## Statkraft

# Coylton BESS

## Surface Water Drainage Strategy

**Final**

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# 1 Introduction

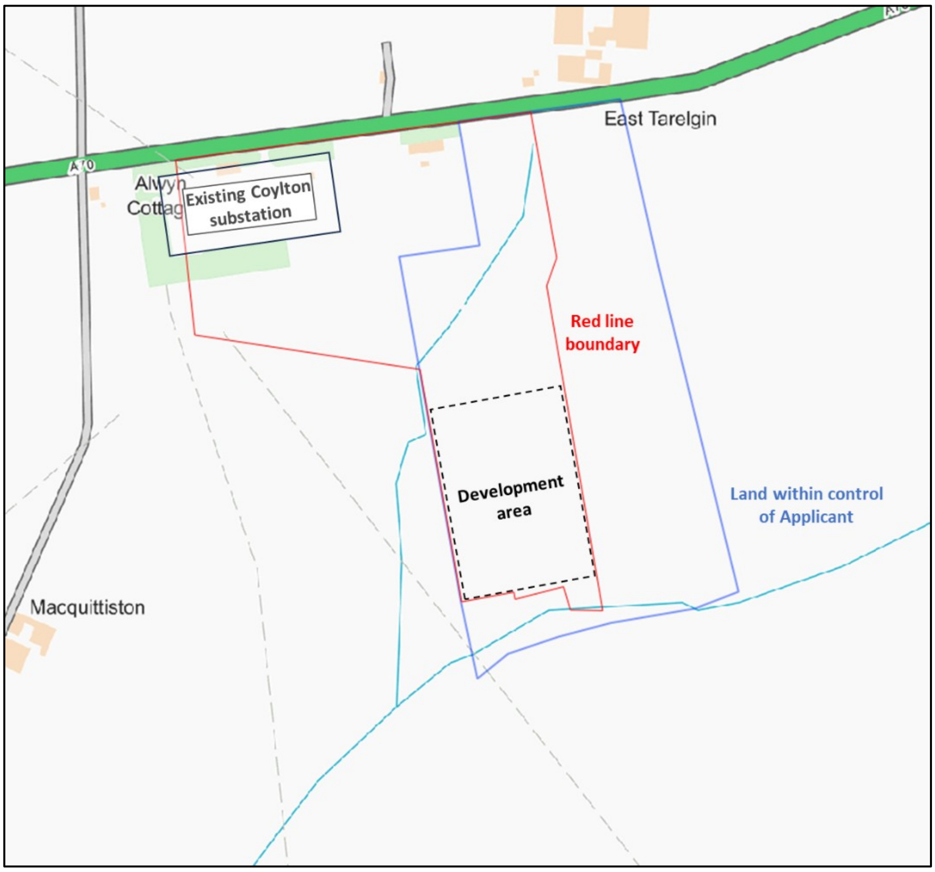
Kaya Consulting Ltd. was commissioned by Statkraft through TNEI to undertake a drainage strategy for the proposed BESS (Battery Energy Storage System) development at the Coylton Substation in East Ayrshire (**Figure 1**).

The red line boundary measures approximately 13.1 ha in area, with the development area measuring approximately 2.3 ha.

The site is situated next to the existing Coylton Substation and is bounded to the north by Ayr Road (A70).

The proposed drainage strategy is summarised in the following sections.

**Figure 1: Location of the site**



# 2 Drainage Strategy

## 2.1 Existing Drainage and Ground Conditions

An unnamed watercourse originating from issues in the north of the Red Line Boundary area flows southwest, outwith the development area. An additional unnamed watercourse flows west approximately 34m to the south of the Red Line Boundary but inside the Land Within Control of the Applicant boundary and continues southwest.

A Drainage Impact Assessment was prepared and approved for a 20MW development (21/0748/PP), by Arcus in October 2021 and provided to Kaya Consulting by the client for use in the preparation of an updated drainage strategy.

