COYLTON GREENER GRID PARK

LAND SOUTH OF AYR ROAD, COYLTON

APPENDIX 2: DRAINAGE IMPACT ASSESSMENT

OCTOBER 2021

Prepared by
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1 INTRODUCTION

1.1 Background

This Drainage Impact Assessment ('DIA') has been produced in support of a planning application for the construction of a Greener Grid Park ('the Development') on land within land south of Ayr Road, Coylton ('the Site').

The DIA has been prepared by Arcus Consultancy Services Ltd ('Arcus'), on behalf of Statkraft UK LTD ('the Applicant') to satisfy the following requirements:

- Scottish Government, Planning Advice Note 61: Planning and Sustainable Urban Drainage Systems[1];
- Scottish Government, Planning Advice Note 79: Planning Advice Note 79: Water and Drainage[2];
- Scottish Environmental Protection Agency (SEPA), Technical Flood Risk Guidance for Stakeholders[3];
- Scottish Water, Sewers for Scotland 4th Edition[4];
- CIRIA, The SuDS Manual (C753)[5];
- East Ayrshire Council ('EAC'), Local Development Plan Policy EN11[6];
- EAC, Local Development Plan Supplementary Guidance[7]; and
- North Ayrshire Council, Ayrshire Local Plan District Local Flood Risk Management Plan[8].

The Site Layout Plan can be found in Appendix A of this report.

1.2 Site Context

The Site comprises an area of approximately 1.99 hectares (ha) and is located south of Ayr Road, Coylton, East Ayrshire. The Site is located approximately 2 kilometres (km) northeast of Drongan and adjacent to the existing Coylton substation centred on National Grid Reference (NGR) of E 246508, N 619639 as shown in Plate 1.

The Site is greenfield with an existing agricultural land use.

[1] Scottish Government, Planning Advice Note 61: Planning and Sustainable Urban Drainage Systems (2001). [Online]. Available at: https://www.gov.scot/publications/pan-61-sustainable-urban-drainage-systems/ (Accessed 05/10/2021)

[2] Scottish Government, Planning Advice note 79: Water and Drainage (2006). [Online]. Available at: https://www.gov.scot/publications/planning-advice-note-pan-79-water-drainage/(Accessed 05/10/2021)

[3] SEPA, Technical Flood Risk Guidance for Stakeholders (2019). [Online]. Available at: https://www.sepa.org.uk/environment/land/planning/guidance-and-advice-notes/ (Accessed 05/10/2021)

[4] Scottish Water, Sewers for Scotland (2018). [Online]. Available at: https://www.scottishwater.co.uk/-/media/ScottishWater/Document-Hub/Business-and-Developers/Connecting-to-our-network/All-connections-information/SewersForScotlandv4.pdf (Accessed 30/09/2021)

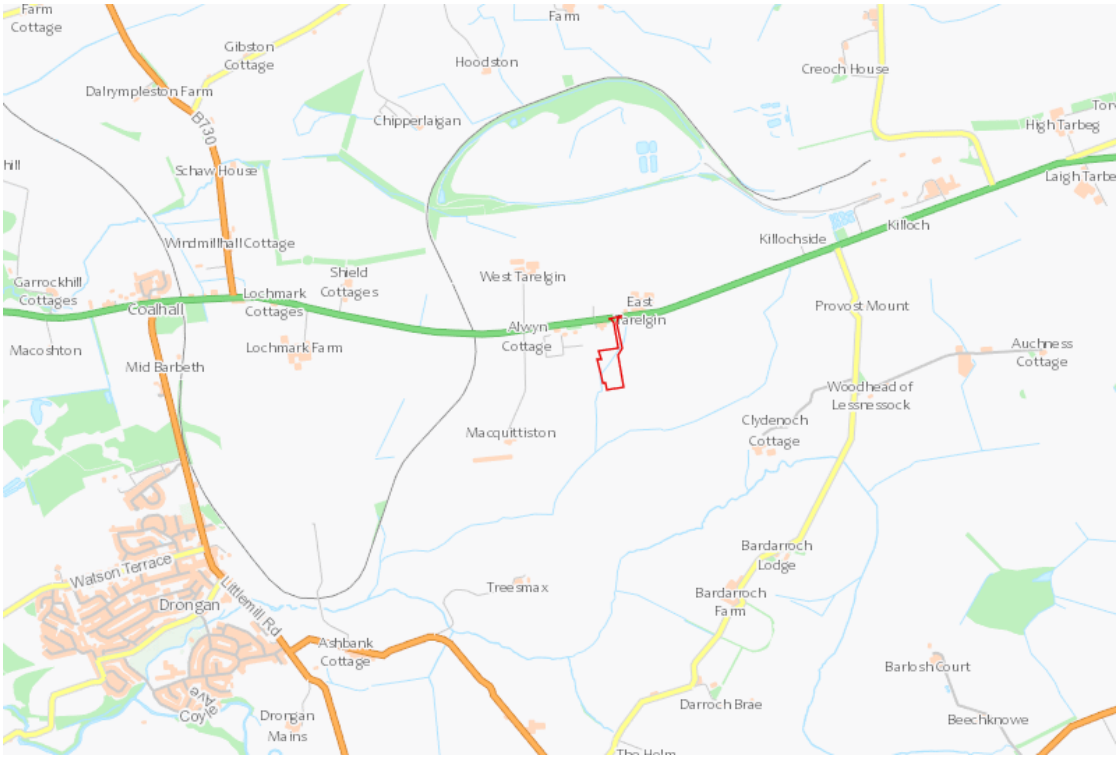
[5] CIRIA, The SuDS Manual (C753) (2015). [Online]. Available at: https://www.ciria.org/AsiCommon/Controls/BSA/Downloader.aspx (Accessed 05/10/2021)

[6] East Ayrshire Council, Local Development Plan, Policy EN11 (2020). [Online]. Available at: https://www.east-ayrshire.gov.uk/PlanningAndTheEnvironment/Development-plans/LocalAndStatutoryDevelopmentPlans/Environment.aspx

[7]East Ayrshire Council, Local Development Plan Supplementary Guidance (2018). [Online]. Available at: https://www.east-ayrshire.gov.uk/Resources/PDF/P/Planning-SG-Masterplanning.pdf (Accessed 05/10/2021)

[8] North Ayrshire Council, Ayrshire Local Plan District Local Flood Risk Management Plan (2016). [Online]. Available at: https://www.east-ayrshire.gov.uk/Resources/PDF/A/Ayrshire-Flood-Risk-Management-Plan.pdf (Accessed 05/10/2021)

Plate 1: Site Location



LiDAR data to 50 centimetre resolution indicates Site elevations are in the range of 149 to 131 metres (m) Above Ordnance Datum ('AOD'), with Site topography falling from a high point in the north to a low point in the south west.

Infiltration testing has been carried out at the Site by SFK Ltd in September 2021. The test pits indicated that underlying strata comprises clays to 1 m below ground level (bgl). The infiltration testing technical note and logs can be found in Appendix B.

1.3 Development Infrastructure

The Site Layout (as shown in Appendix A) will create a total impermeable area of 0.38 ha, detailed further in Table 1.

The proposed access tracks will comprise of permeable materials (*e.g.*, Type 2 aggregate) and will be free draining and are therefore excluded from the total impermeable areas.

