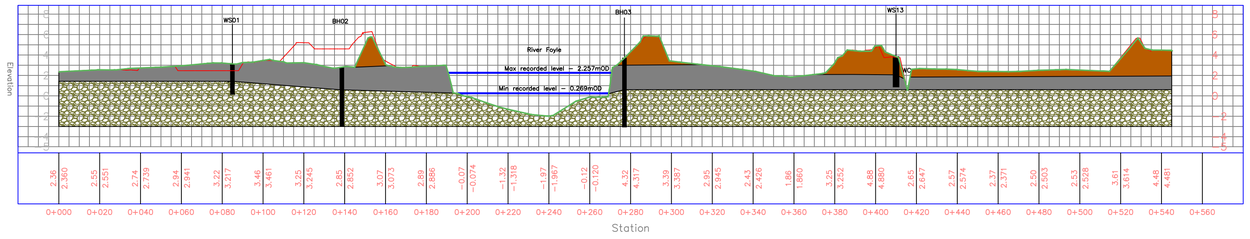

## Alignment Strabane N–S PROFILE



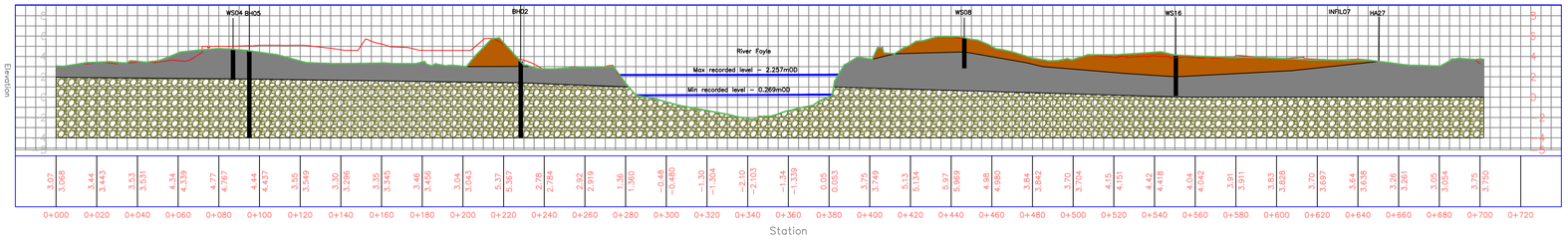

## Alignment 1 – W–E PROFILE




## Alignment 2 – NW–SE PROFILE




## Alignment 3 – SW–NE PROFILE

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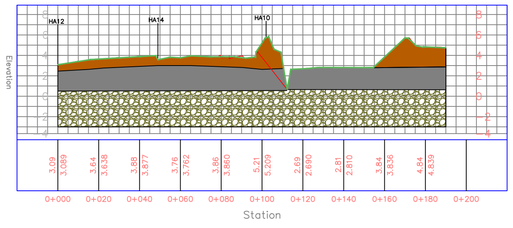


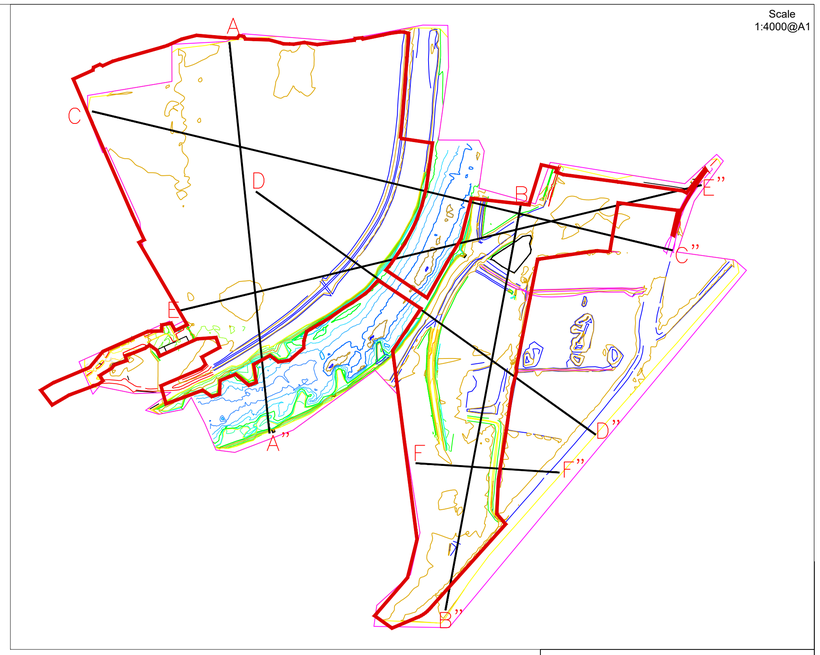


Scale
1:4000@A1

**Notes:**

- Made Ground
- Alluvium
- Sands and Gravel
- Existing Ground Level
- Proposed Ground Level

# McAdam Design

Riverine Community Park - Strabane/Lifford

Appendix 9-10

Geological Cross Sections

| Scale | Drawing No. | Date |
|---|---|---|
| 1:1500@A1 | P2288-SW-F2 | 08/08/21 |


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## Appendix 9-11

### Surface Water Management Plan & Water Quality Management Plan

**APPENDIX 9-11**

# OUTLINE CONSTRUCTION PHASE SURFACE WATER MANAGEMENT PLAN INCLUDING OUTLINE WATER QUALITY MONITORING PLAN

**RIVERINE COMMUNITY PARK**

**AUGUST 2021**

MCL Consulting Ltd
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# CONTENTS


