Flood Risk Statement and Drainage Impact Assessment

Drum Farm Battery Energy Storage System

Ref	04872-3681365

Revision History

Issue	Date	Name	Latest changes
01	14.04.22	Daniel Cole	First created
02	05.05.22	Daniel Cole	Two minor corrections to text

Contents

1 Overview

1.1 Introduction

Drum Farm is a proposed battery-based energy storage system located just east of the town of Keith, Moray, Scotland.

This report sets out the flood risk screening and surface water management plan for the proposed Drum Farm battery energy storage system, which will house battery enclosures along with associated infrastructure and electrical equipment.

The battery storage system comprises battery enclosures with associated power conversion systems, transformers, a switchhouse and grid compliance equipment. All electrical equipment will be set on concrete foundations.

Drawing 04872-RES-LAY-DR-PT-001 included in Appendix A, shows the proposed project layout. The compound area within the fence measures 0.67 hectares, the total area enclosed by the red line boundary measures 2.06 hectares.

Relevant Moray Council compliance checklists and certificates are included in Appendix E.

2 Relevant Guidance and Legislation Requirements

This report uses best practice and conforms with the requirements of the relevant regulatory authorities.

The key legislation and guidance adhered to are as follows:

- The EU Water Framework Directive (2000/60/EC).
- Scottish Planning Policy.
- The Water Environment (Controlled Activities) (Scotland) Regulations 2011.
- SEPA Pollution Prevention Guidance Notes (PPPGs).
- Engineering in the Water Environment, Good Practice Guide, Temporary Construction Methods, First Edition, March 2009.
- Sewers for Scotland 3rd Edition.
- Moray Council Flood Risk and Drainage Impact Assessment for New Developments.
- Supplementary Guidance on Flood Risk and Drainage Impact Assessment for New Developments
- The Sustainable Urban Drainage Scottish Working Party (SUDSWP) Water Assessment and Drainage Assessment Guide.
- Environmental Good Practice on Site, CIRIA C692, 3rd Edition.
- Control of Water Pollution on Construction Sites, CIRIA C532.
- The SUDS Manual 2015. CIRIA C753.
- British Geological Survey (BGS) Maps.

3 Existing Information

3.1 Site Location

The site is located approx. 200m to the east of Keith Substation, which itself abuts the east of the town of Keith, Scotland. Refer to Appendix A for the Site Location Plan.

Access will be taken off Drum Road to the north of the site. The access track to the site will be formed through upgrading an existing core path that runs southwards from Drum Road and abuts the site's north-western boundary.

3.2 Existing Land Use and Topography

A walkover survey of the site has been undertaken, and a topographical survey of the site extents carried out to confirm the existing land use and topography. The existing site land use is for agricultural purposes, confirmed by the landowner during a site walkover.

Ground levels on site falls from approx. 154.30m AOD in the northwest to 149.5m AOD in the southeast. Levels fall at a rough gradient of 1:40; the gradient flattens approaching the northwest boundary.

3.3 Ground Conditions

The BGS map indicates that the site is overlain by superficial deposits of glacial till, underlain by a limestone bedrock. There are no publicly available borehole records near to the site.

3.4 Existing Hydrology / Drainage

The site appears to drain via overland flow into the Burn of Drum, which runs approx. 240m to the southeast. The Burn of Drum lies within the River Deveron catchment of the Scotland river basin district. SEPA classify the Burn of Drum as a 'good' quality surface water body.

SEPA mapping classify the quality of groundwater underneath and around site as 'good'. The site does not fall in a 'drinking water protected area' as defined by SEPA.

A site visit was conducted the day after a rainstorm event. Some water ponding was observed in the adjacent fields to site, indicating the ground on site has limited infiltration potential.

In discussions during a site visit, the landowner stated there are no land drains present on site. No land drains were found in a topographic survey (including buried services) undertaken in February 2022.

As per the Moray Council planning response shown in Appendix C, SEPA require investigation of a potential culverted watercourse under the core path proposed for use as an access track.

A topographic survey was commissioned for the proposed development, including in its extents a section Drum Road, the core path stretch proposed for use as access track, and the extents of field required for the proposed development. The topographic survey finds no evidence of a culvert at either point where watercourses are shown to adjoin the core path on OS mapping. The topographic survey is included in Appendix D.

4 Flood Risk Screening

4.1 Overview

The proposed development is deemed not at risk from flooding as set out in this flood screening section.

4.2 Flooding from Fluvial Sources and Surface Water

Figure 1 below depicts the SEPA flood risk map, with the proposed site red line boundary overlaid. As can be observed in Figure 1 the site does not lie in an area at risk of flooding from fluvial sources (blue zones), or surface water (purple zones).

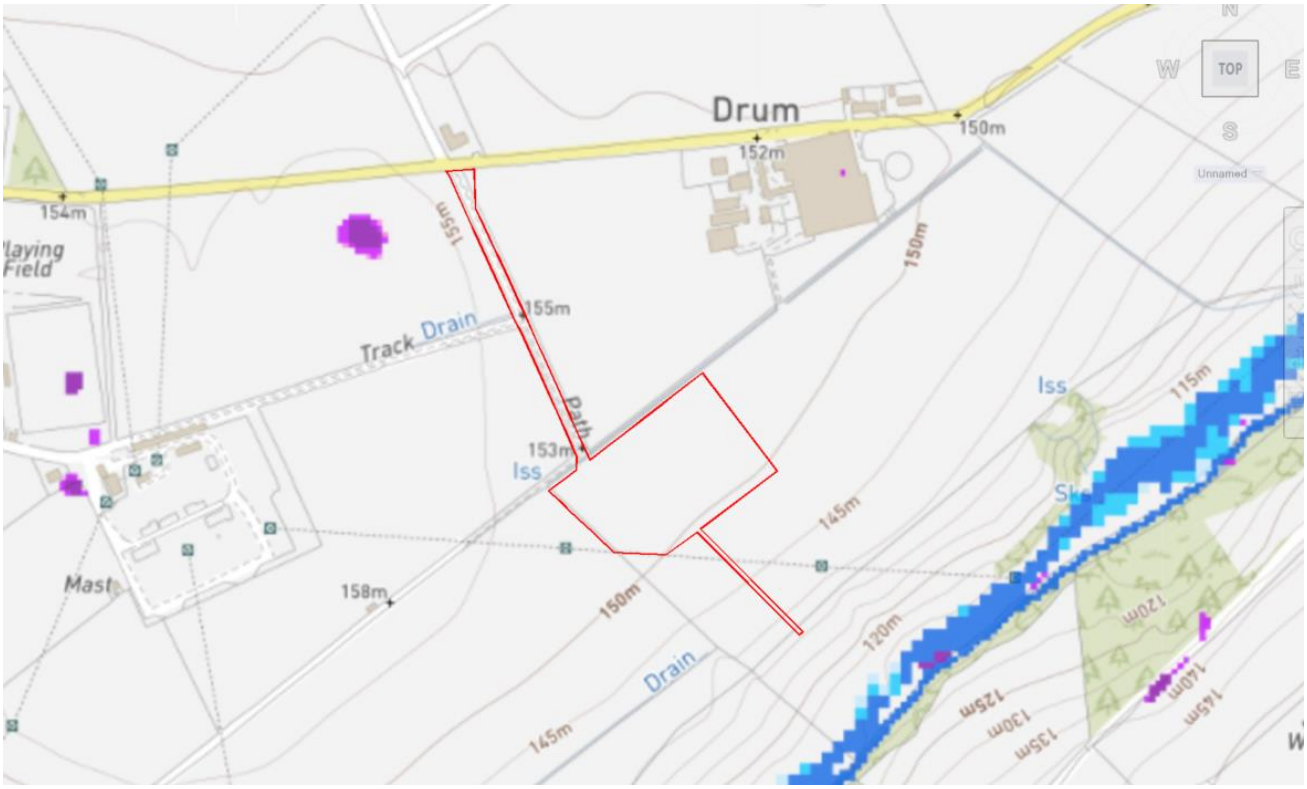


Figure 1 - Excerpt from SEPA surface water and fluvial flood risk map, with proposed site boundary overlaid.

4.3 Flooding from Groundwater

SEPA flood risk mapping shows the proposed development site does not lie in an area at risk of groundwater flooding.

4.4 Flooding from Tidal or Sea Flooding

The development site is located outside of any area of tidal influence based on its ground elevation above ordnance datum of >100m AOD. The proposed development is therefore not considered at risk of tidal or sea flooding.