Table 1: Proposed Impermeable Areas

Hardstanding Infrastructure	Total Area of Hardstanding (m^2)
48 no. Battery Units (12.9 m x 2.44 m per unit)	1,510.8
6 no. Inverter Units (6.1 m x 2.44 m per unit)	89.3
1 no. 275kV AIS and Transformer (14.8 m x 5.05 m per unit)	74.7
2 no. 2500kVA 690 V Transformers (4 m x 4 m per unit)	32
1 no. 1000kVA 400V BoP Auxiliary Transformers (3 m x 3 m per unit)	9
1 no. LV Electrical House (12.19 m x 3.45 m per unit)	42.1
2 no. Synchronous Compensator (38.6m x 20.7 m per unit)	1598

6 no. Air Blast Cooler (9.6 m x 2.4 m per unit)	138.2
2 no. Water Cooler Pump Skid (6.35 m x 2.05 m per unit)	26
2 no. lube oil pump skids (2.15 m x 1.1 m per unit)	4.7
1 no. MV Electrical House (12.19 m x 3.45 m per unit)	42.1
1 no. Comms House (12.19 m x 2.44 m per unit)	29.7
2 no. Emergency Backup Diesel Generator (5.1 m x 2.07 m per unit)	21.1
6 no. Switchgear Container (12.2 m x 2.44 m per unit)	178.6
Total Hardstanding (m²):	**3796.3**
Total Hardstanding (ha):	**0.380**

2 SURFACE WATER DISCHARGE RATES

2.1 Surface Water Discharge Options

In accordance with the SuDS Manual and Sewers for Scotland, an evaluation has been undertaken to determine the most appropriate option to dispose of surface water from the Development.

The Development will be predominantly unoccupied with ad hoc maintenance visits and will therefore have no demand for water re-use onsite.

Infiltration testing has been carried out at the Site in September 2021, with two test pits excavated as detailed in Appendix B. The infiltration test results outline that the underlying strata comprises clay based strata with both test pits failing to provide an infiltration rate and, as such, soakaways at the Site will not be feasible.

Managed discharge to a watercourse will be the most appropriate option to dispose of surface water from the Development in accordance with the SuDS Manual and Sewers for Scotland, with information within Table 2 summarising the appropriate discharge method along with rationale.

Table 2: Surface Water Discharge Methods

Disposal route	Feasible?	Reason
Re-use onsite	✘	Site will be unmanned with infrequent maintenance visits, therefore no demand for water re-use.
Infiltrate to ground	✘	Infiltration testing has been carried out at the Site with no positive infiltration rate obtained, as shown in Appendix B.
Discharge to watercourse	✓	In accordance with the drainage hierarchy surface water will be discharged to a nearby watercourse, if required.
Discharge to surface water sewer	✘	Surface water to discharge into nearby watercourse.
Discharge to combined sewer	✘	Surface water to discharge into nearby watercourse.

2.2 Greenfield Run-off rates

Greenfield runoff rates for the 0.38 ha of impermeable area, outlined in Table 1 and shown in Appendix A, have been calculated using the Interim Code of Practice for SuDS (ICP SuDS) method[9] via Micro Drainage Software with rates shown in Table 3 and Appendix C.

The application of this approach leads to the runoff from the Site to be attenuated and discharged to the greenfield runoff rate of 3.1 l/s in up to the 200-year return period, with appropriate climate change allowances.

Table 3: Site Greenfield Runoff Flow Rates (taken from Micro Drainage)

Return Period	Q (l/s)
Q_{BAR}	3.1
1	2.7
30	5.9
100	8.2
200	9.3

2.3 Return Period and Climate Change Allowance

In accordance with Map 1 of SEPA's climate change allowances[10] a 55 % allowance has been incorporated into the drainage design ('+55 % CC').

In accordance with Paragraph 2.7.1.4 of the Suds Manual and Sewers for Scotland 4th Edition, any on site storage attenuation features will be assessed with flooding and surcharging prevented in up to a 1:30 (+55 % CC) year event and flooding prevented in up to a 1:200-year (+55 % CC) event.

In accordance with Paragraph 2.6.1 and 2.6.8 of the SuDS Manual and Sewers for Scotland 4th Edition and acknowledging the electrically sensitive nature of the onsite infrastructure, it is required that the Site is assessed in up the 1:200-year (+55 % CC) return period runoff volumes.

2.4 Discharge to Watercourse

As detailed in Section 2.1, the SuDS hierarchy has been consulted, with discharge to a nearby watercourse deemed the practicable form of drainage at the Site.

Ordnance Survey ('OS') mapping indicates that there is an open land drain flowing through the Site, which is approximately 600 m in length and discharges into the Taiglum Burn approximately 1.5 km south of the Site. The watercourse is shown to be culverted for approximately 8 m at the Site.

As the Development infrastructure will pass over the route of the open land drain the watercourse will be diverted around the infrastructure in accordance with the existing topography of the surrounding grounds and the watercourse. This option will limit the requirement for culverting the watercourse for land gain and has taken cognisance of SEPA's WAT-PS-06-02: Culverting of Watercourses – Position Statement and Supporting Guidance[11].

[9] National SuDS Working Group, Interim Code of Practice for Sustainable Drainage Systems (2004). [Online]. Available at: https://www.susdrain.org/files/resources/other-guidance/nswg_icop_for_suds_0704.pdf (Accessed 05/10/2021)
[10] SEPA, Climate Change Allowances for Flood Risk Assessment in Land Use Planning (2019). [Online]. Available at: https://www.sepa.org.uk/media/426913/lups_cc1.pdf (Accessed 05/10/2021)
[11] https://www.sepa.org.uk/media/150919/wat_ps_06_02.pdf

The watercourse divergence will be conducted in accordance with SEPA guidance and the SEPA Controlled Activities Regulations ('CAR') will be consulted to obtain authorisation for the divergence.

The CAR approval process and the exact route of the divergence will be confirmed prior to construction and it is assessed that this will be sought through an appropriately worded planning condition.

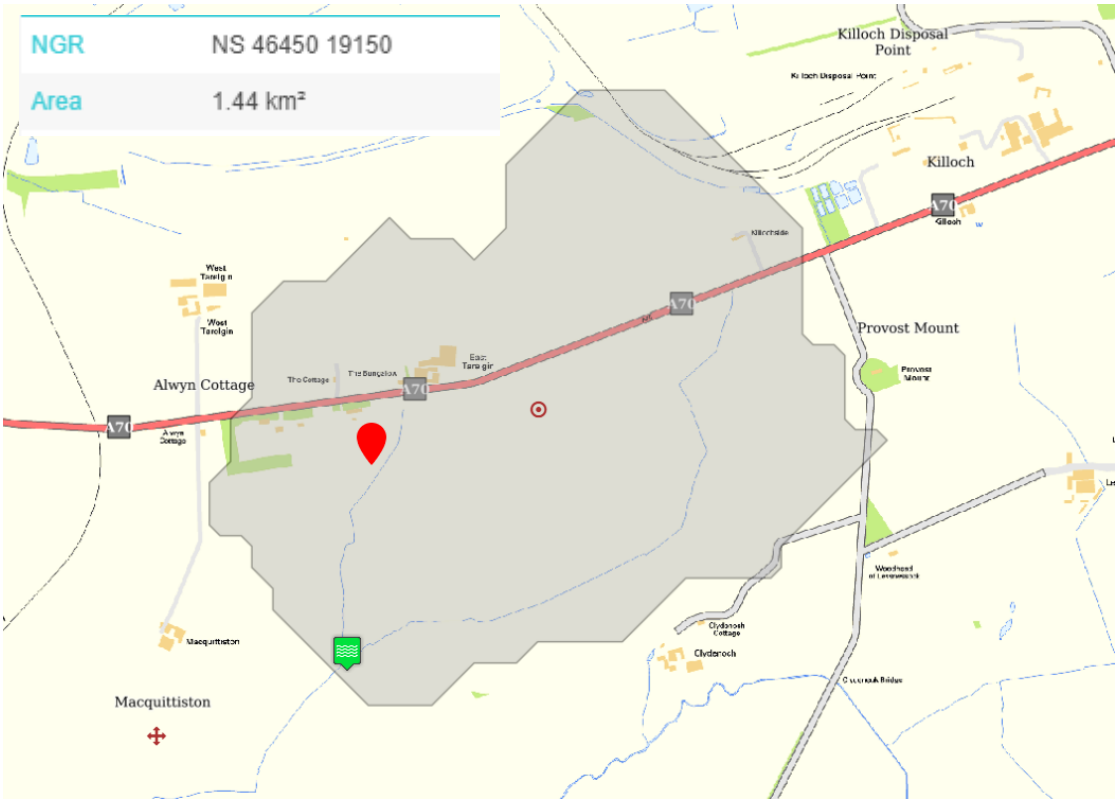
For the purpose of confirming an appropriate discharge location an approximate divergence route is provided in Plate 2.