1.0 INTRODUCTION 1

1.1 Background 1
1.2 Existing Site Conditions 1
1.3 Summary of Hydrology and Hydrogeology 2

2.0 SURFACE WATER MANAGEMENT PLAN 8

3.0 GROUNDWATER MANAGEMENT PLAN 9

4.0 WATER QUALITY MONITORING PROGRAMME 10

4.1 Surface Water Monitoring 10
4.2 Groundwater Monitoring 13
4.3 Sampling Procedures 15
4.4 Re-Sampling and Investigation Procedures 16
4.5 Reporting 16


## Figures


Figure 1: Site Location with approximate extent of site outlined in red
Figure 2: Lifford Water Features
Figure 3: Strabane Water Features
Figure 4: Groundwater Flow Map, Lifford
Figure 5: Groundwater Flow Map, Strabane
Figure 6: Proposed Locations of Surface Water Sampling Points, Lifford & Strabane
Figure 7: Groundwater Monitoring Points, Lifford
Figure 8: Groundwater Monitoring Points, Strabane


## Tables


Table 1: Proposed Surface Water Quality Monitoring Network, Lifford
Table 2: Proposed Surface Water Quality Monitoring Network, Strabane
Table 3: Proposed Surface Water Monitoring Schedule, Lifford and Strabane
Table 4: Proposed Groundwater Quality Monitoring Network, Lifford
Table 5: Proposed Groundwater Quality Monitoring Network, Strabane
Table 6: Proposed Groundwater Monitoring Schedule, Lifford and Strabane

# 1.0 INTRODUCTION

## 1.1 Background

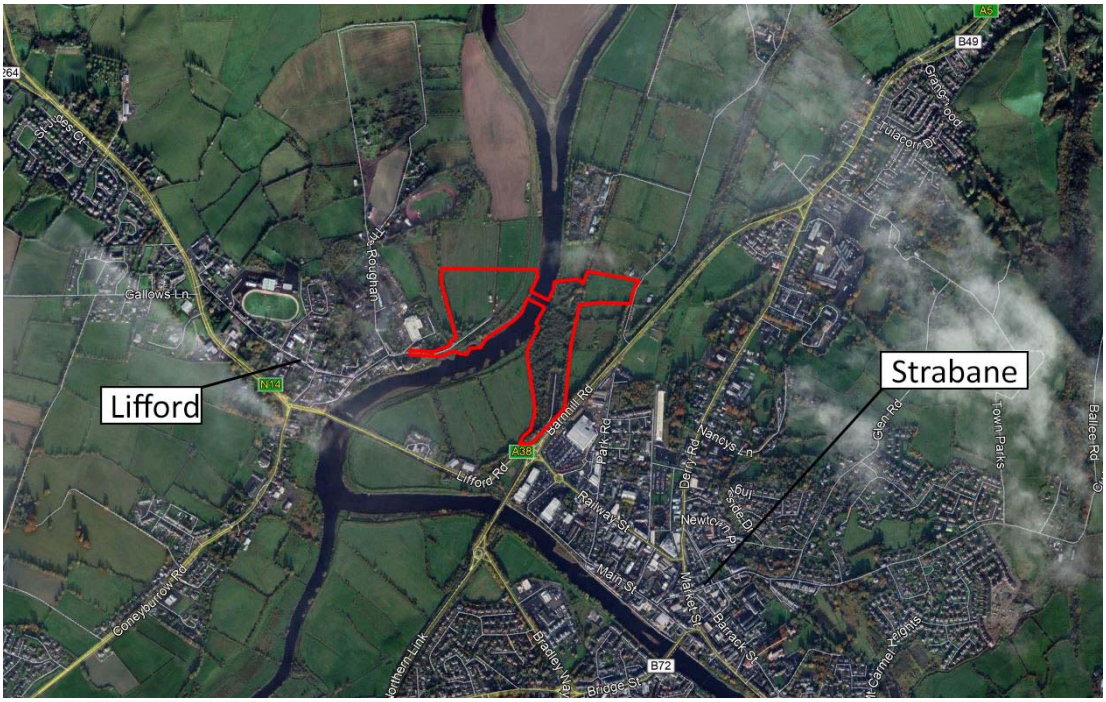
This document comprises an Outline Surface Water Management Plan including an Outline Water Quality Monitoring Plan for the construction phase of the proposed Riverine Community Park development scheme.

This report should be read in conjunction with the EIAr supporting the proposed development, with particular reference to Chapter 9 (Soils and Waters) and the oCEMP (**Appendix 3-1**).

## 1.2 Existing Site Conditions

The **Lifford** site is situated on lands to the west of Station Road in the Town of Lifford, County Donegal, (IGR 233882, 398765). The **Strabane** site is situated at Barnhill Road, in the north-western area of Strabane, County Tyrone (IGR 234119, 398597). The site boundary is indicated within **Figure 1**.

**Figure 1: Site Location with approximate extent of site outlined in red**



Riverine Community Park will be of local and regional importance and will incorporate the core elements of a pedestrian and cycle bridge between Lifford and Strabane, Riverine Park Building, multi-functional outdoor space and external stage provision, play area, river walk and access, landscaped green-spaces interlaced with a network of pathways and cycleways, wetlands supported by car parking provision.

The works will involve considerable construction works to be undertaken, including site reprofiling (cut-fill), clearance works for invasive species, landscaping, planting and seeding, construction of paths, roadways, car parks, hardstanding and buildings, creation of temporary pads for construction, including various piling works.