4.5 Flooding from Overland Sheet Flow

Levels within the site area are proposed to fall to the southeast at a gradient of 1 - 2%, ensuring flooding from sheet flow will not develop on the site.

The proposed development site sits near to the ridge of a local high point (roughly positioned at the Keith substation location). Therefore, land that could be defined as upslope of the site is limited. Furthermore, the upslope boundary of the proposed development site abuts a field boundary along which runs a drainage ditch. Any upslope overland sheet flows would therefore be intercepted by this ditch.

Given the above, the development is not considered at risk of flooding from overland sheet flow.

4.6 Flooding from Sewers

There are no surface water sewers or highway drains in the vicinity of the development. Therefore, the development is not considered at risk of flooding from sewers.

4.7 Flooding as a Result of the Development

The existing flow regime will remain unchanged as a result of the development as set out in Sections 5 and 6 of this report. Therefore, the development is not considered to exacerbate the flood risk of the surrounding area.

4.8 Historic Flooding

There are no known records of historic flooding to the knowledge of the Landowner.

5 Drainage Design Options

5.1 Foul Drainage

There will be no permanent foul drainage from the proposed development.

Any foul drainage from the temporary welfare facilities will be self-contained and disposed off-site appropriately.

5.2 Surface Water Drainage Discharge Options

5.2.1 General

As per Moray Council's Planning Policy EP5 as described in 'Flood Risk and Drainage Impact Assessment for New Developments', the proposed development should be drained by a sustainable urban drainage system that contributes to enhancing blue and green networks. As such, the SUDS Hierarchy as enclosed in Building Regulations Part H will be applied, and adequate infiltration testing to BRE 365 Digest will be undertaken to determine the viability of an infiltration-based drainage solution.

5.2.2 Rainwater Re-Use

Rainwater re-use is not applicable to this project; there are no facilities within the proposed development that have a demand for water.

5.2.3 Infiltration

Based on the hierarchy identified in Section 5.2.1, the preferred method of surface water discharge is via infiltration to the ground. However, the ground on site is not anticipated to support drainage by infiltration due to the following:

- Standing water observed on ground during site visit following rainfall event the previous day;
- Existing drainage systems in place in fields around site comprise field ditch, indicating the need to convey overland flows during storm events.

5.2.4 Attenuate Rainwater in Ponds for Gradual Release

Refer to the infrastructure layout provided in Appendix A for details of the drainage layout.

If infiltration testing shows an infiltration-based drainage solution is not possible, the next preference in the SUDS Hierarchy is to attenuate flows in an on-site basin, discharging from site at a rate that does not exceed that of pre-existing greenfield conditions. Due to the low probability of infiltration capacity on site, it is assumed for design purposes that attenuation basin is the highest option on the SUDS Hierarchy that is viable for the proposed development site.

The surface water drainage will be designed in accordance with the guidance in Section 2, and Section 5.2.1. Flows will be restricted to Qbar and the attenuation basin will be sized to contain the 1 in 200 rainfall event plus a 35% allowance for climate change.

The preferred discharge point for the restricted flow will be to the Burn of Drum to the southeast of site, therefore matching existing drainage routes.

In the preliminary consultation with Moray Council, council preference was noted for flows to be discharged to the burn via overland flow. In discussions regarding drainage, the landowner expressed a preference for water to be piped to the burn instead. The proposed development site sits in a field with high quality grass; concentrating overland flows to a single discharge point will likely compromise this quality for an area of grass due to water over-exposure.

To recognise the interests of both parties, a compromise is proposed where discharged water is conveyed in a pipe to the south-eastern edge of the field enclosing the proposed development site. At this border, water is discharged from the pipe to the burn via an overland breakout, passing over a single field of steeper gradient and of low-quality grass.

6 Development Proposal

6.1 Site Preparation

As part of site preparation, existing topsoil on site will be scraped off and set aside for re-use in the landscaping scheme. For the proposed areas of permanent hardstanding on site (inside the compound), the preferred surfacing will comprise permeable Type 3 stone. For the proposed tracks, and areas of temporary hardstanding, the preferred surfacing will comprise Type 1 stone.

The compound and tracks will facilitate construction traffic and allow safe installation of the electrical infrastructure.

The compound and surrounding temporary hardstanding area will be graded appropriately in line with existing falls, ensuring a fall within the compound does not exceed 2%.

6.2 Management of Surface Water Flows

6.2.1 Post Development Surface Water Runoff

The proposed compound on the development will result in a permanent hardstanding area of in the order of 0.67 ha. To ensure adequate allowances are made at this stage in the project, it is assumed for storage calculations that permanent hardstanding will comprise asphalt, entirely impermeable with a runoff coefficient of 1.

During construction phase, it is expected that Type 3 stone will be used to create all temporary hardstanding areas. During operational phase, the Type 3 stone will be covered by 100mm of topsoil. On this basis, post development runoff characteristics for the temporary hardstanding areas will be considered equivalent to greenfield conditions.

6.2.2 Proposed Attenuation Basin Design

It is proposed to use an attenuation basin to limit off-site surface water runoff from the permanent hardstanding areas on site. Ground levels on site fall to the southeast. The proposed attenuation basin extends along the site's south-eastern boundary, such that surface water in the compound area can be conveyed into the basin naturally via overland flow. This design approach minimises the requirement for constructed drainage infrastructure, reducing the overall environmental impact of the development.

The Drum Farm Infrastructure Plan (included in Appendix A) shows the proposed attenuation basin design. The basin has been designed with a plan area and depth sufficient to accommodate storm flows generated on site during a 200-year event including an additional 35% allowance for climate change. To mitigate ground stability risk and slip / trip risk, basin slopes are limited to 1:3.

Attenuation calculations are summarised in Section 7 and shown in Appendix B. Interception losses, such as those provided by on-site topsoil / grass, hedgerows, and vegetation, are neglected from these calculations as a conservative measure.

6.2.3 Water Quality and Treatment

In line with the requirements noted in the Moray council supplementary guidance document listed in Section 2, a Simple Index Approach is undertaken to ensure the proposed drainage strategy provides adequate water quality treatment, as per Section 26.7.1 of the SUDS Manual 2015 (CIRIA C753).

As a conservative approach, the proposed development is considered a high pollution hazard level based on land use definitions provided in Table 26.2 of the SUDS Manual. The corresponding pollution hazard indices are denoted in Table 1.

Surface water within the proposed development will receive minimum three stages of treatment before being discharged overland to the Burn of Drum. The three main stages are listed below:

1. Filtration of water through grass and hedgerow upstream of basin; mitigation indices for swale: TSS = 0.5, metals = 0.6, hydrocarbons = 0.6.
2. Settlement in attenuation / infiltration basin; mitigation indices for detention basin: TSS = 0.5, metals = 0.5, hydrocarbons = 0.6.
3. Filtration / detention of water through check dams installed in overland breakout; mitigation indices for filter strip: TSS = 0.4, metals = 0.4, hydrocarbons = 0.5.

The treatment provided in stage 1 is equal to that provided in a swale as in both cases filtration of the surface water occurs as it passes through grass.

Table 1 below demonstrates how the pollution hazard index for each contaminant is satisfied by the three stages of water treatment provided as part of the proposed drainage strategy.

Table 1 - Simple Index Calculation

Contaminant Type	Stage 1	Stage 2	Stage 3	Total SUDS Mitigation Index	Pollution Hazard Index	Utilisation
TSS	0.5	0.5(0.5)=0.25	0.5(0.4)=0.2	0.95	0.8	1.19
Metals	0.6	0.5(0.5)=0.25	0.5(0.4)=0.2	1.05	0.8	1.31
Hydrocarbons	0.6	0.5(0.6)=0.3	0.5(0.5)=0.25	1.15	0.9	1.28

During construction phase, temporary silts fences will be installed, providing an additional treatment stage of water filtration.

6.2.4 Exceedance Flow Design

In accordance with CIRIA Report 753, an exceedance route should be considered as part of the SUDS design.

The exceedance route will remain as per the existing scenario, i.e., over vegetation down towards the Burn of Drum southeast of site.

To mitigate flood risk in the event of an exceedance, the attenuation basin will be located downslope of the energy storage facility. The resultant site levels will be such that surface water from any extreme events will flow over the banks of the attenuation basin away from the energy storage facility and then downslope overland away from the site. The edges of the attenuation basin will be vegetated to reduce the risk of scour during an extreme event.

6.2.5 SUDS Layout and Typical Details

Refer to Appendix A for indicative details and layout of the SUDS proposed across the site.