Plate 2: Approximate Watercourse Divergence Route

The UK CEH (FEH) web map[12] indicates that the watercourse is served by a catchment of 1.44 km², as shown in Plate 3.

[12] UK Centre for Ecology and Hydrology, Flood Estimation Handbook. [Online]. Available at: https://fehweb.ceh.ac.uk/GB/map (Accessed 05/10/2021)

Plate 3: Receiving Watercourse Catchment Extents



3 SURFACE WATER DRAINAGE DESIGN

The measures outlined in the following Sections will be implemented by the Applicant's Contractor to ensure that greenfield runoff rates are maintained during the construction and operational phases of the Development. Should the drainage measures or locations differ significantly to what is outlined within this document, then the final detailed drainage design will be provided by the Contractor prior to construction.

3.1 Proposed Surface Water Drainage Scheme

The impermeable areas within the Development will be connected to an attenuation pond to the south of the Site via a piped filter drain system, as shown in Appendix D.

The outfall to the open land drain will be along the diverted route located within the extents of the existing land ownership and no third party access agreements are required for the route to the discharge point.

The outflow of the pond to the nearest watercourse will be controlled by a Hydro-Brake (or other flow control device) and discharge to the watercourse at 3.1 l/s.

In order to provide the Site with suitable attenuation of surface water in relation to the storage structure requirements the pond will comprise of the approximate dimensions in accordance with the SuDS Manual:

- Base area: 152 m²;
- Total area: 405.1 m²;
- Depth: 1.1 m; and
- Side slope: 1 in 4.

The 'worst-case' scenario event in up to a 1:200-year (+55 % CC) event is shown in Plate 4, with the designed pond able to attenuate surface water flows without surcharge.

Details of critical events by return period and cross sections of the pond can be found in Appendix E.

A layout plan of the proposed surface water network can be found in Appendix D.

Plate 4: Network 1:200-Year (+CC) Critical Storm Event (Taken from Micro Drainage)

Storm Event	Rain (mm/hr)	Time to Vol Peak (mins)	Max Water Level (m)	Max Depth (m)	Flooded Volume (m³)	Max Control (l/s)	Discharge Volume (m³)	Σ Max Outflow (l/s)	Maximum Volume (m³)	Status
1440 min Winter	6.580	1126	130.999	1.099	0.0	3.1	469.0	3.1	295.0	Flood Risk

3.2 Exceedance Design

As detailed in Section 3.1 the pond will attenuate surface water for the 1:200-year (+55%) event with no overtopping and therefore will not result in exceedance flows and surface water will be managed onsite.

During extreme rainfall events (*e.g.*, 1:1,000-year) any surface water which overtops the pond will disperse within the Site in accordance with topography.

The pond is located at lower elevations than the Development and any exceedance flows will disperse away from the Development in accordance with topography and no exceedance flows will impact the Development.

The pond is not located within close proximity to residential or commercial property and will not impact surrounding developments during any exceedance event.

3.3 Water Quality

The Development will involve the construction and operation of a Greener Grid Park involving less than 300 traffic movements per day. Table 26.2 *Pollution hazard indices for different land use classifications* of the SuDS Manual identifies that the Development has a Pollution Hazard Level of Low, taken from the 'Low Traffic Roads e.g. residential roads and general access roads, < 300 traffic movements/day' scenario.

Table 5 outlines that the Development includes land uses which have the following Simple Index Approach (SIA) indices.

Table 5: Pollution Hazard Indices for Land Use Classifications

Land use	Pollution Level Hazard	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Individual property driveways, residential car parks, low traffic roads (*e.g.* cul de sacs, home zones and general access roads) and non-residential car parking with infrequent change (e.g. schools, offices) i.e. < 300 traffic movements/day	Low	0.5	0.4	0.4

A SIA has been developed on behalf of the Construction Industry Research and Information Association (CIRIA) to support the implementation of the water quality management design methods set out in the SuDS Manual, with appropriate cross referencing to the relevant 'Design Conditions' in the tool.

The Development has been categorised as 'Commercial/Industrial roofing: Low potential for metal leaching' within the SIA tool.

The permeable / porous roads will be sufficient to effectively mitigate any suspended solids, metals and hydrocarbons held within surface water at the Development prior to discharging into the receiving watercourse under expected conditions i.e. in the absence of large hydrocarbon spills.

The SIA outputs appended to this report, and as shown in Table 6, demonstrate that the combined Pollution Mitigation Indices for the run-off area are met by the installation of a pond.

The outputs of the SIA tool indicate that the SuDS network has the required treatment potential in relation to the potential pollution hazard of the Development in the absence of significant spillages of hydrocarbons or other pollutants.

Table 6: SIA outputs for Low Pollution Hazard Level scenario

	Total Suspended Solids	**Metals**	**Hydrocarbons**
Pollution Hazard Indices	0.5	0.4	0.5
Pond	0.7	0.7	0.5

3.4 Construction Phase

The nature of hydrological incidents that could result from construction activities will be mitigated through the implementation of construction phase SuDS and the application of industry good practice as per CIRIA Guidance (C741)[13].

To prevent any sediment increase in associated runoff during the construction phase SuDS measures (*e.g.* spill kits, bunds, drip trays, plant nappies, designated refuelling points, emergency response plans) will effectively prevent sediment entering surrounding watercourses.

The implementation of such construction phase SuDS is to be confirmed with EAC prior to the construction phase.

4 FOUL WATER DRAINAGE

The Development will be unoccupied throughout the operational phase excluding ad hoc maintenance visits and will therefore not require a main connected foul water drainage solution.

The onsite welfare facility will have 'porta-loo' facilities which will comprise of waste being stored, managed and carried offsite by a licensed waste management courier.

Any foul water associated with a canteen/kitchen within the welfare facility will be stored within a waste water unit and will be managed and carried offsite by a licensed courier.

5 LONG TERM MANAGEMENT AND TIMESCALES

5.1 Long Term Management

It will be the responsibility of the Applicant's Contractor to maintain effective drainage measures and rectify drainage measures that are not functioning adequately. This will be reviewed throughout construction and post-construction. The Contractor will also have responsibility for reporting on the functionality of drainage measures during regular Safety, Health and Environmental Quality meetings.

[13] The Construction Industry Research and information Association (CIRIA), (2015), Environmental Good Practice on Site Guide (C741), CIRIA: London.

Where hardstanding areas will remain through the lifetime of the Development, the SuDS measures serving these areas will also remain in place and will be checked on a regular basis by visiting maintenance staff who will follow the propose management and maintenance programme. Should drainage measures require dredging or unblocking, this will be undertaken as soon as practicable by a local contractor.

Appendix F outlines the management and maintenance programmes for the pond.

5.2 Timescales

Drainage measures outlined within this report should be implemented as soon as practical by the Applicant's Contractor but as a minimum before the construction of any impermeable surfaces which are proposed to drain into the approved drainage system.

Measures such as drainage pipes should be installed at the same time as the excavations, or as soon as practicable thereafter.