Soakaway testing was carried out in September 2021 at the site as part of the assessment. The testing detailed that the site is underlain by clay-based strata, with both trial pits failing to provide an infiltration rate. Infiltration based strategies are therefore not considered feasible.

## 2.2 SuDS, Drainage Hierarchy and Potential Strategies

Sustainable Urban Drainage Systems (SuDS) are used to manage surface water runoff effectively within a development to mitigate against the impacts associated with an increase in the impermeable area such as increased flows and exacerbated flooding downstream.

The SuDS Manual (CIRIA Report C768, 2017) is the current best practice guidance on the use of SuDS. It promotes the use of a hierarchical approach to managing runoff in which the higher priority mechanisms should be implemented whenever possible. As infiltration rates at the site are poor, it is proposed to attenuate flows in a SuDS feature, which will discharge flows at a greenfield rate to the watercourse south of the development area.

## 2.3 Proposed Surface Water Drainage Strategy

The proposed surface water drainage strategy seeks to provide a sustainable and integrated surface water management scheme for the whole site and aims to maintain or reduce downstream flood risk by managing discharges from the site to the local water environment in a controlled manner.

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 final locations of infrastructure differ from what is outlined within this document, then the final detailed drainage design will be provided to East Ayrshire Council under an agreed pre-construction condition. A form of condition is proposed below:

*'Development shall not commence until drainage works have been carried out in accordance with amended design details which have been submitted to and approved in writing by East Ayrshire Council'.*

In compliance with the above, the drainage strategy has been developed to meet the following key principles;

- Mimic existing (greenfield) drainage arrangements as far as possible;
- Avoid increases in the greenfield rate, volume and frequency of offsite discharge;
- Avoid significant deterioration in water quality of discharges and no detrimental impact in downstream water quality;
- Achieve the above criteria for all storms up to and including the 200-year event; and
- Incorporate an allowance for climate change (41%)

**Figure 2** provides an indicative layout of the drainage structures and features proposed at the development area.

Runoff generated within the development area will flow into filter trenches along the southern boundary, discharging to an attenuation feature. Attenuated runoff will then drain to the unnamed watercourse via an outfall pipe restricted to the 2-year greenfield runoff rate. Platformed ground levels should therefore be designed to direct runoff to the filter trench network.

A watershed analysis was undertaken using GIS software. The analysis revealed that an area of approximately 4.7 ha is predicted to reach the development area. We would therefore recommend implementing a bund along the development perimeter to divert runoff from entering the site; therefore, only runoff generated within the development area is routed to an attenuation feature. The diversion bund will allow for flows outwith the development area to follow the pre-development pathways and will therefore not increase flood risk downstream.

Based on Sewers for Scotland, as a minimum, storage should be sized for the 30-year plus climate change uplift event with plans demonstrating flooded areas and flow paths of excess water for storms of greater magnitude, when the system is at capacity or exceeded. Detailed storage calculations and volumes are provided in Section 2.4.

Although the proposed access tracks will be porous, we would recommend that silt traps/check dams be implemented alongside the tracks to reduce erosion and trap any sediments washed from the surface. Expert geotechnical advice will be sought when confirming track material.

**Figure 2: Indicative drainage strategy**

## 2.4 Methodology for calculation of runoff and storage volume

Greenfield and post-development runoff volumes have been calculated using the Wallingford Procedure.

Runoff volumes were calculated for a range of storm durations and return periods including an allowance for climate change, which is considered at a 41% uplift to rainfall intensity following SEPA guidance (2022).

In total, impermeable areas at the site will measure 1.16 ha as indicated in **Figure 2**, with the remainder of the site consisting of porous crushed aggregate or permeable access roads. The extent of impermeable areas introduced will be approximately 50.4% of the total developable site area.

The runoff factor of the hard-standing areas was set to 1.0 to represent the imperviousness of these areas. The runoff factor of the greenfield and permeable access roads was set to 0.47 following the SPR characteristic as extracted from the HR Wallingford Greenfield runoff rate estimation tool.

The total peak runoff volumes (**Table 1**) for a range of storm durations were calculated using the Wallingford procedure.