## 1.3 Summary of Hydrology and Hydrogeology

The site includes lands within the River Foyle SAC and the site is hydraulically connected to the SAC through surface water connections and groundwater connections. Both sites are substantially within the Q100 flood plain.

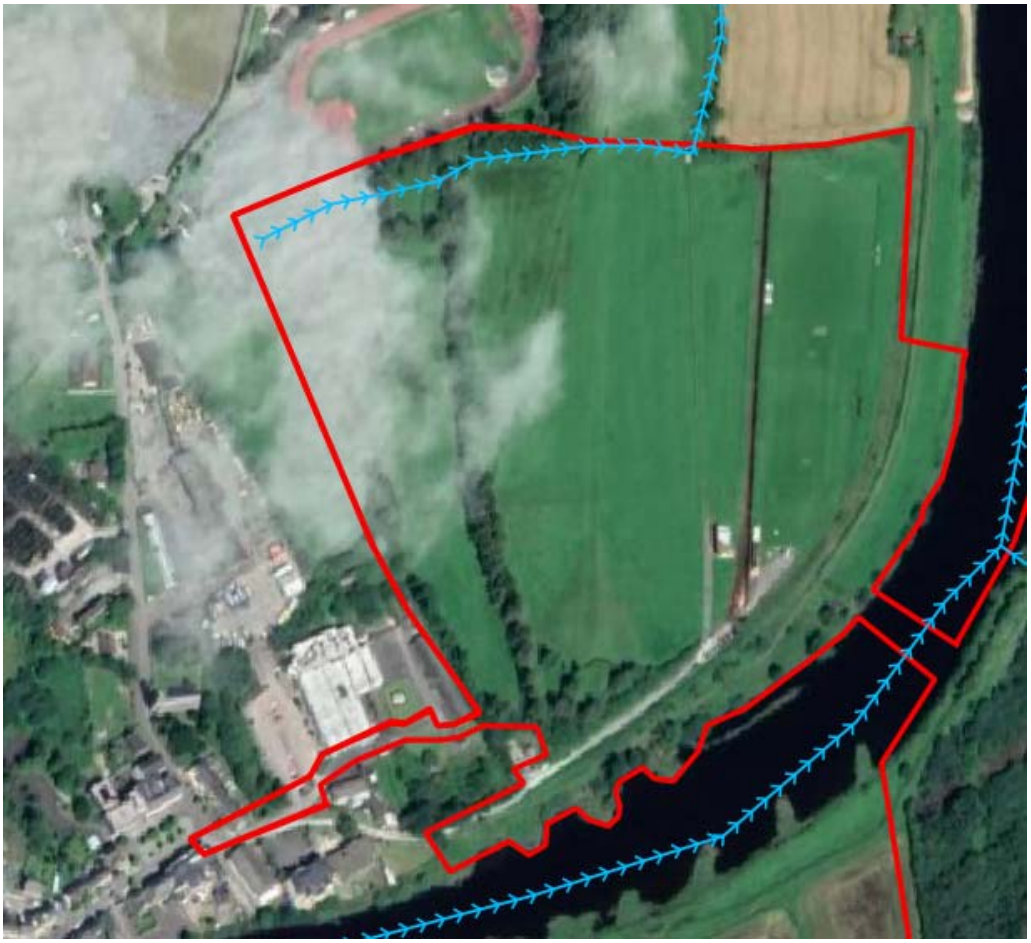
### 1.3.1 Hydrology

**Lifford:**

The main watercourses passing through the sites are shown in **Fig. 2** (Lifford).

A small watercourse, known as the Roughan Stream, flows in an easterly direction through the site from lands to the east, turning north and hence through agricultural lands, discharging to the Deele River c700m to the north of the site. Baseline monitoring indicates the presence of ammonia at c7.4mg/l and chloride (195.2mg/l) in this small stream (see Water Features Survey, Chapter 9, **Appendix 9-4**).