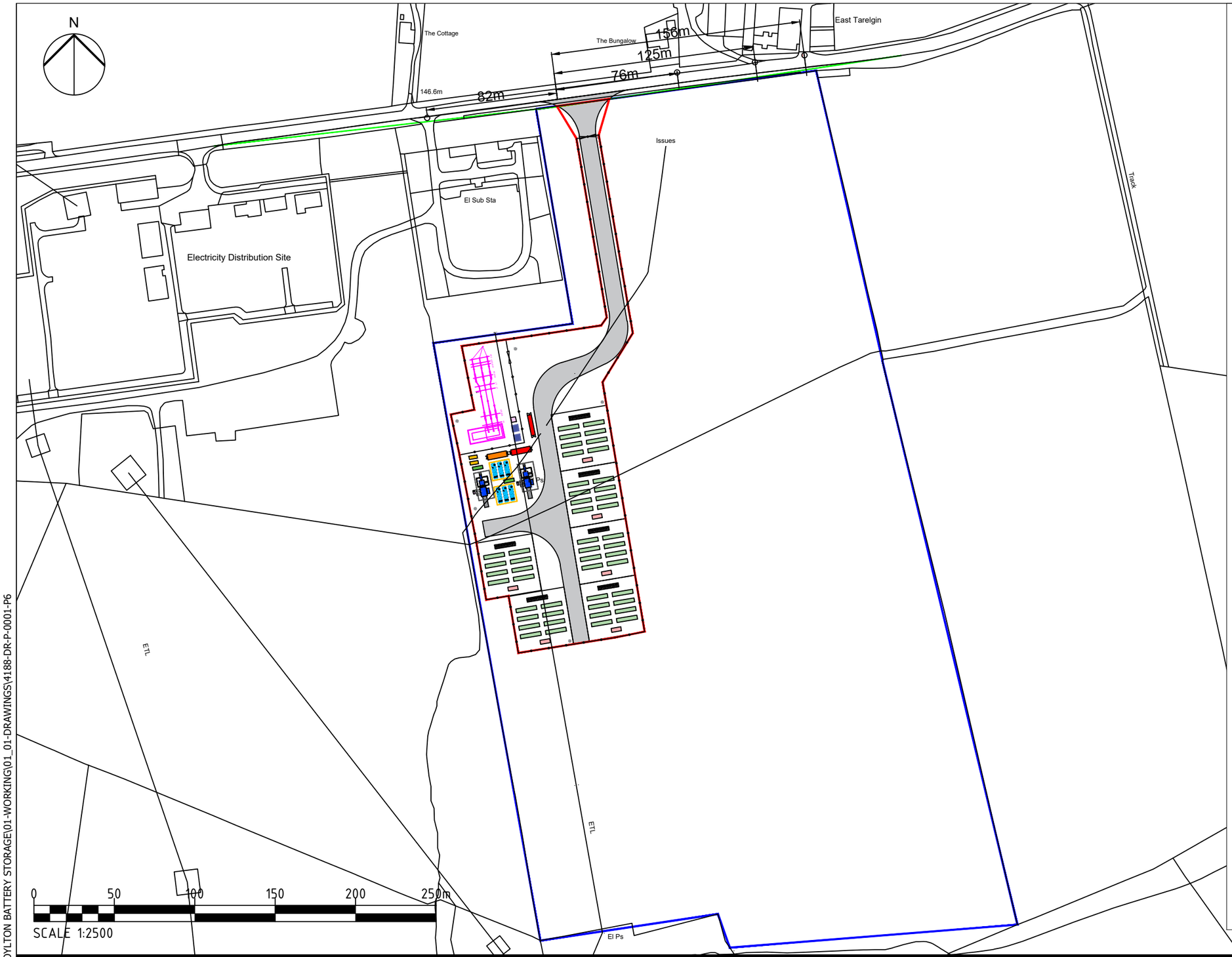
6 CONCLUSION

This report provides details on the volume of storage required to attenuate surface water runoff from the construction of the Development.

Infiltration testing has confirmed that disposal to ground is not possible and therefore surface water will discharge to a watercourse.

The proposed pond and associated piped network detailed within this report are shown to not surcharge during a 1:200-year (+55 % CC) event and discharge to the nearest watercourse at a 3.1 l/s.

APPENDIX A – SITE LAYOUT



KEY:

- SITE BOUNDARY
- LAND OWNERSHIP BOUNDARY
- FENCELINE
- 275kV AIS & TRANSFORMER (1 No. 14.8m x 5.05m x 10.8m)
- SYNC CONDENSER (WITH FLYWHEEL, PONY MOTOR AND FLYWHEEL PROTECTION ENCLOSURE) 2 No. 38.6m x 20.7m x 10.0m ACCESS ENVELOPE)
- AIR BLAST COOLER (6No. 9.6m x 2.4m x 2.5m)
- WATER COOLER PUMP SKID (2 No. 6.35m x 2.05m x 2.6m)
- LUBE OIL PUMP SKID (2 No. 2.15m x 1.1m x 1.1m)
- MV ELECTRICAL HOUSE (1 No. 12.19m x 3.45m x 2.59m)
- LV ELECTRICAL HOUSE (1 No. 12.19m x 3.45m x 2.59m)
- 2500kVA 690V TRANFORMERS (2 No. 4.0m X 4.0m x 2.9m)
- 1000kVA 400V BoP AUXILIARY TRANSFORMERS (1 No. 3.0m x 3.0m x 2.14m)
- BoP COMMS HOUSE (1No. 12.19m x 2.44m x 2.59m)
- EMERGENCY BACK UP DIESEL GENERATOR (2No. 5.1m x 2.07m x 1.6m)
- NOISE ATTENUATION FENCE (4m height)
- PALISADE FENCE (3.4m height)
- SECURITY COLUMN (5No. each 6m height)
- BATTERY (48No. 12.9m x 2.44m x 2.59m)
- INVERTER (6No. 6.1m x 2.44m x 2.59m)
- SWITCHGEAR CONTAINER (6No. 12.2m x 2.44m x 3.0m)

Project Title: COYLTON GREENER GRID PARK

Client: Statkraft

Drawing Title: PROPOSED SITE LAYOUT

Purpose of issue: PLANNING

Designed	Drawn	Checked	Approved
KB	KM	TAT	MG

Arcus Internal Project No.: 4188

Date: 01/03/21

Scale @ A3: 1:2500

Drawing Number: 4188-DR-P-0001

Rev: 6

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Plot Date : 21 October 2021 15:41:48
File Name P:\CAD\4188 COYLTON BATTERY STORAGE\01-WORKING\01_01-DRAWINGS\4188-DR-P-0001-P6

APPENDIX B – INFILTRATION TESTING TECHNICAL NOTE

MASON EVANS

Geo-Environmental Consultants

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3 Swinegate
York
Y018AJ

Our ref: P21/346/01/NH/KO

27 September 2021

LETTER REPORT ON SOAKAWAY TESTING
AYR ROAD, COYLTON

Introduction

In September 2021, we were requested by Arcus Consultancy Services Limited (the Client), to undertake an assessment of the underlying soils below the proposed energy infrastructure development on a site near Coylton, Ayrshire, in relation to infiltration rates and soakaway design.

SKF Limited were commissioned to undertake the testing that took place on the 20th September 2021, comprising 2 No. soakaway tests. The intrusive investigations are now complete, and we would offer the following comments.

Ground Conditions

Works comprised 2 No. soakaway tests undertaken in the central and southern areas of the site to calculate indicative infiltration rates at the site. Two trial pits were excavated to a depth of 1.00 mbgl by mini-digger and utilised for soakaway testing in general accordance with BRE Special Digest 365. A location plan of soakaway positions, as provided by Arcus Consultancy Services Limited is included within Appendix A.

Trial pits TP01 and TP02 both recorded topsoil to a depth of 0.1 mbgl, granular soils were encountered to 0.55 m in TP01, underlain by stiff mottled grey and orange CLAY at the base of the trial pit. Trial pit TP02 encountered stiff brown sandy gravelly CLAY to 0.5m and stiff brown grey and orange sandy gravelly CLAY to the base of the trial pit at 1.0m depth.

Groundwater strikes were not recorded within either trial pits.

Soakaway Testing

Two soakaway tests (TP01 and TP02) were undertaken. The results of the soakaway tests are indicated in Table 01 below.

