# Appendix 4.4: Outline Drainage Strategy

Pell Frischmann

# An Càrr Dubh Wind Farm

# Outline Drainage Strategy

Technical Note



## Introduction

Pell Frischmann have been commissioned by LUC (referred to as the "Client" throughout the document) to provide an outline Drainage Strategy for the proposed An Càrr Dubh Wind Farm (referred to as the "Proposed Development" throughout the document), on behalf of Car Duibh Wind Farm Limited.

This report provides an outline surface water management strategy to mitigate any impact from surface water runoff attributed to the Proposed Development. The strategy is developed in accordance with sustainable drainage principles and allows the Site to mitigate flood risk during design storm events, whilst ensuring no increase of flood risk to offsite receptors and avoiding deterioration of the water environment.

The drainage strategy presented in this document has been developed to demonstrate measures that could be used across the Site to protect the existing hydrological regime. Examples of mitigation measures are provided throughout the report with detailed proposals for measures to be documented prior to construction. Measures will provide the same or greater protection for the water environment. The measures are designed to be proportionate to the risk and, where greater risk is highlighted at specific locations prior to construction, specific measures would be agreed for those locations.

The drainage strategy has been prepared in accordance with the advice and requirements prescribed in current best practice documents relating to management of flood risk in development, published by the Construction Industry Research and Information Association (CIRIA)[1], the British Standards Institution (BSI) BS8533[2] and Scottish Environment Protection Agency (SEPA) National Standing Advice on Development and Flood Risk[3].

The Site is within the jurisdiction of Argyll and Bute Council (ABC).

To complete the Drainage Strategy, the following key stages of work have been undertaken:

- Collation of desk-based information and undertaking a review of publicly available information, including local data, policy and guidance.
- A desktop review of other data that has been made available such as topographical surveys/elevation information and Proposed Development layout options.
- Estimation of the required surface water attenuation storage and provision of outline Sustainable Urban Drainage Systems (SuDS) features arrangement.

## Background and Site Context

Turbine 1 (T1) of the Proposed Development is the closest to Inveraray, located approximately 6km to the north-west, and T13 is the closest to Dalavich, approximately 4.5km to the east. The location of the Site is shown on Figure 1.

[1] CIRIA Drainage Guidance can be found here: https://www.susdrain.org/resources/ciria-guidance.html
[2] Information on BSI 8533 can be found here: https://knowledge.bsigroup.com/products/assessing-and-managing-flood-risk-in-development-code-of-practice/standard
[3] SEPA National Standing Advice: https://www.sepa.org.uk/media/535237/sepa-standing-advice-for-planning-authorities-and-developers-lups-gu8-v11-web.pdf