**Figure 2: Lifford Water Features**



**Strabane**

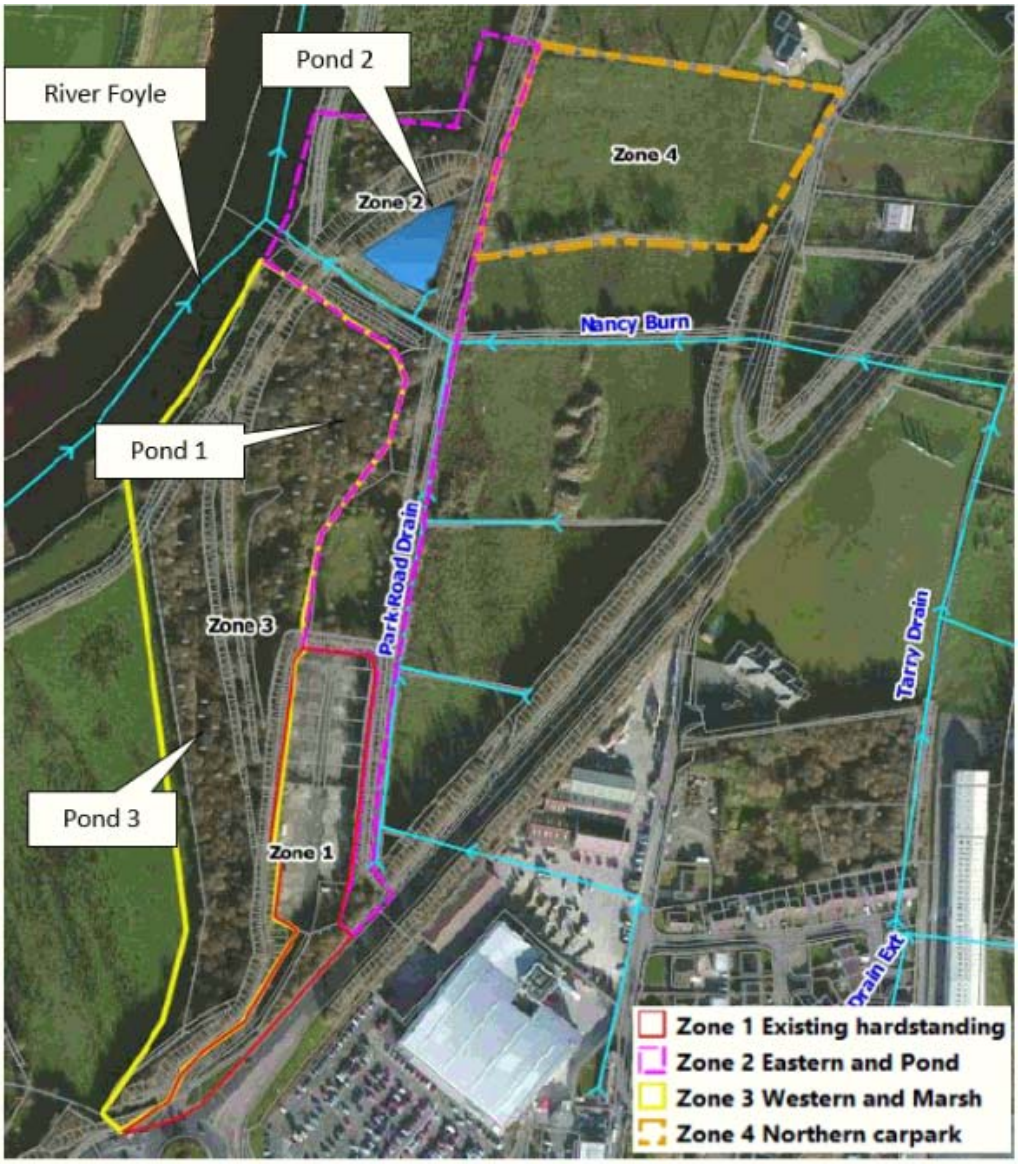
The main watercourses passing through the sites are shown in **Fig. 3** (Strabane).

The two main named watercourses draining the site and surrounding lands are the Park Road Drain and the Nancy Burn.

Drainage waters from the urban area of Strabane, likely including some road runoff inputs are picked up by various minor field boundary watercourses (sheughs) flowing westwards which flow into the Park Road Drain at various points along the eastern site boundary.

A larger watercourse, the Nancy Burn also flows westwards through urban area of Strabane.

**Figure 3: Strabane Water Features**




The Park Road Drain (SH03) merges with the Nancy Burn along the eastern site boundary, with a concrete headwall and flap valve installed in the Park Road drain immediately upstream of the convergence point with the Nancy Burn. From this point, the Nancy Burn flows under the historical railway embankment discharging to the River Foyle via a large concrete headwall, fitted with a flap.

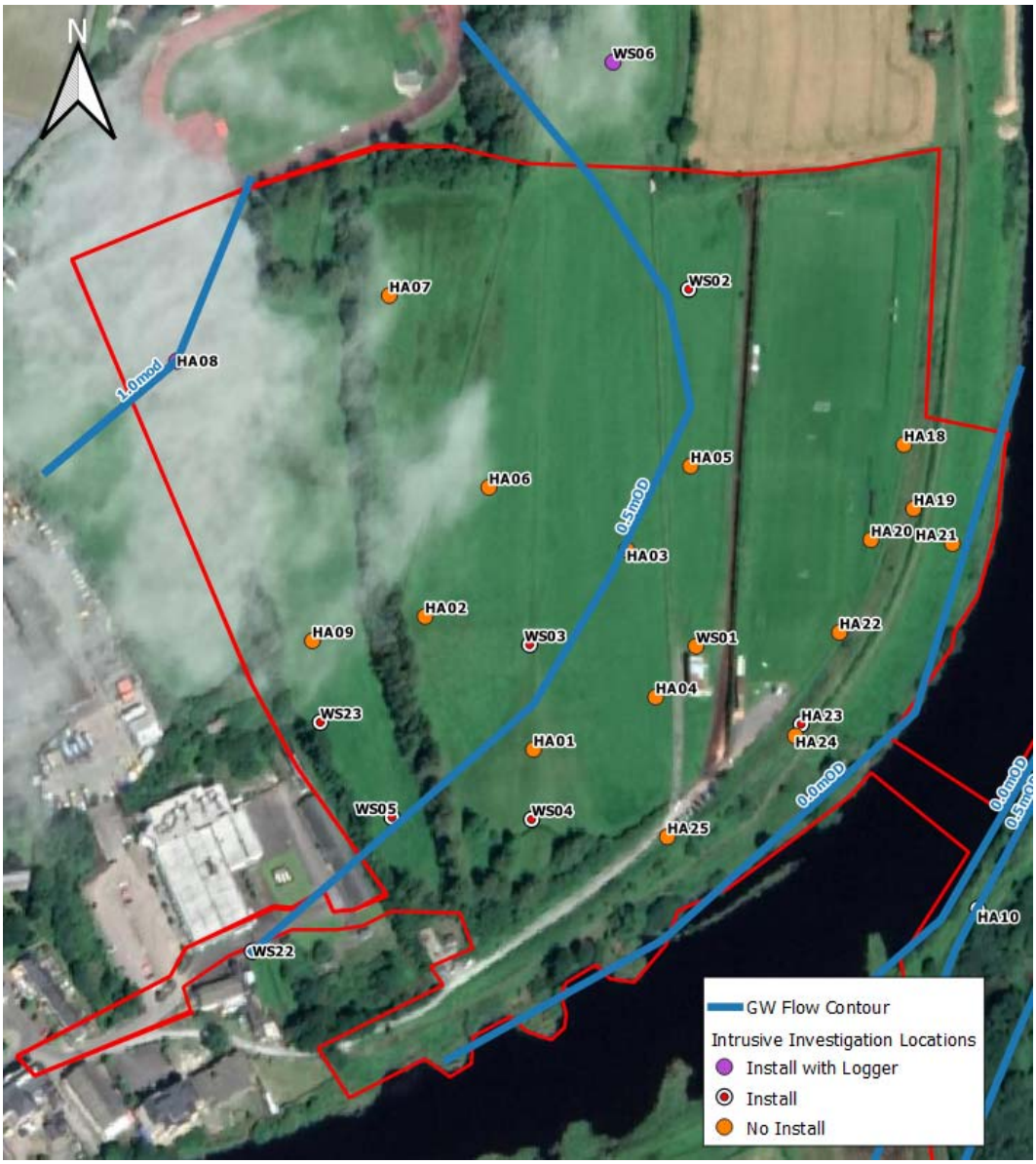
Upflow water quality in the Park Road Drain shows various impacts typical of an urban catchment including benzo(a)pyrene 0.025ug/l, Total PAH 0.438µg/l), oils (EPG C8-C40 at 3.23mg/l), PAH (Total PAH 2.273µg/l) and high suspended solids (588mg/l) and ammonia (1.19mg/l NH3_N).