TABLE 01 - Soakaway Test Results

Soakaway Test	Depth of Trial Pit (mbgl)	Water Level at Start (mbgl)	Water Level at End (mbgl)	Time Elapsed (minutes)	Infiltration Rate (m/s)
TP01	1.00	0.41	0.59	135	NO RESULT
TP02	1.00	0.43	0.45	140	NO RESULT

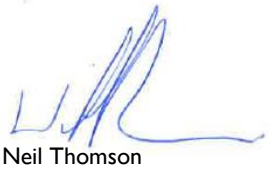
Soakaways TP01 and TP02 have not been able to have an infiltration rate calculated due to insufficient drainage within the pit. It is noted that the granular material encountered within location TP01 was recorded as 'clayey' and terminated over clay soils at 0.55m depth. It is anticipated that the high clay content within the soils is prohibiting infiltration.

Conclusions

An infiltration rate was not able to be calculated due to insufficient drainage within soakaway pits TP01 and TP02. Although a figure could not be determined at these positions, this demonstrates that the soils have a poor permeability, and soakaways would not be suitable for use within these areas.

We trust the above meets your current needs, but if there are any queries please do not hesitate to contact the undersigned.

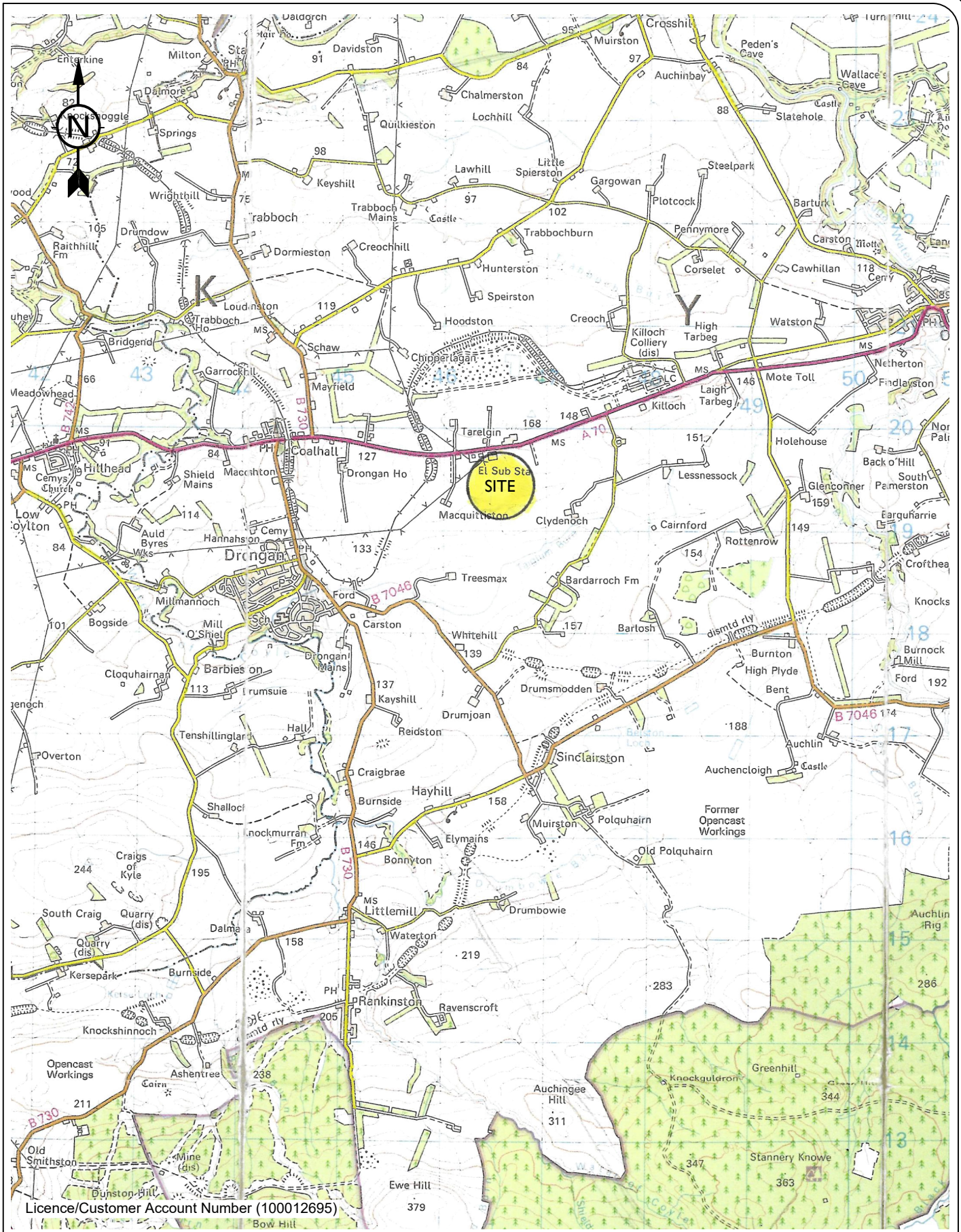
Yours faithfully
MASON EVANS PARTNERSHIP LIMITED



Neil Thomson
Director

Enc

Appendix A Drawings
Appendix B Trial Pit Logs
Appendix C Soakaway Results



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client details: ARCUS CONSULTANCY SERVICES Ltd

project title: COYLTON

drawing title: SITE LOCATION PLAN

project no:	drawing no:	revision:	date:	drawn by:	approved by:	scale:
P21/346	P21/346/LR-01/F/01		27.09.21	RC	NT	1:50,000

A4 border: 277 x 190

NOTES

Site boundary

TP01 & TP02 — Trial pits/Soakaways excavated by Mason Evans Partnership (Sep 2021)

REV	DATE	DETAILS

ARCUS CONSULTANCY SERVICES Ltd

PROJECT TITLE

COYLTON

DRAWING TITLE

TRIAL PIT
LOCATION PLAN

DRAWN BY	CHK'D BY	APP'D BY	DATE	SCALES
RC	NH	NT	27.09.21	Not to Scale

PROJECT No.	DRAWING No.	REVISION
P21/346	P21/346/LR-01/F/02	

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A4 border: 297 X 210

SKF Ltd, Constablewood Estate, Brisbane Glen, Largs
TEL: 01475 672409 or 07795 493892 FAX: 01475 672409

TRIAL PIT NO. TP01

Contract: AYR ROAD, COYLTON
Contract No: 6502
Status: FINAL

Client: MASON EVANS PARTNERSHIP
Pit Dimensions: 1.20X0.30
Co-ordinates E

Date: 20/09/2021
Equipment: VOLVO EC27C
N

Description of Strata	Legend	Depth	Level	Sampling	SPT Blows U Blows Hand Vane	Pipe
Ground Surface						
MADE GROUND: Topsoil / rough grass [GL-0.10].		0.10				
Medium dense* brown clayey SAND and GRAVEL. Gravel fine to coarse and angular to sub rounded.occasional cobbles.		0.55				
Stiff brown mottled grey and orange sandy gravelly CLAY. Gravel fire to coarse and angular to sub rounded. Occasional cobbles.		1.00				

Water Strikes
Strike: Dry Flow:

Details
Casing: Final Depth: 1.00

Stability: Stable
Shoring: None
Backfilling: Backfilled on completion
Notes: SOAKAWAY TEST CARRIED OUT

SYMBOLS KEY

B - BULK
U - UNDISTURBED
D - SMALL DISTURBED
J - JAR
V - VIAL
W - WATER
NR - NO RECOVERY
* - ESTIMATED DENSITY

SKF Ltd, Constablewood Estate, Brisbane Glen, Largs
TEL: 01475 672409 or 07795 493892 FAX: 01475 672409

TRIAL PIT NO. TP02

Contract: AYR ROAD, COYLTON
Contract No: 6502
Status: FINAL

Client: MASON EVANS PARTNERSHIP
Pit Dimensions: 1.20X0.30
Co-ordinates E

Date: 20/09/2021
Equipment: VOLVO EC27C
N

Description of Strata	Legend	Depth	Level	Sampling	SPT Blows U Blows Hand Vane	Pipe
Ground Surface						
MADE GROUND: Topsoil / rough grass [GL-0.10].		0.10				
Stiff brown sandy gravelly CLAY with occasional cobbles. Gravel the to coarse and angular to sub rounded.		0.50				
Stiff brown mottled grey and orange sandy gravelly CLAY. Gravel fire to coarse and angular to sub rounded. Occasional cobbles.		1.00				