7 Hydraulic Assessment

A preliminary runoff and attenuation calculation for compound and temporary hardstanding has been undertaken using a HR Wallingford online design tool available from:

https://www.uksuds.com/tools/greenfield-runoff-rate-estimation

The inputs taken have been assumed as "worst case" and as such has determined the maximum drainage component extents required for the project. This includes assuming all permanent infrastructure (other than the access track) has an asphalt surface, and that drainage by infiltration is not possible.

A detailed drainage design will be performed following the ground investigation and compound earthing design (to determine surface finishes).

All methods and inputs are taken in accordance with the relevant guidance documents provided in Section 2.

7.1 Greenfield Peak Runoff Rates from Site

Current and future greenfield runoff rates for the development have been estimated using the IH124 Method. Using the mapping software within HR Wallingford Design Tool, the site-specific parameters have been established:

- Standard average annual rainfall between 1941 – 1970 (SAAR): 870mm;
- Standard percentage run-off: 47%;
- Total drained area: 1.01ha;
- M5-60 rainfall depth: 17mm;
- Ratio M5-60 / M5-2day: 0.2.

Total drained area is defined as the catchment area for the attenuation basin, which comprises the area inside the compound (0.67ha) and the temporary hardstanding area surrounding the compound (0.34ha). The extents of both areas are shown on the Infrastructure Layout in Appendix A, where each area is defined by a hatch pattern.

Refer to Appendix B for the Qbar design tool calculation summary.

The peak runoff rate calculated for a Qbar (1 in 2.3) rainfall event is 6.3 l/s. It is proposed to match this discharge rate through use of a flow control device installed in a manhole positioned immediately downstream of the basin.

7.2 Attenuation Storage Required Post Development

The surface water storage volume estimation tool uses a storage assessment method developed by HR Wallingford based on correlations between storage requirements and hydrological and hydraulic characteristics of sites.

Attenuation storage will be provided to accommodate the peak runoff rate calculated up to the critical 1 in 200 storm plus a 35% allowance for climate change.

Refer to Appendix B for the storage volume calculation summary.

As per the calculation described in Section 7.1, allowable discharge from the basin is set to the calculated greenfield runoff rate of 6.3 l/s.

Due to site levels and basin positioning as described in Section 6.2.2, the catchment area for the basin is defined as the compound area and surrounding temporary hardstanding area, 1.01ha. In the permanent case, the area defined as temporary hardstanding will be grassed, comprising a layer of topsoil minimum 100mm in thickness. This area is therefore considered a permeable. For these permeable areas, a runoff coefficient of 0.4 is applied, based on having a grassed surface, a silty subsoil, and a gradient of 5%. In the absence of confirmed soil data at this stage, each of these assumed permeable area characteristics are worst case, providing a conservatively high coefficient.

The attention volume calculated based on the above criteria is approximately 761m^3. 3D modelling has been carried out to prove this volume can be accommodated within the site boundary. The attenuation volume should be considered a maximum volume, this assumes that all permanent infrastructure (other than the access track) has an asphalt surface and that drainage by infiltration methods is not possible.

As per the Moray Council planning response shown in Appendix C, it is required that following a critical 1 in 30 year event (including 35% climate change), any proposed attenuation basin is able to empty within 24 hours. From the storage volume calculation included in Appendix; it can be observed that for the 30 year return period calculation, a maximum attenuation volume of 467m^3 is required. Based on an outfall rate of 6.3 l/s, 465m^3 would take 20.5 hours to drain completely.

8 Operation and Maintenance Requirements

All surface water drainage and pollution control features associated with the site will remain private and will be maintained by the site operator.

The following section outlines the proposed maintenance for the various aspects of the drainage system. If necessary, these outline maintenance proposals will be refined when the site is operational to suit specific conditions.

A maintenance record log will be maintained for all maintenance work carried out. Where problems persist on each six-monthly inspection, advice will be sought from the SUDS designer on an alternative drainage solution.

8.1 Discharge Pipe

The anticipated maintenance plan for the attenuation basin discharge pipe is outlined in Table 2.

Table 2 – Typical Discharge Pipe Operation and Maintenance Requirements

Discharge Pipe Maintenance Schedule	
Maintenance Action	**Minimum Frequency**
Inspect manhole / pipe. Where pipe has become clogged with silt, the pipe will be cleared out	Half yearly
Remove litter and debris	Half yearly
Inspect inlets and outlets for blockages, and clear (if required)	Half yearly

8.2 Infiltration / Attenuation Basin

The anticipated maintenance plan for the basin at the site is outlined in Table 3.

Table 3 – Typical Basin Operation and Maintenance Requirements

Basin Maintenance Schedule	
Maintenance Action	**Minimum Frequency**
Remove litter and debris	Half yearly
Inspect inlets and outlets for blockages, and clear (if required).	Half yearly
Inspect inlets and outlets for noticeable effects of erosion, suitable erosion protection measures such as reno-mattress or placement of large stones (>150mm) to dissipate water energy levels will be installed at the area affected.	Half yearly
Inspect silt accumulation rates in any forebay and in main body of the pond and establish appropriate removal frequencies	Half yearly
Reseed areas of poor vegetation growth, alter plant types to better suit conditions (if required).	As required, or if bare soil is exposed over 10% or more of the basin treatment area

9 Conclusion

A flood risk assessment has been undertaken across the site. The site has been deemed at low risk of flooding.

An assessment of the drainage options has also been undertaken, and it has been concluded that drainage by infiltration is unlikely to be a viable option. As such, the current proposal is the drain the site via an attenuation basin, with a restricted discharge rate into the Burn of Drum. Infiltration testing will be undertaken on site prior to detail design, and should acceptable infiltration rates be found, an infiltration solution will be adopted during detail design.

The required attenuation volume has been calculated as approximately 761m^3. This should be considered a maximum volume, based on the assumption that all permanent infrastructure (other than the access track) has an asphalt surface and that drainage by infiltration methods is not possible.

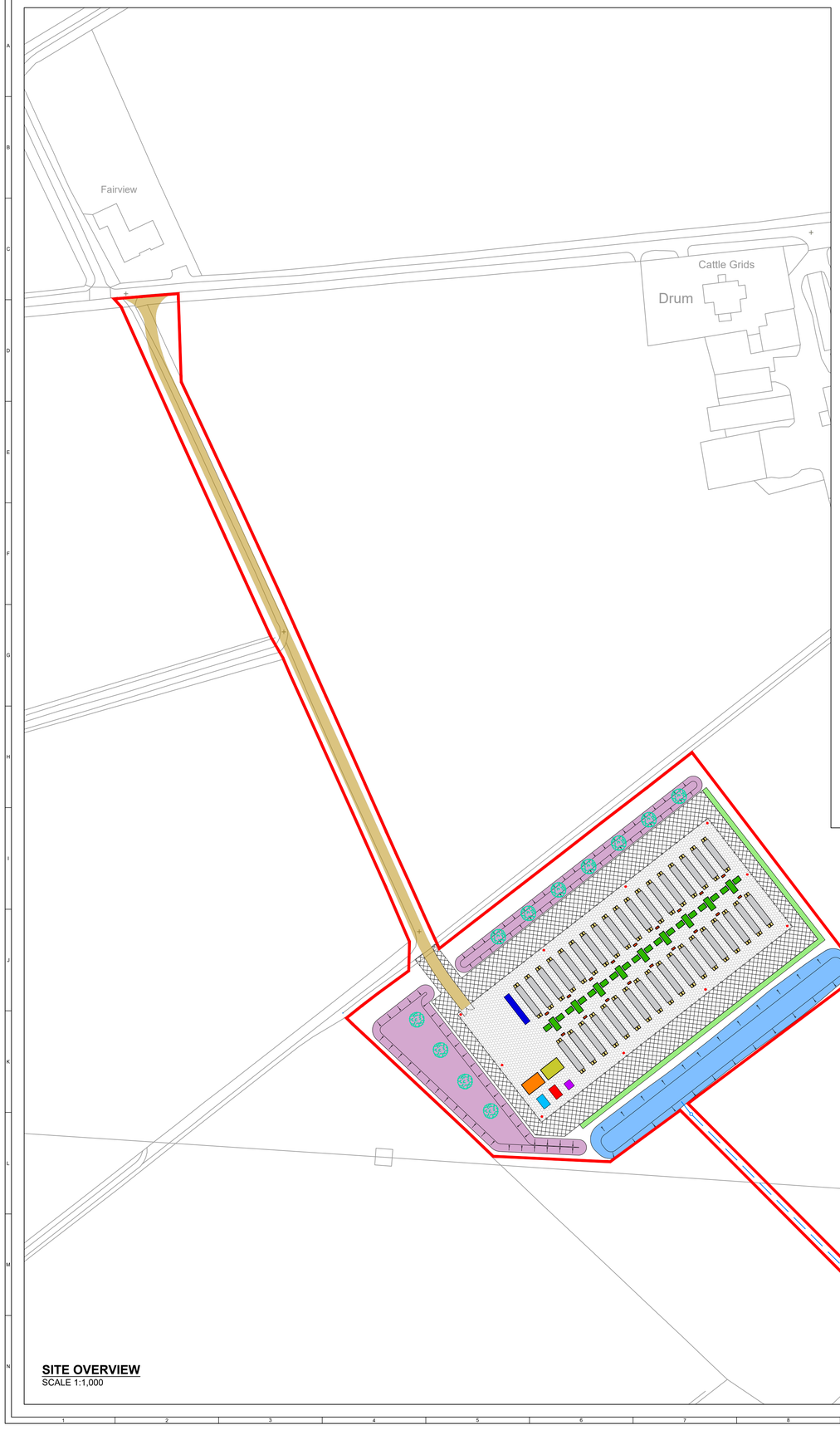
A site investigation, 3D earthworks design, earthing design, and a further assessment of the proposed discharge will be undertaken to inform the detailed design of the site drainage.