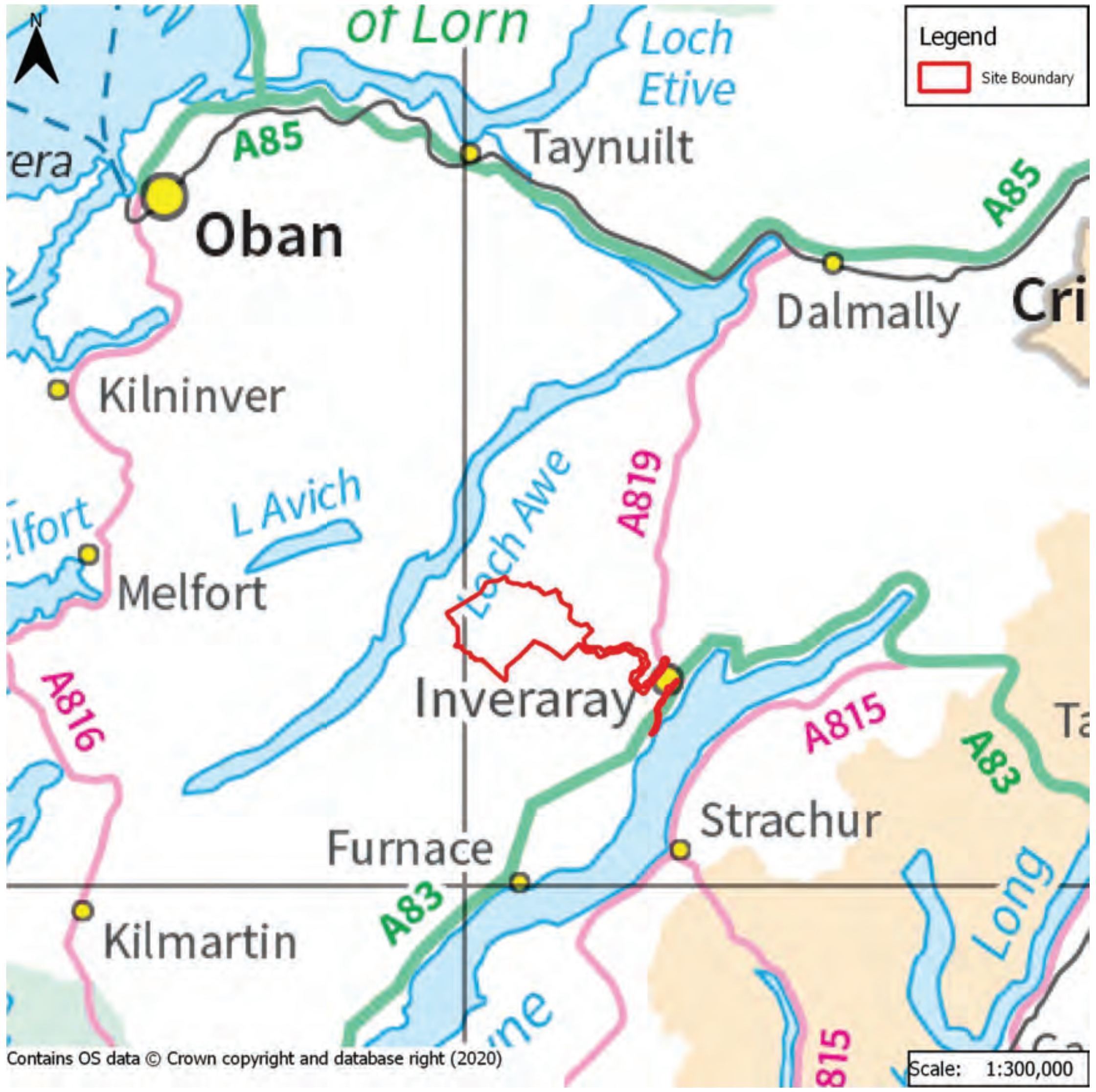


**Figure 1 Site Location Plan**

## Proposed Development

The Proposed Development will comprise up to 13 wind turbines and associated infrastructure as described in detail in Chapter 4: Project Description of the EIA Report.

## Local Watercourses

The main watercourse catchments within the proposed Site boundary are:

- Allt Blarghour (including the Eas an Amair subcatchment);
- Kames River;
- Allt a' Ghlinne;
- Erallich Water (including the Alltan Airigh Mhic Choinnich and All an t-Sluichd subcatchments);
- Allth Bail' a' Ghobhainn;





- Allt Riabhachan;
- Quakers Burn; and
- Crom Allt.

There are a number of unnamed sub-catchments of these larger catchments located within the Site boundary, the channels of which are also crossed by the proposed onsite tracks. Figure 2 shows the extent of existing watercourses crossed by the infrastructure and a catchment map is provided as Figure 7.1 of the EIA Report.

Kaya Consulting (KC) have undertaken a hydrological analysis for each individual catchment at the watercourse crossing location, determining the design flows for 2-, 10-, 30-, 50- and 100-year return periods.

74 new watercourse crossings will be required over the identified tributaries as a result of the Proposed Development. The watercourse crossing location plan, showing proposed and existing crossing locations, is provided in Annex A.