Water Strikes
Strike: Dry Flow:

Details
Casing: Final Depth: 1.00

Stability: Stable
Shoring: None
Backfilling: Backfilled on completion
Notes: SOAKAWAY TEST CARRIED OUT

SYMBOLS KEY

B - BULK
U - UNDISTURBED
D - SMALL DISTURBED
J - JAR
V - VIAL
W - WATER
NR - NO RECOVERY
* - ESTIMATED DENSITY

RESULTS OF SOAKAGE TEST

SKF Ltd
Ground Investigation & Site Surveys

TEST PIT NO. TP01

Contract Name: AYR ROAD, COYLTON
Contract No.: 6502
Date: 20/09/2021
Weather: DRY & SUNNY SPELLS
Time to fill pit: 2 MINS
Ground Level (mAOD)
Dimensions (m)
Length: 1.20
Width: 0.30
Depth: 1.00

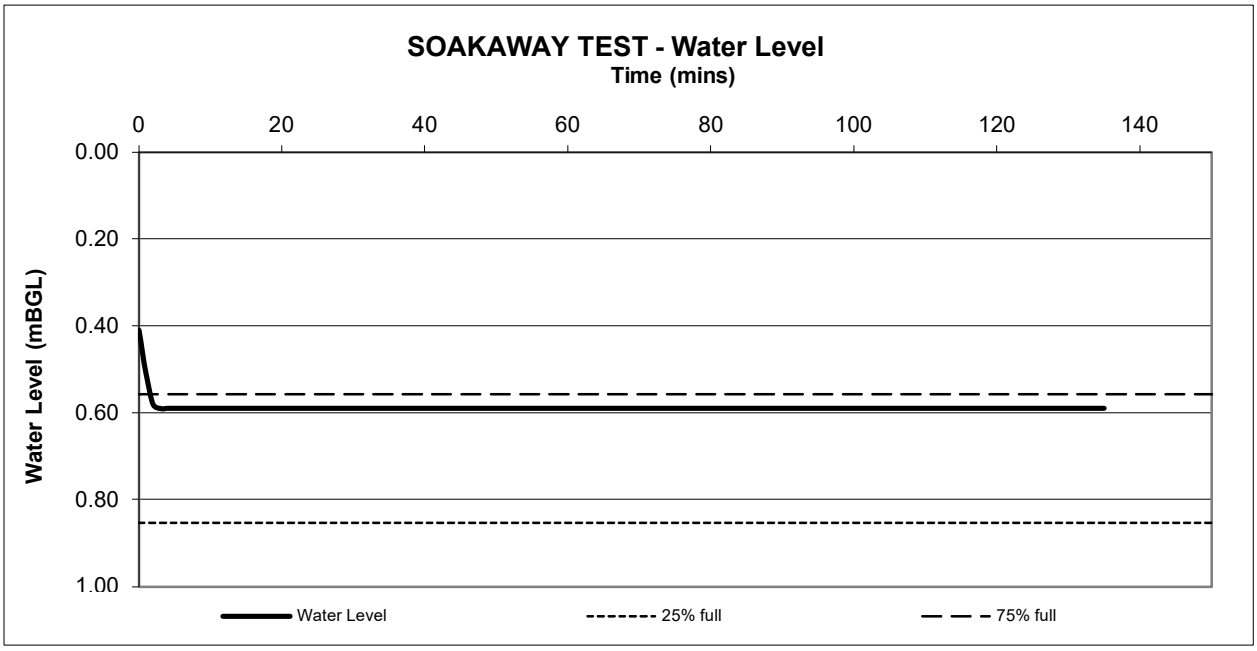
From graph (seconds)
tp75-25 =

Using formula $f = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$ from BRE Digest 365

f = soil infiltration rate
Vp75-25 = volume of outflow between 75% and 25% eff. depth
ap50 = mean surface area (pit sides to 50% eff. depth + base)
tp75-25 = time for outflow between 75% and 25% eff. depth

Time (mins)	Water Level (mBGL)	Water Level (mAOD)
0.00	0.41	
1.00	0.51	
2.00	0.58	
3.00	0.59	
4.00	0.59	
5.00	0.59	
12.00	0.59	
30.00	0.59	
50.00	0.59	
75.00	0.59	
120.00	0.59	
135.00	0.59	

INFILTRATION RATE (m/s) f = N/A



RESULTS OF SOAKAGE TEST

SKF Ltd
Ground Investigation & Site Surveys

TEST PIT NO. TP02

Contract Name: AYR ROAD, COYLTON
Contract No.: 6502
Date: 20/09/2021
Weather: DRY & SUNNY SPELLS
Time to fill pit: 2 MINS
Ground Level (mAOD)
Dimensions (m)
Length: 1.20
Width: 0.30
Depth: 1.00

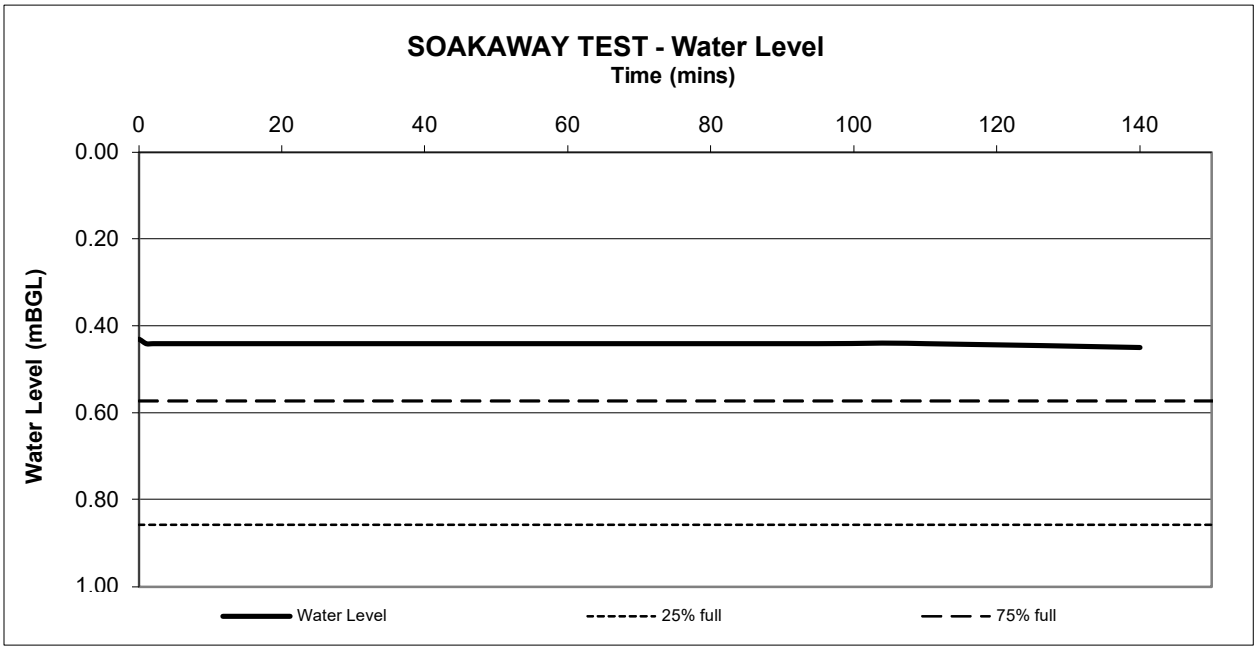
From graph (seconds)
tp75-25 =

Using formula $f = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$ from BRE Digest 365

f = soil infiltration rate
Vp75-25 = volume of outflow between 75% and 25% eff. depth
ap50 = mean surface area (pit sides to 50% eff. depth + base)
tp75-25 = time for outflow between 75% and 25% eff. depth