The drainage strategy proposed will provide sufficient water quality treatment as demonstrated using the Simple Index Approach.

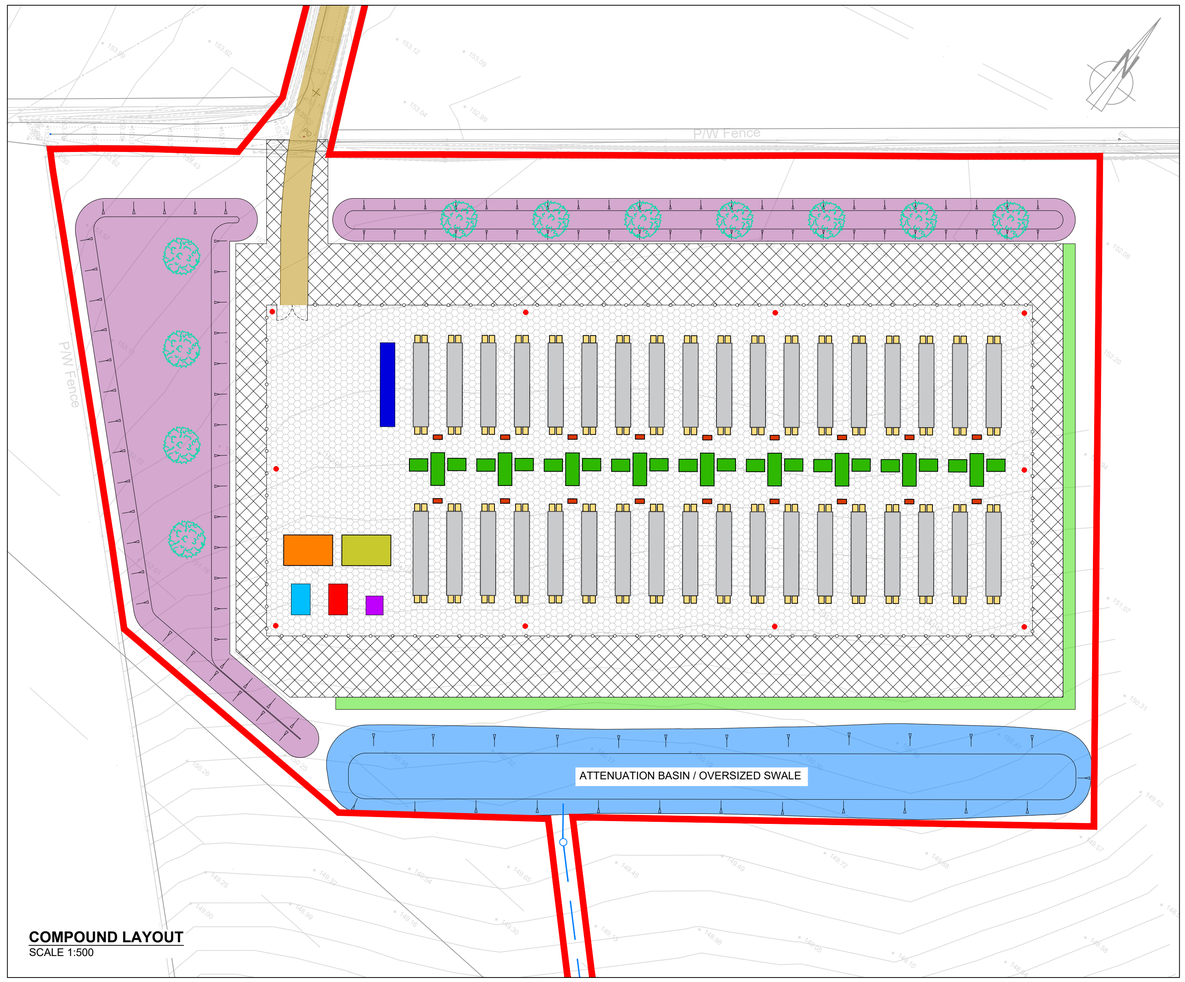
Appendix A Project Drawings

A.1 Infrastructure Layout – 04872-RES-LAY-DR-PT-001

A.2 Typical Drainage Details – 04872-RES-DRN-DR-CE-001



SITE OVERVIEW
SCALE 1:1,000



COMPOUND LAYOUT
SCALE 1:500

KEY:

- APPLICATION BOUNDARY (DENOTED BY OUTSIDE EDGE OF LINE)
- BATTERY CONTAINERS
- HVAC UNIT
- AGGREGATION PANEL
- DNO SUBSTATION
- CLIENT SUBSTATION
- AUXILIARY TRANSFORMER
- HARMONIC FILTER
- SPARES CONTAINER
- PRE-INSERTION RESISTOR
- PCS / TRANSFORMER
- ACOUSTIC FENCING UP TO 3m IN HEIGHT
- SURFACE WATER DISCHARGE PIPE
- ACCESS TRACK
- SURFACE FINISH TYPICALLY COMPRISING COMPACTED TYPE 1, SINGLE SIZED STONE OR ASPHALT IF REQUIRED FOR EARTHING
- TEMPORARY CONSTRUCTION AREA / HARDSTAND
- PROPOSED TREE LINED HEDGE
- PROPOSED NATIVE WOODLAND PLANTING ON BUND UP TO 1.5m HIGH
- CCTV & LIGHTING

NOTES:

1. EQUIPMENT DETAILS AND CONFIGURATION WITHIN THE ENERGY STORAGE COMPOUND ARE INDICATIVE AND SUBJECT TO DETAILED DESIGN.
2. EXACT LOCATION OF SURFACE WATER DRAINAGE IS INDICATIVE AND SUBJECT TO DETAILED DESIGN
3. ACOUSTIC FENCING SPECIFIED AS NOISE ATTENUATION MEASURE BASED ON ACOUSTIC ANALYSIS

ISSUE	DRAWN	CHKD	APPD	DATE	REVISION NOTES
2	JL	DC	JF	2022-04-04	BUNDS AND LANDSCAPING REVISED.
1	DC	MC	TS	2022-03-17	First Issue