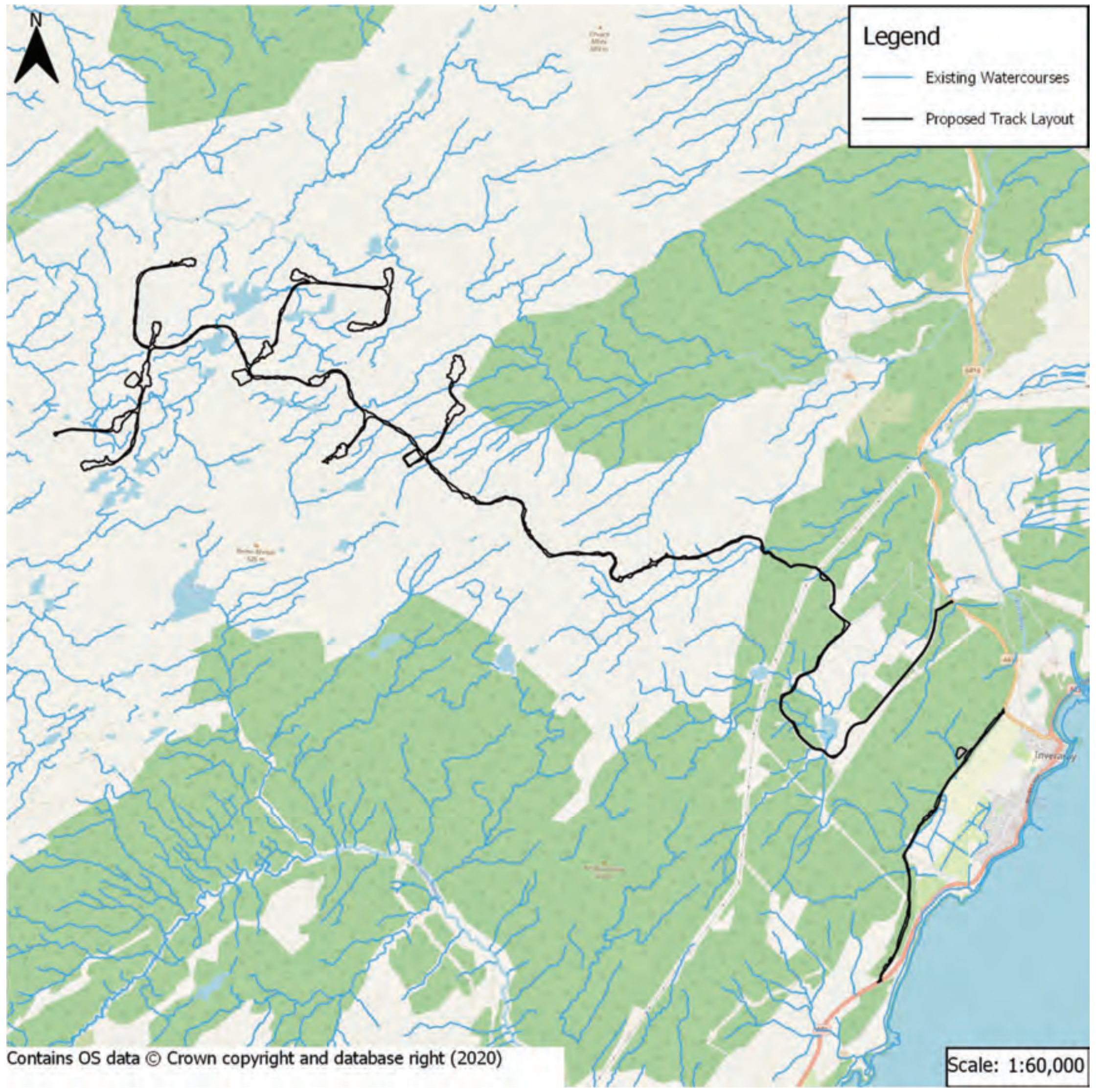


**Figure 2 Existing Watercourses**

## Topography

The highest elevation is within the centre of the Site, adjacent to Beinn Bhreac peak at 526m AOD (Above Ordnance Datum). Ground levels fall northwest and southeast from that location towards Loch Awe and Loch Fyne respectively. The lowest elevations are along proposed access track from the A819 road at approximately 78m AOD. The proposed tracks and wind turbine platforms at the western part of the Site are at approximately 330m AOD.