### 1.3.2 Hydrogeology

**Lifford**

The site is characterised by a shallow groundwater system in the underlying sands and gravels, with groundwater flow direction in a general easterly direction toward the River Foyle, see Figure 4. The non-saline groundwater shows typical semidiurnal tidal fluctuations and provides baseflow to the river at the bottom of the tidal cycle.

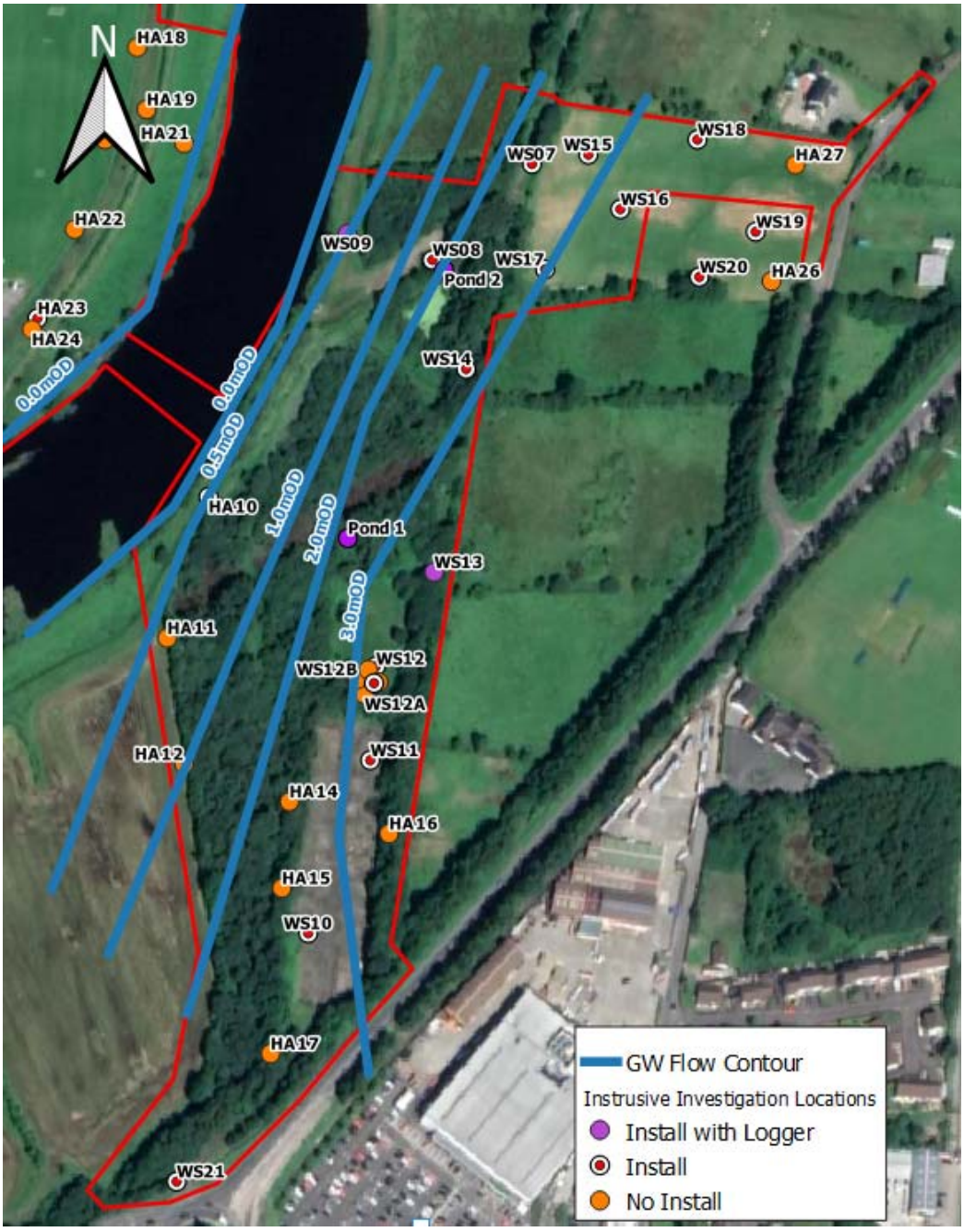
**Figure 4: Groundwater Flow Map, Lifford**



**Strabane**

The site is characterised by a shallow groundwater system in the underlying sands and gravels, with groundwater flow direction in a general westerly direction toward the River Foyle, see Figure 5. The non-saline groundwater shows typical semidiurnal tidal fluctuations and provides baseflow to the river at the bottom of the tidal cycle.