PURPOSE: PRELIMINARY	COORDINATES: OSGB 1936
SCALE: AS SHOWN @ A1	LEVEL DATUM: N/A
LAYOUT DWG: N/A	T-LAYOUT NO.: N/A

PROJECT TITLE
DRUM FARM ENERGY STORAGE FACILITY

DRAWING TITLE
INFRASTRUCTURE LAYOUT

RES DRAWING NUMBER: 04872-RES-LAY-DR-PT-001
REV: 2

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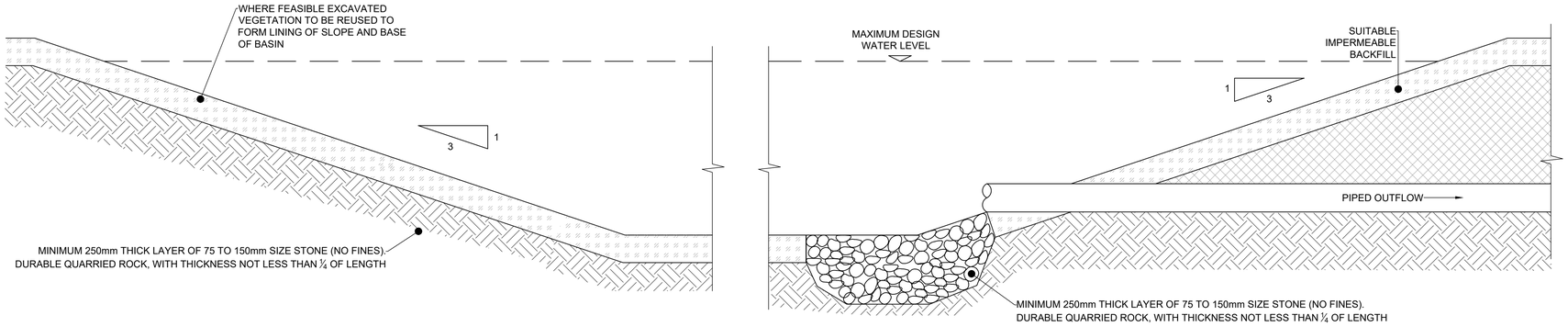
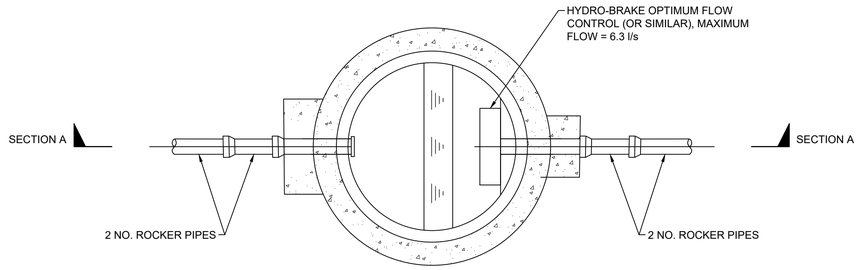


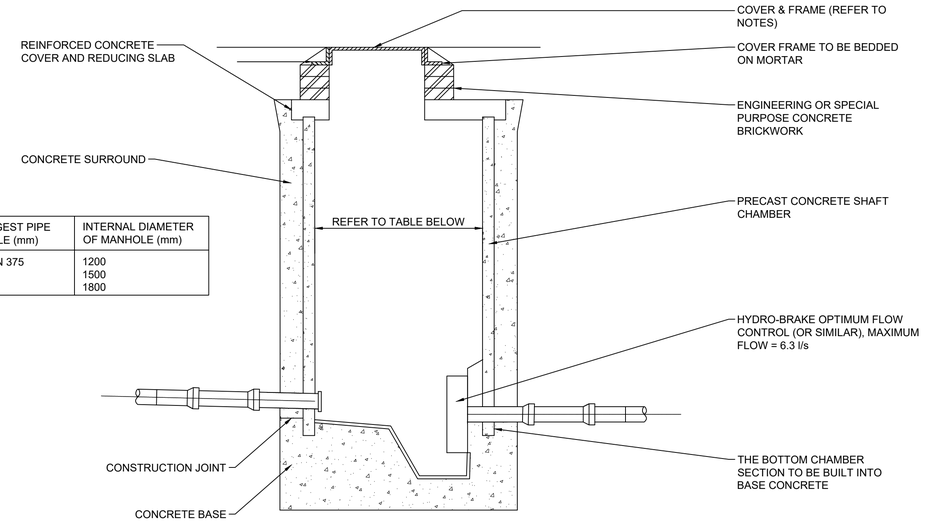
DETENTION BASIN DETAIL
SCALE 1:10

NOTES

1. DO NOT SCALE, ANY DISCREPANCIES SHALL BE HIGHLIGHTED TO THE DESIGNER FOR CONFIRMATION.
2. SUDS SYSTEMS TO BE CONSTRUCTED PRIOR TO, OR AT THE SAME TIME AS THE ACCESS TRACK AND COMPOUND. INTERIM MEASURES SUCH AS THE PLACEMENT OF SILT FENCES TO BE USED AROUND WATERCOURSES AND RETAINED IN PLACE UNTIL SUDS ARE ESTABLISHED AND PROVIDING SUFFICIENT SILT REMOVAL.
3. WHERE RESEEDING IS REQUIRED, NATIVE SPECIES SEED MIX SHALL BE USED BASED UPON THE SURROUNDING HABITAT. THE PLANTING SHALL BE CAPABLE OF RESISTING DROUGHT CONDITIONS.
4. AREAS STRIPPED OF VEGETATION SHOULD BE KEPT TO A MINIMUM.
5. SILT LEVELS AT DETENTION BASIN TO BE VISUALLY INSPECTED AS PART OF AN ONGOING MAINTENANCE PROGRAMME DURING THE CONSTRUCTION PHASE. WHERE CHECK DAMS BECOME CLOGGED WITH SILT OR VEGETATION, STONE CHECK DAM TO BE REMOVED AND DISPOSED OF APPROPRIATELY.
6. SUDS DETAILS, DIMENSIONS AND LEVELS MAY BE MODIFIED DURING DETAILED DESIGN. CHANGES WILL ADHERE TO THE REQUIREMENTS AND PHILOSOPHY IN THE DRAINAGE MANAGEMENT PLAN.

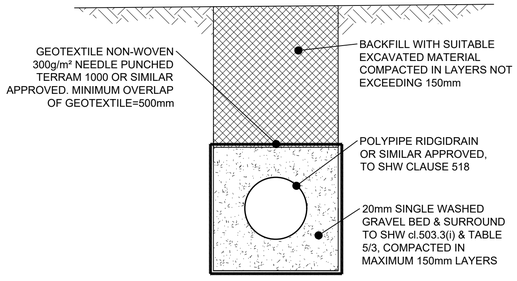


MANHOLE DETAIL WITH FLOW CONTROL DEVICE
SCALE 1:20

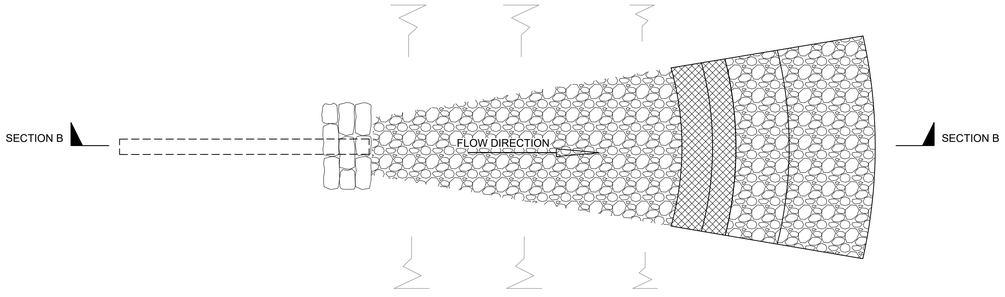


Ø OF LARGEST PIPE IN MANHOLE (mm)	INTERNAL DIAMETER OF MANHOLE (mm)
LESS THAN 375	1200
375 - 700	1500
750 - 900	1800

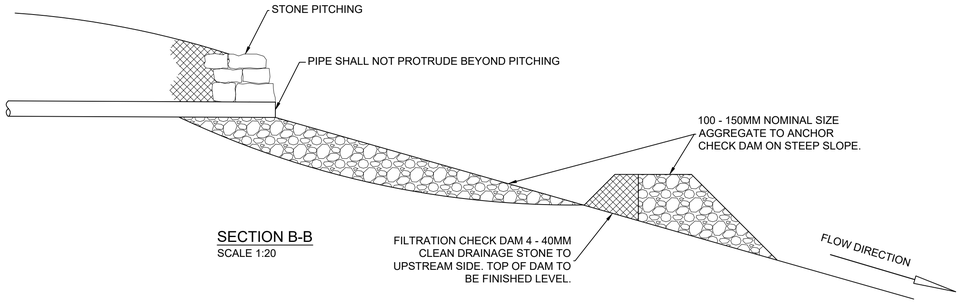
SECTION A-A
SCALE 1:20



OUTFALL PIPE CROSS SECTION
SCALE 1:10



OVERLAND BREAKOUT PLAN VIEW
SCALE 1:20



SECTION B-B
SCALE 1:20

1	DC	JM	JM	2022-04-14	First Issue
ISSUE	DRAWN	CHKD	APPD	DATE	REVISION NOTES

PURPOSE: PRELIMINARY
COORDINATES:
SCALE: AS SHOWN @ A1
LEVEL DATUM: N/A
LAYOUT DWG: N/A
T-LAYOUT NO.: N/A

PROJECT TITLE: DRUM FARM ENERGY STORAGE FACILITY

DRAWING TITLE: TYPICAL DRAINAGE DETAILS

RES DRAWING NUMBER: 04872-RES-DRN-DR-PE-001
REV: 1

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Appendix B Calculations

B.1 Greenfield Runoff Calculations - 04872-3751319

B.2 Attenuation Storage Calculations - 04872-3751320

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Dan Cole
Site name:	Drum Farm
Site location:	Keith