**Figure 3** shows the greenfield runoff rate to which the outfall will be limited.

**Table 1** indicates that with development in place, approximately 808 $m^3$ of surface water runoff would need to be stored within the drainage system during a 30-year plus climate change uplift storm across the site. Approximately 1,381 $m^3$ of surface water runoff would need to be accommodated within the site during a 200-year plus climate change uplift storm.

**Table 1: Peak post-development storage volumes required for a range of storm durations including climate change uplift assuming 2-year GRR of 18.71 l/s**

| Duration (hours) | Volumes Required ($m^3$) Return Period (Years) | | | | |
|---|---|---|---|---|---|
| | 2 | 30 | 30+41% CC | 200 | 200+41% CC |
| **1** | 120.1 | 492.1 | 721.5 | 871.5 | 1256.4 |
| **2** | 121.6 | 521.9 | 791.2 | 921.9 | 1355.1 |
| **3** | 100.4 | 514.2 | 807.9 | 920.5 | 1380.8 |
| **4** | 68.7 | 491.0 | 802.8 | 899.5 | 1378.8 |
| **6** | 0.0 | 422.3 | 761.1 | 830.4 | 1336.6 |
| **12** | 0.0 | 150.2 | 543.2 | 556.5 | 1116.0 |
| **24** | 0.0 | 0.0 | 0.0 | 0.0 | 568.7 |
| **Critical Volume** | **121.6** | **521.9** | **807.9** | **921.9** | **1380.8** |

**Figure 3: Greenfield runoff rate**

hr wallingford

## Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

| | |
|---|---|
| Calculated by: | Lee Ruddick |
| Site name: | Coylton |
| Site location: | Coylton |

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: | 55.44427° N |
| Longitude: | 4.43082° W |
| Reference: | 1967027022 |
| Date: | Oct 02 2023 13:05 |

### Runoff estimation approach

IH124

### Site characteristics

Total site area (ha): 2.311

### 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): | 1089 | 1089 |
| Hydrological region: | 2 | 2 |
| Growth curve factor 1 year: | 0.87 | 0.87 |
| Growth curve factor 30 years: | 1.95 | 1.95 |
| Growth curve factor 100 years: | 2.63 | 2.63 |
| Growth curve factor 200 years: | 2.99 | 2.99 |

### 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): | 18.71 | 18.71 |
| 1 in 1 year (l/s): | 16.28 | 16.28 |
| 1 in 30 years (l/s): | 36.49 | 36.49 |
| 1 in 100 year (l/s): | 49.21 | 49.21 |
| 1 in 200 years (l/s): | 55.95 | 55.95 |

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement , which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

## 2.5 Site Storage

Proposed ground levels at the site are not available at this stage although platforming of the site will likely be required. An attenuation feature will be constructed at the southern boundary of the site. It is recommended that, as a minimum, the feature is designed to contain the 30 year plus climate change volume. The area assigned for surface water attenuation is provided in blue in **Figure 2**. The area is indicative only, based on the final design, it is possible that not all of the area identified would be required.

The final design should account for sloping embankments and buffers required for maintenance.

## 2.6 Surface Water Quality

The proposed development is for a BESS site. The site will be unmanned and will not be visited daily. In addition, when being visited, the type of vehicles are not likely to be larger vehicles such as HGVs etc.

Surface water at the site will be treated via filter drains. A water quality risk assessment has been carried out using the SuDS hazard mitigation indices in accordance with the SuDS Manual, CIRIA Report C753. Considering the low expected traffic volumes and appropriate containment of any hazardous substances, the residual pollution hazard level is considered to be low hazard levels similar to that of a low traffic road and non-residential car parking with infrequent change. Total Suspended Solids, Metals and Hydrocarbons are not predicted to exceed 0.4 therefore the proposals are deemed sufficient, see **Table 2**.