## Trackside Drainage

The proposed trackside drainage layout for the Proposed Development is shown in Drawings SK01-SK03 (Annex C).

The ditches will be sized by the contractor at the detailed design stage to accommodate surface runoff from the track for the 1 in 30-year design storm event.

All permanent drainage should be installed concurrently with all adjacent infrastructure.

All drainage channels should be sufficiently wide as is practicable to allow wildlife to safely enter and exit the channel. The channel banks shall be at a minimum slope of 1 in 3.

Permanent check dams should be specified at the detailed design stage. They should be spaced at regular intervals within the drainage ditches. Check dams are required to reduce the velocity and slow down sediment transportation while also preventing channel scour.

Check dams are proposed to be constructed of clean aggregate graded 50mm-300mm and embedded into the side walls and invert of the excavation by at least 100mm. The number and location of check dams will be dependent on the slope gradient with a minimum spacing of 1 check dam per 75m length of ditch.

The spacing of relief drains crossing the access tracks should be determined at the detailed design stage. The spacing of relief drains should not exceed 200m as per best practice.

## Watercourse Crossings

The proposed access track and wind farm infrastructure layout intersects a large number of existing watercourses (shown in Figure 2). To maintain hydrological continuity, a number of new watercourse crossings have been incorporated into the design.

KC has identified 105 watercourse crossings associated with the Proposed Development (31 existing crossings and 74 proposed new crossings).

### Design Criteria

The watercourse crossing outline design is based on the following guidance:

- SEPA River Crossings Engineering in the water environment: good practice guide.[4]
- CIRIA The SuDS Manual C753.[5]

[4] SEPA River Crossings Engineering in the Water Environment: Good Practice Guide can be found here: https://www.sepa.org.uk/media/151036/wat-sg-25.pdf
[5] CIRIA The SuDS Manual C753 can be found here: https://www.ciria.org/ItemDetail?iProductCode=C753&





In addition, following consultation with ABC at the EIA Scoping stage (refer to Table 7.1 in Chapter 7 of the EIAR) it was agreed that watercourse crossings would be designed to maintain, and not reduce, the existing capacity of the channel. Crossings were to be sized using runoff calculations to inform dimensions.

### Methodology

The location of the watercourse crossings is based KC's assessment (plan is shown in Annex A).

The ground elevations within the Site boundary are informed from OS Terrain 5 data, hence the cross-section and slope of the watercourses cannot be determined with confidence.

The method for sizing the watercourse crossings included:

1. Estimating the length of the hydraulic structure, based on satellite imagery, OS Terrain 5 data, hydrological characteristics and the extents of the proposed infrastructure.
2. Estimating the slope of the structure, based on upstream and downstream invert levels, informed from OS Terrain 5 data.
3. Sizing the structure based on the above parameters and the requirement to convey the 1 in 30-year return period flows, based on the Manning-Strickler equation and verified with Innovyze Microdrainage for all specified pipe culverts.

The method provides reasonable estimation, the exact slope, however should be assessed on site by the contractor.

### Watercourse Crossing Outline Design

The full results, including the Innovyze Microdrainage output, for all watercourse crossings are provided in Annex B. The following is a summary of the watercourse crossing outline design:

- Watercourse crossings 8 and 9 are shown as located below the T10 foundation and its associated hardstanding. Furthermore, the hydraulic structures would require a length of over 60m. Positioning culverts underneath or in close proximity to the turbine foundation is not recommended as it may compromise bearing capacity and would present a maintenance and serviceability risk. It is recommended that the runoff is intercepted by a cut-off drain along the upslope perimeter of the hardstanding and is then conveyed to a linear drain at the downslope side of the proposed turbine location and discharging the runoff overland, maintaining the hydrological continuity. The proposed layout is shown on Drawing SK01.