Time (mins)	Water Level (mBGL)	Water Level (mAOD)
0.00	0.43	
1.00	0.44	
2.00	0.44	
3.00	0.44	
4.00	0.44	
5.00	0.44	
20.00	0.44	
45.00	0.44	
65.00	0.44	
95.00	0.44	
110.00	0.44	
140.00	0.45	

INFILTRATION RATE (m/s) f = N/A



APPENDIX C – ICP RURAL RUNOFF RATES

ICP SUDS Mean Annual Flood

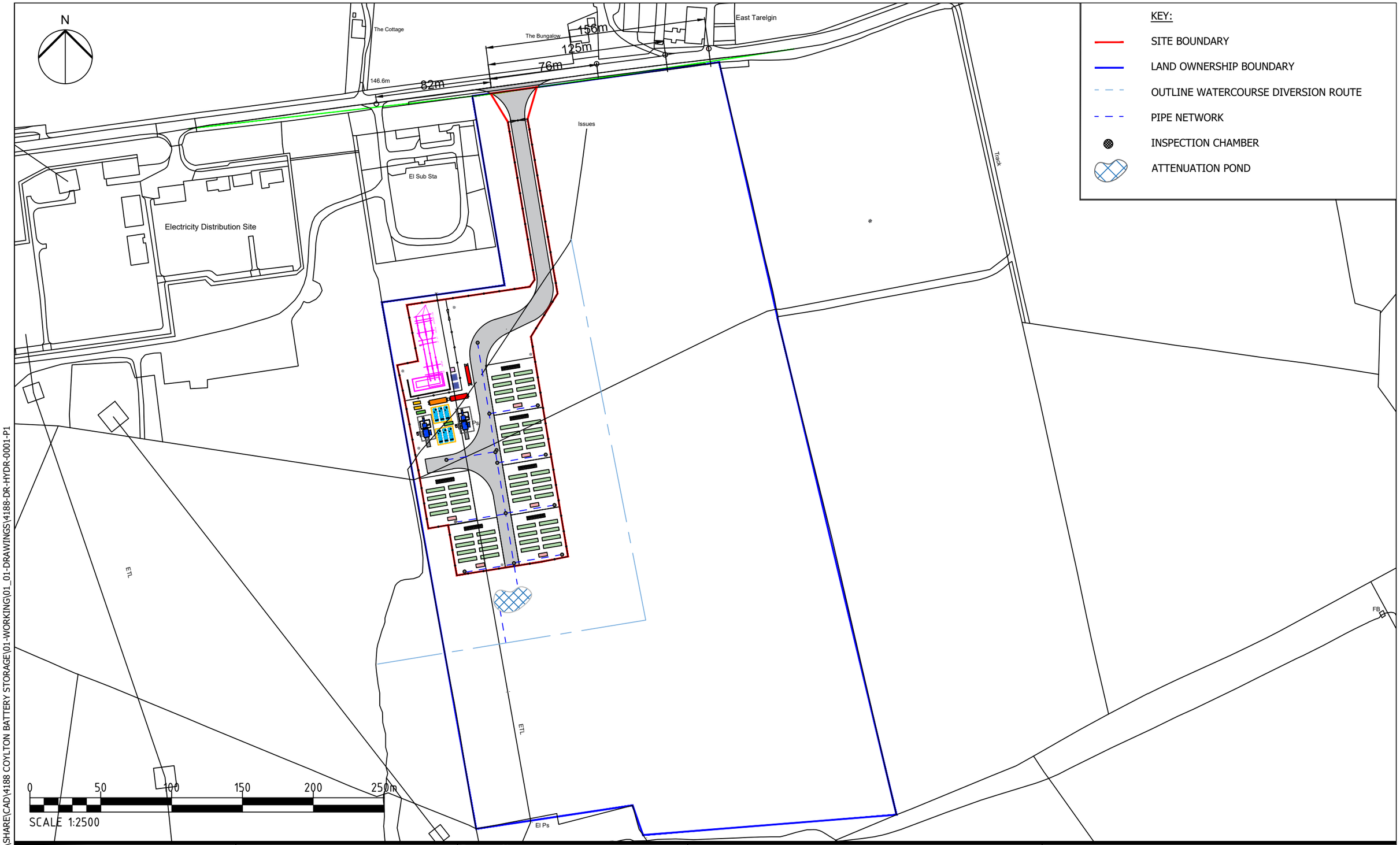
Input

Return Period (years)	200	Soil	0.450
Area (ha)	0.380	Urban	0.000
SAAR (mm)	1200	Region Number	Region 2

Results l/s

QBAR Rural	3.1
QBAR Urban	3.1
Q200 years	9.3
Q1 year	2.7
Q30 years	5.9
Q100 years	8.2

APPENDIX D – OUTLINE DRAINAGE LAYOUT



Plot Date : 13 October 2021 14:20:20
File Name :\\192.168.1.10\SHARE\CAD\4188 COYLTON BATTERY STORAGE\01-WORKING\01_01-DRAWINGS\4188-DR-HYDR-0001-P1

Project Title: COYLTON GREENER GRID PARK	Drawing Title: OUTLINE DRAINAGE LAYOUT	Purpose of issue: PLANNING			
Client: Statkraft		Designed: RD	Drawn: RD	Checked: LN	Approved: MG
		Arcus Internal Project No.: 4188		Date: 13/10/2021	
		Scale @ A3: 1:2500			

Drawing Number	Rev
4188-DR-P-0001	2

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APPENDIX E – MICRODRAINAGE MODEL OUTPUTS

Summary of Results for 200 year Return Period (+55%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	130.483	0.583	3.1	121.6	O K
30 min Summer	130.568	0.668	3.1	145.4	O K
60 min Summer	130.656	0.756	3.1	172.2	O K
120 min Summer	130.744	0.844	3.1	200.5	Flood Risk
180 min Summer	130.791	0.891	3.1	216.6	Flood Risk
240 min Summer	130.821	0.921	3.1	227.1	Flood Risk
360 min Summer	130.854	0.954	3.1	238.9	Flood Risk
480 min Summer	130.868	0.968	3.1	244.1	Flood Risk
600 min Summer	130.872	0.972	3.1	245.5	Flood Risk
720 min Summer	130.870	0.970	3.1	244.9	Flood Risk
960 min Summer	130.883	0.983	3.1	249.8	Flood Risk
1440 min Summer	130.894	0.994	3.1	253.7	Flood Risk
2160 min Summer	130.893	0.993	3.1	253.5	Flood Risk
2880 min Summer	130.882	0.982	3.1	249.5	Flood Risk
4320 min Summer	130.812	0.912	3.1	224.0	Flood Risk
5760 min Summer	130.736	0.836	3.1	198.0	Flood Risk
7200 min Summer	130.656	0.756	3.1	172.1	O K
8640 min Summer	130.553	0.653	3.1	141.1	O K
10080 min Summer	130.447	0.547	3.1	112.0	O K
15 min Winter	130.537	0.637	3.1	136.6	O K
30 min Winter	130.628	0.728	3.1	163.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	175.471	0.0	124.1	26
30 min Summer	105.682	0.0	149.4	41
60 min Summer	63.649	0.0	181.0	70
120 min Summer	38.334	0.0	218.1	128
180 min Summer	28.496	0.0	243.1	188
240 min Summer	23.088	0.0	262.7	246
360 min Summer	17.162	0.0	292.8	364
480 min Summer	13.905	0.0	316.3	482
600 min Summer	11.811	0.0	335.8	600
720 min Summer	10.336	0.0	352.5	674
960 min Summer	8.570	0.0	389.4	796
1440 min Summer	6.580	0.0	444.6	1060
2160 min Summer	5.053	0.0	518.1	1476
2880 min Summer	4.189	0.0	572.7	1904
4320 min Summer	3.116	0.0	638.8	2728
5760 min Summer	2.526	0.0	691.1	3536
7200 min Summer	2.147	0.0	734.1	4336
8640 min Summer	1.880	0.0	771.1	5104
10080 min Summer	1.680	0.0	803.7	5752
15 min Winter	175.471	0.0	139.0	26
30 min Winter	105.682	0.0	167.2	40