**Table 2: Simple Index Approach**

| Pollution Hazard Indices for different land use classifications | | | | |
|---|---|---|---|---|
| **Type** | **Hazard Level** | **Suspended Solids** | **Metals** | **Hydrocarbons** |
| Commercial roofing: Inert materials | Very Low | 0.3 | 0.2 | 0.05 |
| Very Low Traffic Roads | Low | 0.4* | 0.4 | 0.4 |
| **Pollution Mitigation Indices** | | | | |
| **Type of SuDS component** | | **Suspended Solids** | **Metals** | **Hydrocarbons** |
| Filter Drain | | 0.4 | 0.4 | 0.4 |

## 2.7 Construction Phase Drainage Arrangements

During the construction phase, additional drainage measures should be implemented to help attenuate the increase in surface water flows if surface water is observed discharging from the construction compound.

Runoff from these areas is anticipated to have high silt loading due to mobilised soil from excavated surfaces, fines from track aggregate and sludge due to traffic.

We would recommend that hardstanding runoff be directed to a swale on the site's lower points. This drainage scheme can be removed at the end of the construction stage and the area reinstated. It is recommended that vegetation disturbance is minimised during construction. Decompaction of ground post-construction should be provided in the areas where necessary.

If any underground culverts or land drains are damaged as part of the construction phase, then they should be repaired or replaced.

# 3 Road Crossing

A road crossing a small ditch is required to gain access from the A70. An assessment has also been undertaken to provide the size of the culvert.

## 3.1 Hydrology Assessment

The ditch drains a very small catchment area to the north of the site. LiDAR DTM data was used to undertake a watershed analysis to ascertain the area that could drain towards the site. The catchment is shown in Figure 4. The area able to drain to the site was predicted to be approximately 22ha.

**Figure 4: Watershed Analysis**


In addition, a 0.3m diameter culvert also discharges into the drain, just to the south of the A70, see Photo 1. The catchment that the 0.3m diameter culvert drains is not known.

**Photo 1: 0.3m diameter outlet**

Flows in the natural catchment have been estimated using the Institute of Hydrology "Flood estimation for small catchments" Report No. 124 methodology. The following parameters were used:

- SAAR (Standard Annual Average Rainfall): 1,072mm
- Area: 0.22km$^2$
- SOIL: 0.45
- Region: 2

Based on the above, the 200 year flow predicted to reach the crossing is calculated to be approximately 0.51m$^3$/s. Making a conservative assumption that the 0.3m diameter culvert does not drain land within the natural catchment (Figure 4), up to 0.14m$^3$/s could flow from the pipe during full bore conditions.

Combining the flow from the natural catchment and the pipe adds to 0.65m$^3$/s.

## 3.2 Hydraulic sizing

Culvert capacity calculations were undertaken based on elevations and channel dimensions extracted from the topographic survey. Results indicate that a 1m diameter culvert would be sufficient to pass the 200 year flow with appropriate freeboard.  Ground levels on the access road should be arranged so that in the event of a blockage or exceedance, flood waters would be able to return to the channel.

# 4 Summary

The proposed surface water drainage strategy for the development seeks to provide a sustainable and integrated surface water management scheme for the site and aims to ensure no increase in downstream flood risk by managing discharges from the site to the local water environment in a controlled manner.

Storage volumes should be sized for the 30-year plus climate change uplift event with plans demonstrating flooded areas and flow paths of excess water for a 200-year storm plus climate change when the system is at capacity or exceeded.

The proposed strategy is to capture surface water runoff from the site in a filter drain which is then routed to an attenuation feature. Attenuated surface water will then discharge into an unnamed watercourse at greenfield runoff rates. The attenuation feature will be confirmed in the detailed design.

The drainage proposals outlined in this strategy demonstrate sufficient storage and treatment capacity is available at the site. Flood risk to the development has not been considered in this document.

A new road access is proposed. Hydraulic calculations have been undertaken that indicate a 1m diameter culvert would be sufficient to pass extreme flows predicted to reach the road crossing. A foul sewer is also noted to traverse the road, it is understood that the sewer location will be identified and appropriate mitigation measures will be implemented to protect the pipe.