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	57.54065° N
Longitude:	2.93242° W
Reference:	1455003839
Date:	Mar 30 2022 15:32

Runoff estimation approach IH124

Site characteristics

Total site area (ha): 1.01

Methodology

Q_{BAR} estimation method: Calculate from SPR and SAAR

SPR estimation method: Calculate from SOIL type

Soil characteristics	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics	Default	Edited
SAAR (mm):	870	870
Hydrological region:	1	1
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	1.95	1.95
Growth curve factor 100 years:	2.48	2.48
Growth curve factor 200 years:	2.84	2.84

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates	Default	Edited
Q_{BAR} (l/s):	6.29	6.29
1 in 1 year (l/s):	5.35	5.35
1 in 30 years (l/s):	12.26	12.26
1 in 100 year (l/s):	15.6	15.6
1 in 200 years (l/s):	17.86	17.86

Drum Farm - Storage Volume Calculation

PROJECT:	Drum Farm
PROJECT NO:	4872
REFERENCE NO:	04872-3751320

Issue	Date	Author	Nature and Location of Change
1	13.04.22	Daniel Cole	First issue

Note: revision history should include design stage, revision of load and other relevant information.

Attenuation Storage

1. INPUT PARAMETERS AND ASSUMPTIONS
1.1 First category of inputs - Hydrological Characteristics

m5-60	17.00	mm	*Five Year - 60 Minute Rainfall Depth (see "Data" Tab)*
r	0.20		*Ratio M5-60/M5-2day (see "Data" Tab)*
Location	S/NI		*E/W (England and Wales) or S/NI (Scotland and Northern Irela*
Fc	1.35		*Climate Change Factor (refer to the hyperlink for what to choos*

1.2 Second category of inputs - Catchment Area Characteristics

Ap	0.34	ha	*Permeable Area*
Cp	0.4		*Permeable area runoff coefficient (see "Data" Tab)*
Ai	0.67	ha	*Impermeable Area (C= 1 assumed) (ha)*
Qa	0.00630	m³/s	*Allowable Discharge*

2. CALCULATIONS
2.1 First calculation section - effective catchment area calculation

Ae	0.81	ha	*Effective area (see "Data" Tab)*

2.2 Second calculation section - calculation to dermine the m5 rainfall for various durations

D (min)	Z1	m5 - D (mm)
15.00	0.53	9.01
30.00	0.72	12.30
60.00	1.00	17.00
120.00	1.34	22.78
240.00	1.80	30.60
360.00	2.16	36.78
600.00	2.70	45.90
1440.00	3.83	65.17

m5-D calculation

Note: z1 is calculation in the "Att Data" Tab

2.3 Third calculation section - attenuation volume calculations for various durations and return periods

D (min)	Z2	MT-10 (mm)	Inflow Vol m^3	Outflow vol (m^3)	Att Volume
15.00	0.68	8	66	6	61
30.00	0.68	11	92	11	80
60.00	0.69	16	128	23	106
120.00	0.71	22	175	45	130
240.00	0.72	30	240	91	149
360.00	0.73	36	294	136	157
600.00	0.75	46	373	227	146
1440.00	0.76	67	540	544	-4

1 year return period calculation

Note: z2 is calculation in the "Att Data" Tab

D (min)	Z2	MT-10 (mm)	Inflow Vol m^3	Outflow vol (m^3)	Att Volume
15.00	1.03	13	101	6	95
30.00	1.03	17	137	11	126
60.00	1.02	23	189	23	166
120.00	1.02	31	253	45	207
240.00	1.02	42	340	91	249
360.00	1.02	51	408	136	272
600.00	1.02	63	509	227	283
1440.00	1.02	90	723	544	179

5 year return period calculation

Note: z2 is calculation in the "Att Data" Tab

D (min)	Z2	MT-10 (mm)	Inflow Vol m^3	Outflow vol (m^3)	Att Volume
15.00	1.19	14	116	6	111
30.00	1.19	20	160	11	148
60.00	1.20	27	221	23	199
120.00	1.18	36	294	45	248
240.00	1.18	49	393	91	302
360.00	1.17	58	469	136	333
600.00	1.16	72	581	227	355
1440.00	1.15	101	814	544	270

10 year return period calculation

Note: z2 is calculation in the "Att Data" Tab

D (min)	Z2	MT-10 (mm)	Inflow Vol m^3	Outflow vol (m^3)	Att Volume
15.00	1.48	18	145	6	139
30.00	1.49	25	200	11	188
60.00	1.49	34	275	23	252
120.00	1.47	45	363	45	318
240.00	1.44	60	480	91	389
360.00	1.42	71	569	136	433
600.00	1.39	86	694	227	467
1440.00	1.35	119	955	544	411

30 year return period calculation

Note: z2 is calculation in the "Att Data" Tab

D (min)	Z2	MT-10 (mm)	Inflow Vol m^3	Outflow vol (m^3)	Att Volume
15.00	1.95	24	191	6	185
30.00	1.97	33	264	11	253
60.00	1.96	45	363	23	340
120.00	1.91	59	473	45	428
240.00	1.85	76	614	91	524
360.00	1.80	89	719	136	583
600.00	1.74	108	869	227	642
1440.00	1.66	146	1177	544	632

100 year return period calculation

Note: z2 is calculation in the "Att Data" Tab

D (min)	Z2	MT-10 (mm)	Inflow Vol m^3	Outflow vol (m^3)	Att Volume
15.00	2.22	27	218	6	212
30.00	2.25	37	302	11	290
60.00	2.24	51	414	23	391
120.00	2.17	67	537	45	492
240.00	2.08	86	694	91	603
360.00	2.02	100	807	136	670
600.00	1.94	120	971	227	744
1440.00	1.84	162	1306	544	761

200 year return period calculation

Note: z2 is calculation in the "Att Data" Tab

3. RESULTS

Att 1	157	m³	*Attenuation volume required in a 1 in 1 year event*
Att 5	283	m³	*Attenuation volume required in a 1 in 5 year event*
Att 10	355	m³	*Attenuation volume required in a 1 in 10 year event*
Att 30	467	m³	*Attenuation volume required in a 1 in 30 year event*
Att 100	642	m³	*Attenuation volume required in a 1 in 100 year event*
Att 200	761	m³	*Attenuation volume required in a 1 in 200 year event*

Appendix C Correspondence with Moray Council

C.1 Relevant Pre-application Advice Response from Moray Council

Given the open nature of the site and the proximity to the town landscaping is required to further integrate the proposal into the landscape, minimise any potential impacts and maintain the transition into the countryside. A Landscaping Plan must be provided with any future planning application which sets out detailed information about species, specifications and numbers as well as timescales for planting and maintenance. Landscaped areas must provide seasonal variation (mix of planting and colour), including native planting for pollination. We would be happy to provide further advice on this as your plans develop.

Further details are required for the connection to the grid which was mentioned at the meeting. The proposal to underground it is welcomed in this location given that it will go through the CAT. For the avoidance of doubt this element of the scheme does require planning permission.

7. Access and Parking

Core Path

It was discussed at the meeting that our preference would be for the core path to be upgraded to provide access to the site. The upgrading of the existing path is a more sustainable use of resources and an additional path running parallel to the core path may be visually confusing.

Comments from Transportation will be forwarded on separately.

More information on servicing, access and parking can be found at:

http://www.moray.gov.uk/moray_standard/page_65633.html

8. Drainage and Water

In addition to the Flood Risk Assessment (FRA) and Surface Water Management Plan proposed a detailed Drainage Impact Assessment (DIA) will be required.

The drainage impact assessment should include plans and calculations for the proposed drainage system. Plans submitted with the application should include the proposed layout of the drainage system. The drainage system should be designed to a 1:30 year return period (including 35% climate change), without surcharging. If attenuation is used the system should drain completely within 24 hours. If the proposed system involves infiltration, information on the ground conditions is

required as well as infiltration testing on or near the location for the infiltration system. The applicant should demonstrate that the post development run-off rate does not exceed the pre-development run-off rate, or increase the risk of flooding to the surrounding land.

Further guidance for drainage and flooding can be found in "Supplementary Guidance on Flood Risk and Drainage Impact Assessment for New Developments" - www.moray.gov.uk/downloads/file133646.PDF

Contact Scottish Water for guidance on connections to the public water/drainage network:
0845 601 8855

You can find more information on SUDS at: http://www.susdrain.org/

You can view SEPA's small-scale development and other guidance here: http://www.sepa.org.uk/planning.aspx

9. Flood Risk

The proposed scope of assessment set out in the submitted documents is supported. It is noted above that a DIA is also required. The findings of the FRA and DIA will inform more detailed assessment.