Summary of Results for 200 year Return Period (+55%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	130.724	0.824	3.1	193.8	Flood Risk
120 min Winter	130.819	0.919	3.1	226.6	Flood Risk
180 min Winter	130.872	0.972	3.1	245.7	Flood Risk
240 min Winter	130.906	1.006	3.1	258.5	Flood Risk
360 min Winter	130.946	1.046	3.1	273.9	Flood Risk
480 min Winter	130.966	1.066	3.1	281.8	Flood Risk
600 min Winter	130.975	1.075	3.1	285.4	Flood Risk
720 min Winter	130.978	1.078	3.1	286.3	Flood Risk
960 min Winter	130.992	1.092	3.1	292.0	Flood Risk
1440 min Winter	130.999	1.099	3.1	295.0	Flood Risk
2160 min Winter	130.990	1.090	3.1	291.0	Flood Risk
2880 min Winter	130.965	1.065	3.1	281.1	Flood Risk
4320 min Winter	130.855	0.955	3.1	239.6	Flood Risk
5760 min Winter	130.736	0.836	3.1	197.8	Flood Risk
7200 min Winter	130.590	0.690	3.1	151.9	O K
8640 min Winter	130.400	0.500	3.1	100.0	O K
10080 min Winter	130.263	0.363	3.1	67.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	63.649	0.0	202.7	70
120 min Winter	38.334	0.0	244.2	126
180 min Winter	28.496	0.0	272.3	184
240 min Winter	23.088	0.0	294.2	242
360 min Winter	17.162	0.0	327.9	358
480 min Winter	13.905	0.0	354.2	470
600 min Winter	11.811	0.0	375.9	582
720 min Winter	10.336	0.0	394.6	692
960 min Winter	8.570	0.0	435.3	898
1440 min Winter	6.580	0.0	469.0	1126
2160 min Winter	5.053	0.0	580.3	1600
2880 min Winter	4.189	0.0	641.4	2056
4320 min Winter	3.116	0.0	715.3	2948
5760 min Winter	2.526	0.0	774.1	3816
7200 min Winter	2.147	0.0	822.2	4688
8640 min Winter	1.880	0.0	863.7	5200
10080 min Winter	1.680	0.0	900.3	5840

Rainfall Details

Rainfall Model	FEH
Return Period (years)	200
Site Location	GB 246950 619350 NS 46950 19350
C (1km)	-0.022
D1 (1km)	0.385
D2 (1km)	0.465
D3 (1km)	0.387
E (1km)	0.254
F (1km)	2.370
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+55

Time Area Diagram

Total Area (ha) 0.380

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.127	4	8	0.127	8	12	0.127

Model Details

Storage is Online Cover Level (m) 131.000

Tank or Pond Structure

Invert Level (m) 129.900

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	152.0	1.100	405.1

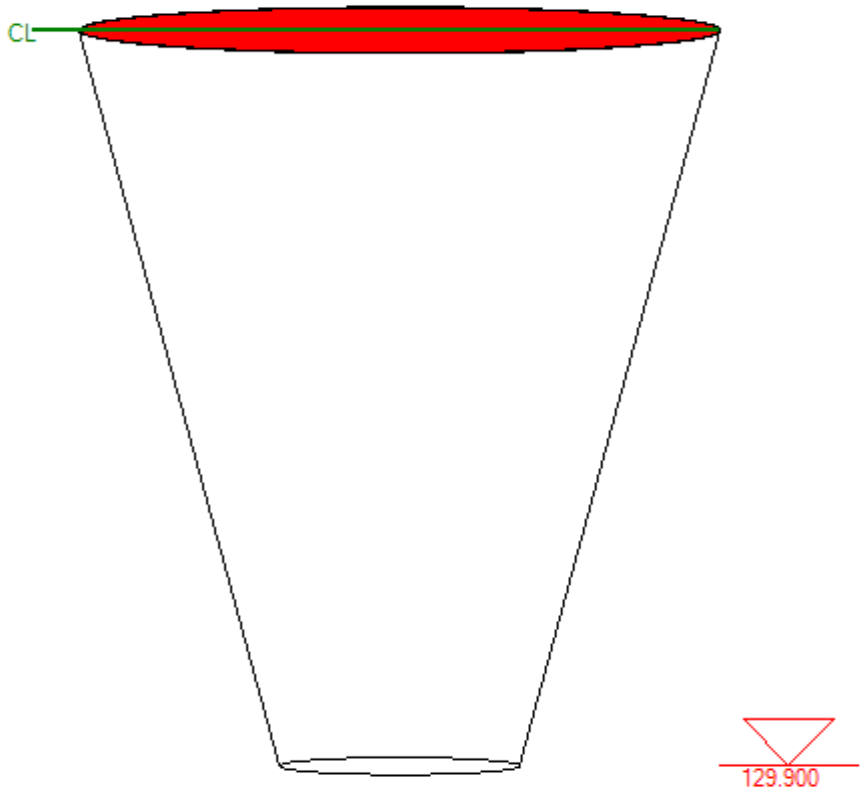
Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0082-3100-1100-3100
Design Head (m)	1.100
Design Flow (l/s)	3.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	82
Invert Level (m)	129.900
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.100	3.1
Flush-Flo™	0.332	3.1
Kick-Flo®	0.682	2.5
Mean Flow over Head Range	-	2.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake Optimum® as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.4	1.200	3.2	3.000	4.9	7.000	7.3
0.200	2.9	1.400	3.4	3.500	5.3	7.500	7.6
0.300	3.1	1.600	3.7	4.000	5.6	8.000	7.8
0.400	3.1	1.800	3.9	4.500	5.9	8.500	8.0
0.500	3.0	2.000	4.1	5.000	6.2	9.000	8.2
0.600	2.8	2.200	4.2	5.500	6.5	9.500	8.5
0.800	2.7	2.400	4.4	6.000	6.8		
1.000	3.0	2.600	4.6	6.500	7.1		



Invert Level of Structure (m): 129.900

APPENDIX F – POND MAINTENANCE SCHEDULE

Long-term Maintenance Schedule for the Attenuation Pond[1]

Maintenance schedule	**Required action**	**Typical frequency**
Regular Maintenance	Remove litter and debris	Monthly (or as required)
	Cut the grass (in public areas)	Monthly (during growing season)
	Cut meadow grass	Half yearly (spring, before nesting season, and autumn)
	Inspect marginal and bankside vegetation and remove nuisance plants for first 3 years	Monthly (as start, then as required)
	Inspect inlets, outlets, bankside, structures, pipework etc for evidence of blockage and/or physical damage	Monthly
	Inspect water body for signs of poor water quality	(Monthly (May – October)
	Inspect silt accumulation rates in any forebay and in main body of the pond and establish appropriate removal frequencies; undertake contamination testing on some build up has occurred, to inform management and disposal options	Half yearly
	Checky any mechanical devices (e.g., penstocks)	Half yearly
	Hand cut submerged and emergent aquatic plants (at minimum of 0.1 m above pond base; include max 25% of pond surface)	Annually
	Remove 25% of bank vegetation from water's edge to a minimum of 1 m above water level	Annually
	Tidy all dead growth (Scrub clearance) before start of growing season (Note: tree maintenance usually part of overall landscape management contract)	Annually
	Remove sediment from any forebay	Every 1-5 years, or as required
	Remove sediment and planting from one quadrant of the main body of ponds without sediment forebays	Every 5 years, or as required
Occasional Maintenance	Remove sediment from the main body of big ponds when pool volume is reduced by 20%	With effective pre-treatment, this will only be required rarely, e.g., every 25-50 years
Remedial actions	Repair erosion or other damage	As required
	Replate where necessary	As required
	Aerate pond when signs of eutrophication are detected	As required
	Realign rip-rap or repair other damage	As required
	Repair/rehabilitate inlets, outlet, overflows and vents	As required

[1] Based on Table 23.1 - Operation and maintenance requirements for attenuation pond and wetlands of the SuDS Manual