**Figure 5: Groundwater Flow Map, Strabane**



**River Foyle**

The River Foyle is a low salinity water course, sulphate fluctuates slightly adjacent to the site. However, from upstream of the Lifford WwTW to downstream of the application area on the Strabane side, sulphate reduces from 10mg/l to 8mg/l and chloride remains static at 16mg/l. Over this same distance ammoniacal-N reduces from 1mg/l to 0.05mg/l and nitrate stays stay static at 4mg/l. There is a small increase in ammoniacal-N to 0.7mg/l immediately downstream of the Lifford works.

Ammoniacal-N at 0.7mg/l classifies lowland water courses with low alkalinity as a Moderate Water Standard (between 0.3 and 0.75mg/l). However, this is rapidly dispersed to negligible levels further downstream and is due to limited initial dilution. Notwithstanding this infrastructure improvements to the Lifford WwTW are intended to increase the capacity of the works and improve discharge quality.

The Strabane WwTW is downstream of the application sites and is expected to be outside of any sphere of influence from the downstream works.

## 2.0 SURFACE WATER MANAGEMENT PLAN

The Contractor will be obliged to ensure no deleterious discharges are released from the site to surrounding watercourses during the construction stage. Throughout the works the Contractor will also take account of relevant legislation and best practice guidance including but not limited to the following:

- CIRIA C649: Control of water pollution from linear construction projects (2006);
- CIRIA C741: Environmental Good Practice on Site Guide (2015);
- CIRIA C753: The SuDS Manual (2015);
- CIRIA C769: Guidance on the construction of SuDS (2017);
- DEFRA Good Practice Guide for Handling Soils (MAFF 2000);
- BS 8582:2013 Code of practice for surface water management for development sites; and
- Guidance on Pollution Prevention (GPP) SEPA & NIEA, 2018.

The quality of local watercourse receptors must not be significantly impacted by the construction works, which includes works in and around watercourses. Ensuring good water quality is necessary to protect the important terrestrial and aquatic habitat which has important foraging resources for local wildlife. Being hydraulically linked to the SAC, the protection of surface water quality and flow is essential to ensuring that no negative impact to the SAC results during the construction phase.

A range of mitigating measures have been designed to protect surface waters during the construction phase, see oCEMP, **Appendix 3-1**. These include the following key mitigating measures:

- 10m buffer zones for all watercourses (100m for River Foyle SAC) with respect to concrete mixing and washing, with no wash-water to be discharged to the environment.
- 10m buffer zones for all watercourses (100m for River Foyle SAC) with respect to refuelling of vehicles, machinery etc, with refuelling only taking place at designated hardstanding refuelling areas spill kits stored at key locations.
- Close management of site runoff, including temporary sedimentation control measures.

- 10m buffer zones for all watercourses (100m for River Foyle SAC) with respect to fuel storage, which must have appropriate bunding and spill prevention controls.
- Use of silt traps, silt fencing and plant nappies where appropriate.
- Prevention of silt release to River Foyle during bridge construction and in-river works, using appropriate engineering solutions such as membranes and coffer dam or similar controls.
- Each site will be services by a wheel wash which will be self-contained with no environmental discharge.
- Each site will be served by a Biosecurity washdown facility located within the Construction Compound. These facilities will be self-contained with no environmental discharge.
- Environmental Clerk of Works on site to monitor construction activities and receptors for signs of pollution and advise on the deployment of control measures.
- Programme of routine Water Quality Monitoring (see Section 3 of this report).

Full details of all relevant procedures and controls for the management of surface waters in the construction phase are provided within the oCEMP, **Appendix 3-1**.

## 3.0 GROUNDWATER MANAGEMENT PLAN

Measures and controls provided for the protection of local surface waters will also serve to protect local groundwater quality to ensure no degradation of groundwater quality occurs across the sites during the construction phase. It is important to protect groundwater during this phase of works, as the system is considered as having a HIGH Vulnerability status, having little or no natural protection from surface sources of pollution.

# 4.0 WATER QUALITY MONITORING PROGRAMME

It is proposed to implement a programme of surface water and groundwater quality monitoring for the duration of the works. This will comprise the following key elements:

- Baseline (pre-commencement) Survey.
- Construction Phase Routine Monitoring.
- Re-sampling and investigations where necessary for exceedences of EQSs or increasing trends of contamination levels.
- Post-completion Survey.

## 4.1 Surface Water Monitoring

Suitable surface water quality monitoring points have been established based on the results of the Water Features Survey. These are described in **Table 1** (Lifford) **and Table 2** (Strabane). The monitoring points have been selected to allow for both upflow and downflow water quality to be monitored, such that downflow data can be compared to assess any impacts occurring.