SEPA require investigation of a potential culverted watercourse under the core path which may be upgraded form the access. The OS map appears to indicate a watercourse that terminates to the north of the track but then re-appears to the south. It may be culverted below or alongside the track. If there is a watercourse, then there may be opportunities to de-culvert or at the very least ensure it is protected during construction works.

You can view SEPA's flood risk map here at:
http://www.sepa.org.uk/environment/water/flooding/flood-maps/

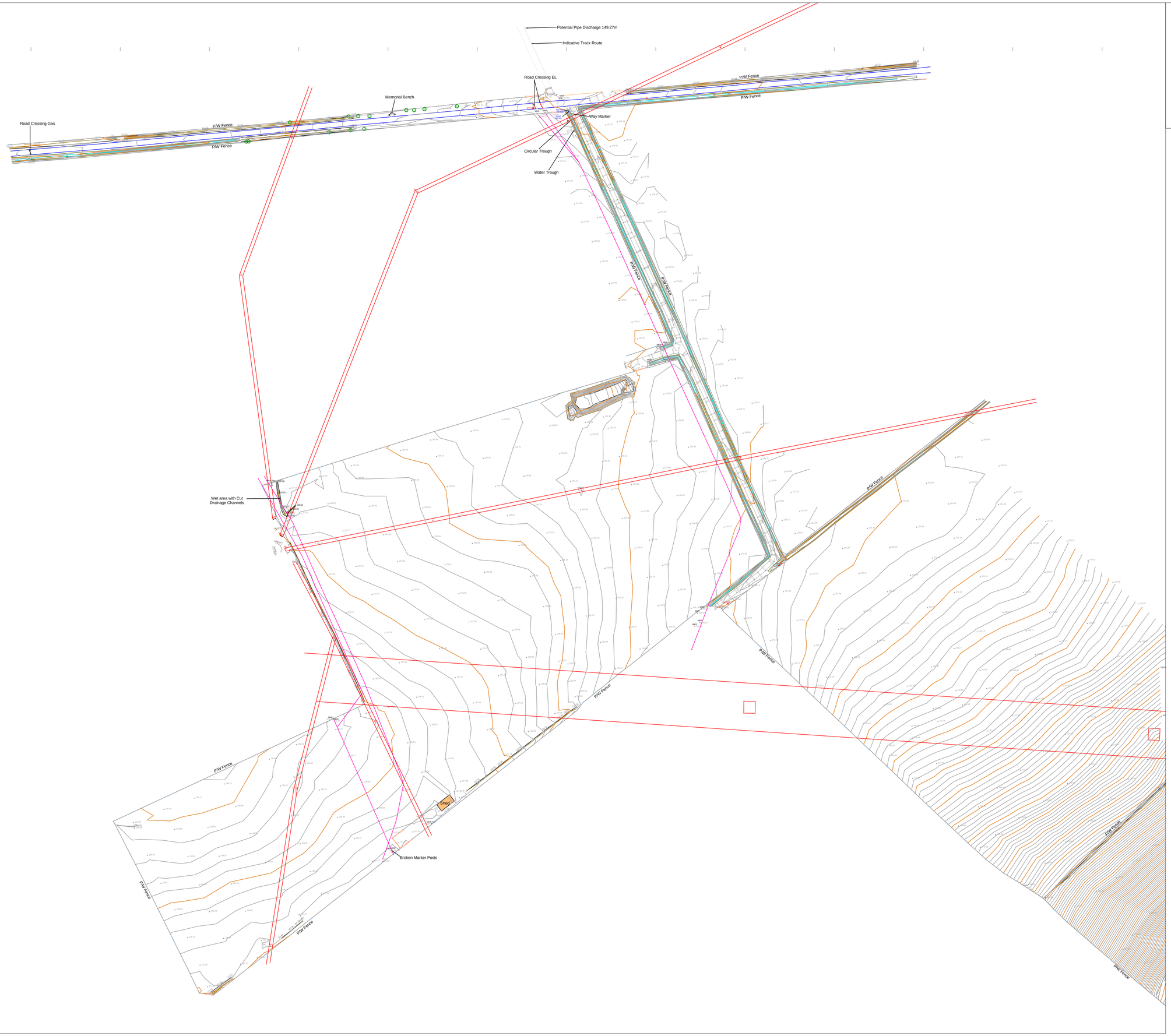
10. Listed Buildings, Conservation Areas and the Historic Environment

The site is not covered by any designation and no impacts on the historic environment would be anticipated. In this instance we would not require any archaeological mitigation pre- or post-determination.

Check if your building, or any building close by, is/are listed or falls within an historic designation at:

Appendix D Surveys

D.1 Topographic Survey



Station	Easting	Northing	Level	Description
gmc01	344131.414	850715.912	153.988	Hilti Nail In Road
gmc02	344194.949	850721.576	153.377	Hilti Nail In Road
gmc03	344240.330	850438.309	153.754	Hilti Nail In Wooden Peg
gmc04	344269.078	850459.909	153.104	Hilti Nail In Wooden Peg

north

REV:	DESCRIPTION:	BY:	DATE:

STATUS: For Information

gmcsurveys
Surveys, Setting Out, Civil Engineering Design
T: 07557 431 702
E: gmcsurveys@gmail.com

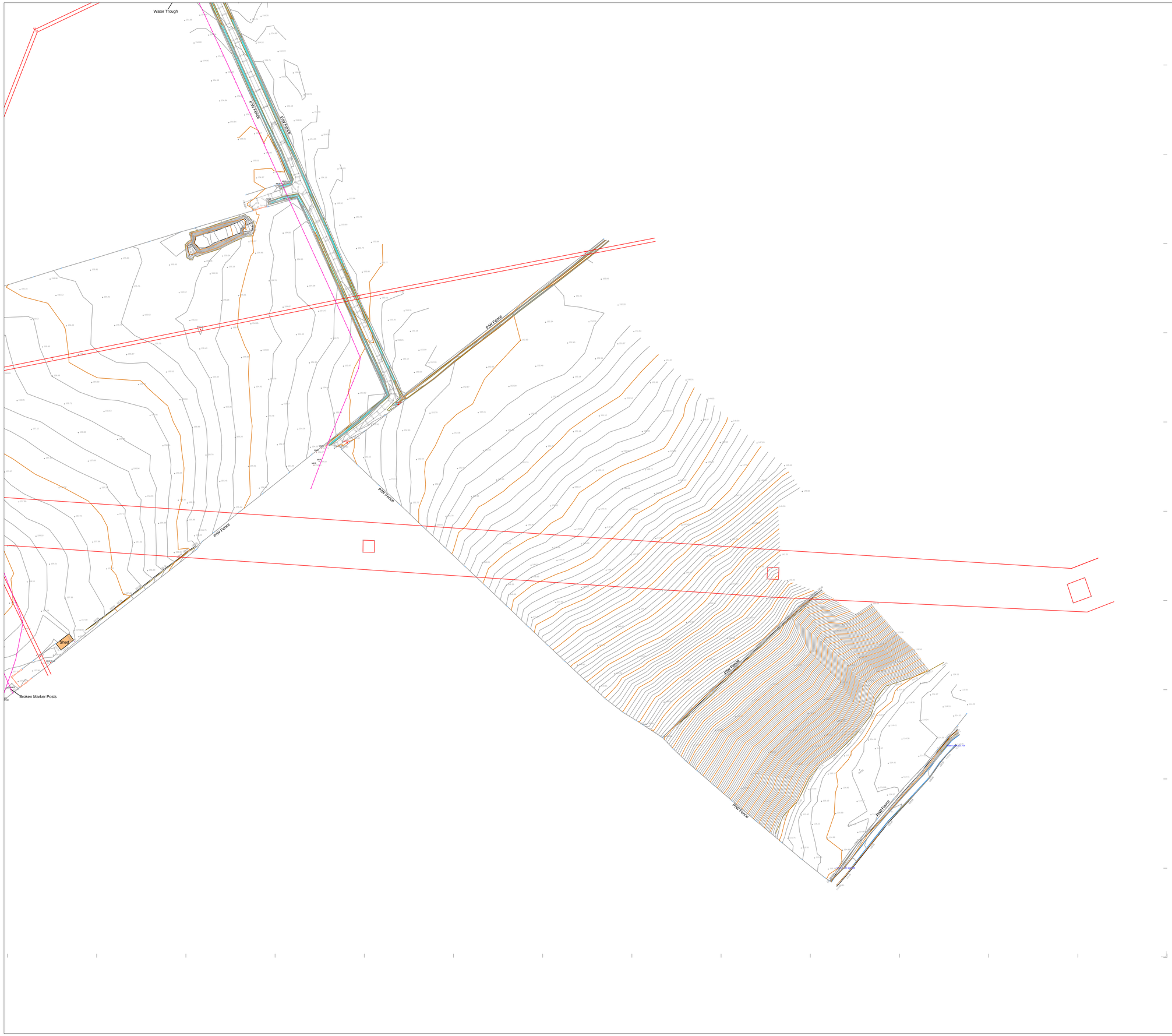
CLIENT:
Renewable Energy Systems Ltd
Beaufort Court
Egg Farm Lane
King Langley
WD4 8LR