**Table 1: Proposed Surface Water Quality Monitoring Network, Lifford**

| Surface Water ID | Description | Notes |
|---|---|---|
| SW-L1 | Upflow, Roughan Stream | Drains from Lifford Town |
| SW-L2 | Downflow, Roughan Stream | Discharges to River Deele |
| SW-F1 | Upflow, River Foyle ROI Bank | Upgradient water quality in River Foyle. |
| SW-F2 | Downflow of Bridge Landing Site ROI side and associated works, River Foyle ROI Bank | To monitor for impacts from bridge works, crane pad, working pad etc. |
| SW-F3 | Downflow, River Foyle ROI Bank | Downgradient water quality in River Foyle. |

**Table 2: Proposed Surface Water Quality Monitoring Network, Strabane**

| Surface Water ID | Description | Notes |
|---|---|---|
| SW-S1 | Upflow, Park Road Drain | Drains from urban area of Strabane. |
| SW-S2 | Downflow, Park Road Drain | Prior to confluence with Nancy Burn. |
| SW-S3 | Upflow, Nancy Burn | Drains from urban area of Strabane. |
| SW-S4 | Downflow, Nancy Burn (and Park Road Drain and Pond 1 and Pond 3) | Main site runoff discharge to River Foyle. |
| SW-F4 | Upflow, River Foyle NI Bank | Upgradient water quality in River Foyle. |
| SW-F5 | Downflow of Bridge Landing Site NI side. | To monitor for impacts from bridge works. |
| SW-F6 | Downflow, River Foyle NI Bank | Downgradient water quality in River Foyle. |
| Pond 1 | Main wetland area | Fed Pond 3, which has inflow from local watercourse entering site from south. Hydraulically connected to River Foyle SAC. |
| Pond 2 | Triangle pond | Eutrophic and stagnant. Rainwater dependent. |
| Pond 3 | Secondary wetland area | Hydraulically connected to Pond 1 and River Foyle SAC, dries in summer. |

The locations for all proposed surface water sampling for Lifford and Strabane is presented in **Figure 6**.

**Figure 6: Proposed Surface Water Sampling Points, Lifford & Strabane**




The proposed surface water monitoring schedule for both Lifford and Strabane is presented in **Table 3**.

**Table 3: Proposed Surface Water Monitoring Schedule, Lifford and Strabane**

| Parameter Suite | Monitoring Frequency |
|---|---|
| Visual inspection of Turbidity and Colour. | Baseline, then<br>Daily then<br>Post-completion (within 1 month) |
| Field readings : Temperature, EC, pH, DO, Ammonia<br>Lab Testing : Suspended Solids | Baseline then<br>Weekly then<br>Post-completion (within 1 month) |
| Lab Testing:<br>Suspended Solids, NH4-N (Ammonia), Electrical Conductivity, BOD, COD, Phosphate, pH, Chloride, Total Oxidised Nitrogen, Sulphate, Total Alkalinity, Total Organic Carbon, Sodium, Calcium, Potassium, Magnesium, Iron, Manganese, Cadmium, Chromium, Copper, Nickel, Lead, Zinc, Total TPH, Total PAH | Baseline then<br>Monthly for duration of works then<br>Post-completion (within 1 month) |

## 4.2 Groundwater Monitoring

Suitable groundwater quality monitoring points have been established through the drilling of boreholes as part of the GQRA (**Appendix 9-6**) and Geotechnical Investigation works (**Appendix 9-8** and **Appendix 9-8**).

The proposed groundwater monitoring schedule for both Lifford and Strabane is presented in **Table 4** (Lifford) **and Table 5** (Strabane). The positions of the relevant installed boreholes available for sampling are provided in **Figure 7** (Lifford) and **Figure 8** (Strabane), with proposed sampling locations highlighted.

**Table 4: Proposed Groundwater Quality Monitoring Network, Lifford**

| Groundwater ID | Description |
|---|---|
| HA08 | Upflow shallow groundwater (alluvium), northwestern corner of site. |
| WS02 | Midflow shallow groundwater (sands and gravels), northern side of side (accommodation works) |
| CBH02 | Downflow shallow groundwater (sands and gravels) close to bank of River Foyle, eastern edge of site, downflow of Construction Compound. |

**Table 5: Proposed Groundwater Quality Monitoring Network, Strabane**

| Groundwater ID | Description |
|---|---|
| WS13 | Upflow shallow groundwater (sands and gravels), located on eastern boundary of site. |
| WS20 | Upflow shallow groundwater (sands and gravels), located to northeast of site (proposed car park area) |
| WS11 | Midflow shallow groundwater (sands and gravels), located proximal to Construction Compound |
| CBH03 | Downflow shallow groundwater (sands and gravels) close to bank of River Foyle, western edge of site. |

Where any groundwater boreholes are damaged or require re-positioning to accommodate the progression of the development, replacement boreholes must be drilled.

The proposed surface water monitoring schedule for both Lifford and Strabane is presented in **Table 6**.

**Table 6: Proposed Groundwater Monitoring Schedule, Lifford and Strabane**

| Parameter Suite | Monitoring Frequency |
|---|---|
| Visual inspection of Turbidity and Colour. | Baseline, then<br>Daily then<br>Post-completion (within 1 month) |
| Field readings : Temperature, EC, pH, DO, Ammonia | Baseline then<br>Weekly then<br>Post-completion (within 1 month) |
| Lab Testing:<br>NH4-N (Ammonia), Electrical Conductivity, BOD, COD, Phosphate, pH, Chloride, Total Oxidised Nitrogen, Sulphate, Total Alkalinity, Total Organic Carbon, Sodium, Calcium, Potassium, Magnesium, Iron, Manganese, Cadmium, Chromium, Copper, Nickel, Lead, Zinc, Total TPH, Total PAH | Baseline then<br>Monthly for duration of works then<br>Post-completion (within 1 month) |

**Figure 7: Groundwater Monitoring Points, Lifford**

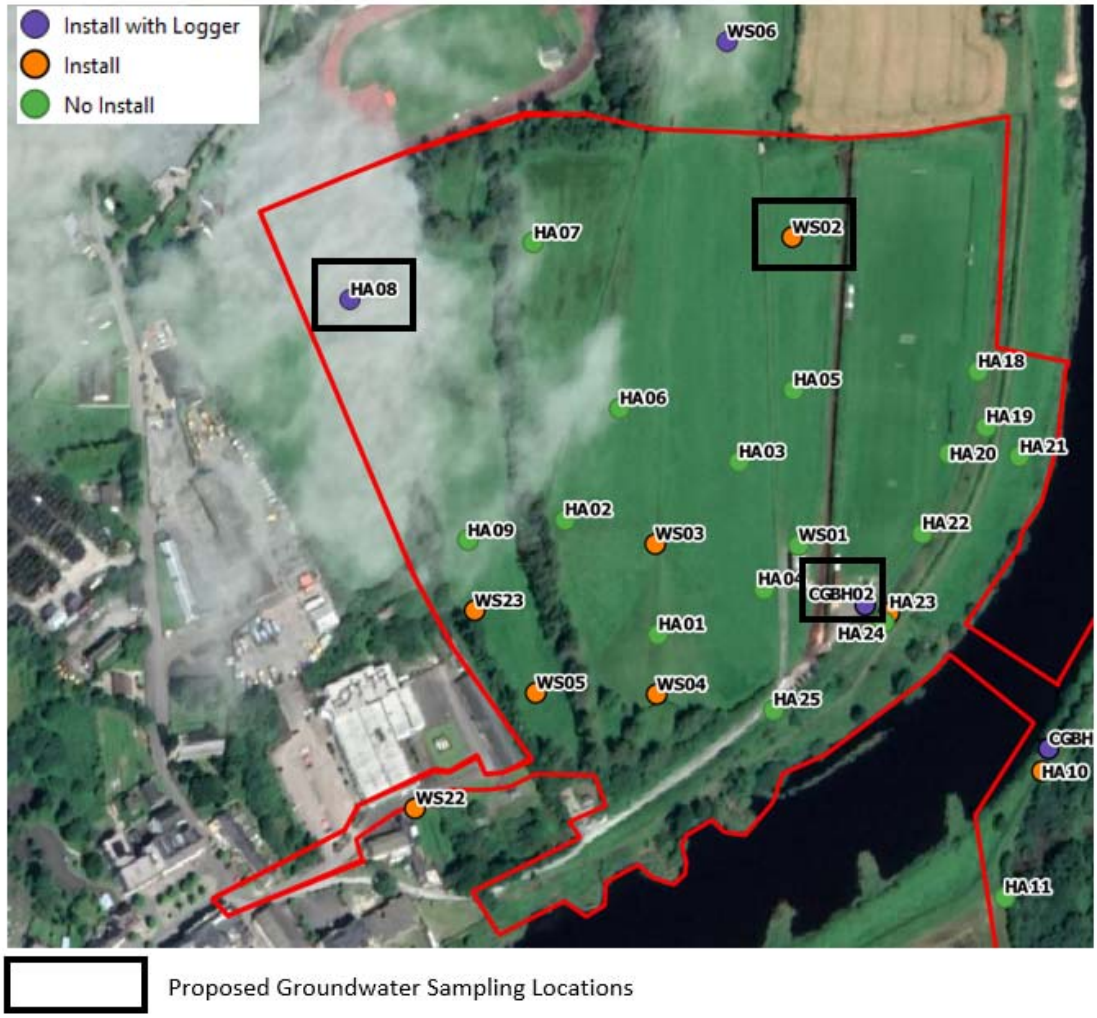


**Figure 8: Groundwater Monitoring Points, Strabane**




## 4.3 Sampling Procedures

Samples for laboratory testing shall be obtained by a qualified environmental scientist and sent to an appropriate laboratory for UKAS-accredited testing in line with standard sample Duty of Care protocols. Laboratory detection limits for all parameters shall be suitably low to allow for comparison against environmental EQS Standards.

Routine monitoring data should not show any significant degradation in downflow water quality compared to the upflow conditions and baseline data, subject to any seasonality. The above self-monitoring should be carried out in additional to any monitoring that may be required under conditions of regulatory discharge consents.

## 4.4 Re-Sampling and Investigation Procedures

Where any significant deterioration in downflow water quality is identified by monitoring, the following procedures will be implemented:

- Re-sampling of relevant sampling points for relevant parameter as soon as possible after the sample failure.
- Where re-sample results passes, record event for reporting, no further action.
- Where re-sample confirms failure:

    - carry out further investigations to identify the source / cause and implement additional appropriate environmental controls / changes to work practices to remedy the situation.
    - Undertaken further re-sampling to confirm remedy is effective.
    - Repeat process in the event that failure is persistent.

## 4.5 Reporting

An interpretative Baseline Report on water quality monitoring data shall be prepared for the baseline (pre-commencement) monitoring. This shall establish appropriate Control and Tigger Thresholds for key monitoring parameters, including Suspended Solids, Chloride, BOD and TPH.

Monthly interpretive reports shall be provided for the duration of the construction phase, detailing all routine tests and results of any re-sampling, investigations, additional mitigation measures of required.

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