SITE: Drum Farm
Keith

TITLE: Topographic Survey
Sheet 1 of 2

SCALE AT A1:	DATE:	DRAWN:	CHECKED:
1:1000	FEB22	GM	

PROJECT NO:	DRAWING NO:	REVISION:
DF01	900	-



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north

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Surveys, Setting Out, Civil Engineering Design
T: 07557 431 702
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CLIENT:
Renewable Energy Systems Ltd
Beaufort Court
Egg Farm Lane
King Langley
WD4 8LR

SITE: Drum Farm
Keith

TITLE: Topographic Survey
Sheet 2 of 2

SCALE AT A1:	DATE:	DRAWN:	CHECKED:
1:1000	FEB22	GM	

PROJECT NO:	DRAWING NO:	REVISION:
DF01	901	-

Appendix E Compliance Documents

E.1 Level 1 Flood Risk Statement Checklist

E.2 Level 2 Drainage Impact Assessment Checklist

E.3 DIA Compliance Checklist

Appendix 1 - Checklist

Flood Risk

Level 1 Flood Risk Statement			
Essential	**Document Reference** 04872-3681365	**Source**	**Signatory** *(eg architect, Applicant, Agent)*
Brief statement/ screening.	Section 1.1 / Section 4		Daniel Cole
General description of the development, its size, location and surrounding topography.	Section 1 / Section 3		Daniel Cole
Description of existing drainage arrangements on site and any sewers.	Section 3.4 / Section 4.6		Daniel Cole
FR from all sources considered/ commented on (based on authors' knowledge/ observations/ experience).	Section 4		Daniel Cole
Reference to SEPA flood maps where applicable	Figure 1		Daniel Cole

Level 2 Flood Risk Assessment			
Essential	**Document Reference**	**Source**	**Signatory** *(e.g. Civil Engineer, Hydrologist or equivalent Chartered Member of professional institution e.g. ICE, CIWEM, ISTRUCTE)*
As Flood Risk Statement providing a full report including drawings/ calculations/ figures. Flood risk from all sources considered. Desk study approach. Consultation with SEPA & Scottish Water. Details of proposed development design/ mitigation measures.			

Level 2 Drainage Impact Assessment- A full DIA will be required for all proposed developments other than those identified for a Level 1.

Essential	Document Reference 04872-3681365	Source	Signatory *(e.g. Civil Engineer, Hydrologist or equivalent Chartered Member of professional institution e.g. ICE, CIWEM, ISTRUCTE)*
Report including drawings/calculations/ figures.	Appendix A / B	https://www.uksuds.com/tools/greenfield-runoff-rate-estimation	
Description of existing drainage rights/ arrangements on site.	Section 3.4		
Assessment of pre/ post runoff rates, changes in impermeable areas.	Section 7		
Evidence of proposed runoff rates and storage volumes for a variety of return periods.	Appendix B		
Outline Drainage Design showing use/ application of SUDS supported by calculations/ model results.	Appendix A		
Wastewater drainage proposals including a letter of agreement from Scottish Water to accept foul flows (if applicable).	Section 4.6		
Reporting of onsite infiltration tests (where suitable).	Not proposed		
Proposals relating to discharge rate control methods, receiving water bodies, structures etc.	Section 6.2.2		

Appendix 3 - DIA Compliance Certificate

Drainage Impact Assessment

Compliance Certificate

I certify that all reasonable skill, care and attention to be expected of a qualified and experienced professional in this field have been exercised in carrying out the attached Assessment. I also confirm that I maintain the required Professional Indemnity Insurance*.
The report has been prepared in support of the below named development in accordance with the reporting requirements issued by Moray Council.

Assessment Ref No: 04872-3681365

Assessment Date: 14.04.22

Assessment Revision: 01

Name of Development: Drum Farm Energy Storage Facility

Planning Application No: 21/01609/PEMAJ

Name of Developer: Renewable Energy Systems

Supporting Information

Name and Address of Organisation preparing this Assessment: Renewable Energy Systems,
Beaufort Court
Egg Farm Lane
Kings Langley
WD4 8LR

Signed:

Name: Vincent Morgan

Date: 06.05.22

Position Held: Head of Civil Engineering

Qualification ** CEng

* Please attach appropriate evidence of Professional Indemnity Insurance
** A chartered member of a relevant professional institution

Willis Towers Watson

1 November 2021

Website www.willistowerswatson.com
Direct Line +44 (0)20 3124 6030
E-mail oliver.warren@willistowerswatson.com

TO WHOM IT MAY CONCERN

Dear Sirs

As Insurance Brokers to Renewable Energy Systems Holdings Limited and Subsidiary Companies, we are writing to confirm that our client holds the following policy:

Business Description: Development, design, consultancy, construction, maintenance, operation and ownership of onshore and offshore wind farms, electricity transmission, storage, and distribution projects, marine energy projects, including wave, tidal stream and tidal range, development of large scale biomass heat and power, photovoltaic and thermal solar energy, renewables in buildings, energy storage, sustainable built environments, property ownership, onshore and offshore site measurement masts and equipment and the provision of services related to the Insured's business. Such services include, but are not limited to, asset and operational management, offshore management contracting, architectural, structural, mechanical and electrical design, project management services, provision of advice, consultancy, measurement, evaluation and prediction of wind speeds, climatic and metocean conditions, the assessment and prediction of energy yield and performance and the running and maintenance of facilities. Other activities include, but are not limited to, exhibitions, presentations, social events, involvement with local educational establishments, open days and community work.:

Public Liability

Insurer	AXA XL
Policy Number	IEG0043405LI21A
Period	01 November 2021 to 31 October 2022 both days inclusive
Limit of Indemnity	GBP10,000,000 any one occurrence and in the aggregate any one Period of Insurance in respect of Liability arising from Products and for Pollution and Contamination such aggregates to apply separately.

Employers Liability

Insurer	AXA XL
Policy Number	UKG0043414LI21A
Period	01 November 2021 to 31 October 2022
Limit of Indemnity	GBP10,000,000 any one occurrence Terrorism – GBP5,000,000 any one occurrence Offshore – GBP10,000,000 any one occurrence
Extensions	Indemnity to Principals automatically included

Professional Indemnity

Insurer	W/R/B Underwriting and others
Policy Number	B080133932G21
Period	1 November 2021 to 31 October 2022
Limit of Indemnity	GBP5,000,000 each and every claim and in the annual aggregate with one reinstatement, such reinstatement not to apply to any and all subsidiaries domiciled in the US & Canada or to any claims or circumstances made or actions instituted in US and Canada

Motor

Insurer	Royal & Sun Alliance Insurance Plc
Policy Number	RSAP1015001300
Period	01 November 2021 to 31 October 2022 both days inclusive
Limit of Indemnity	Death/bodily injury to Third Parties – unlimited Accidental Damage to Third Party property:- Business cars Limit GBP 20,000,000 All other vehicles Limit GBP5,000,000 Applies to all vehicles registered in the United Kingdom for which the Insured is responsible used in connection with the business
Extensions	Indemnity to Principals automatically included

This letter is provided as a courtesy to our client as a matter of information only and confers no rights on the holder. Our duties in relation to this insurance are to our client and we accept no duty of care or responsibility to you or any other third party and any liability to you or any third party is excluded. This letter does not amend, extend or alter the coverage afforded by the policies, nor does it purport to set out all of the policies' terms, conditions and exclusions. The policy terms, conditions, limits and exclusions may alter after the date of this document or the insurance may terminate or be cancelled, and the limits shown may be reduced by paid claims. We have no obligation to advise you of any changes which may be made to the policies or to advise you of their cancellation or termination.

Signed on behalf of WILLIS LIMITED

Authorised Signatory