- Watercourse crossings 34 and 35 are shown as located below the proposed turbine T01 foundation and its associated hardstanding. Furthermore, the hydraulic structures would require a length of over 60m.
  It is recommended that runoff is intercepted by a cut-off drain along the upslope side of the hardstanding and is conveyed by a culvert below the proposed track to the north.

- Watercourse crossings 74 – 106 are existing culverts. Their capacity was also assessed, and upsizing was recommended based on the outlined approach above.

- Watercourse crossings 2, 16, 22, 27, 29, 36, 72 and 85 are required to convey large flows that cannot be accommodated by pipe culverts. It is therefore recommended for the track to bridge over these watercourses, which would enable them to maintain existing capacity and have the least impact as per SEPA guidance. Current SEPA guidance advises that box culverts are only suitable for small streams in lowland rivers, therefore, not recommended for the highlighted crossings.

The proposed pipe culverts will have to incorporate concrete structural protection to account for the abnormal loadings and mitigate against structural failure. The concrete surround specification will be determined at the detailed design stage of the project.

The design of the proposed bridge structures will be undertaken at the detailed design stage, as further survey will be required to confirm the necessary span and deck level.

The proposed culverts should be laid in natural ground or into the bed of the watercourse where applicable. All culvert sizes have been designed to maintain self-cleansing velocity during the design event (in in 30-year return period).

## Flow Attenuation

Current best practice relating to sustainable surface water management is outlined in the SuDS Manual (CIRIA Report C753) which provides details on the use of SuDS for managing surface water runoff:

- Prevention – the use of good site design and housekeeping measures on individual sites to prevent runoff and pollution (e.g. minimise areas of hard standing).
- Source Control – control of runoff at or very near its source (such as the use of rainwater harvesting, permeable paving or green roofs).
- Site Control – management of water from several sub-catchments (including routing water from roofs and car parks to one or several soakaways or attenuation ponds for the whole site).
- Regional Control – management of runoff from several sites, typically in a retention pond or wetland.

It is generally accepted that implementation of SuDS, as opposed to conventional drainage systems, provides several benefits by:

- Reducing peak flows to watercourses or sewers and potentially reducing the risk of flooding downstream. Reducing the volumes and frequency of water flowing directly to watercourses or sewers by removing pollutants from diffuse pollutant sources.
- Improving water quality over conventional surface water sewers by removing pollutants from diffuse pollutant sources.
- Reducing potable water demand through rainwater harvesting.
- Improving amenity through the provision of public open spaces and providing biodiversity and wildlife habitat enhancements.
- Replicating natural drainage patterns, including the recharge of groundwater so that the baseflows are maintained.

The Surface Water Drainage Strategy for the Proposed Development will comprise the management of surface water runoff from the hardstanding and roof areas.

In accordance with CIRIA Report C753, the hierarchy for favoured disposal of surface water runoff from development sites is as follows:

1. Water reuse, where a demand is identified.
2. Infiltration to Ground, where ground conditions permit.
3. Discharge to Surface Waters.
4. Discharge to Sewer.

### Proposed Surface Drainage

The impermeable areas within the Proposed Development consist of the substation platform and the turbine hardstanding areas. They will consist of compacted gravel. The drainage design is based on a conservative assumption that they are 80% impermeable.





Greenfield runoff rates have been estimated through application of methodology outlined in IH124 as set out within the Interim Code of Practice for SuDS (ICPSuDS). The IH124 method can be used to estimate Greenfield runoff rates for a range of Annual Exceedance Probability (AEP) events, or return periods by applying regional growth curve factors to the mean annual peak runoff (i.e. QBAR). The UK hydrological region for the Site is Region 1 therefore the appropriate growth curve factors for this region have been incorporated into the analysis undertaken in the MicroDrainage software suite.

The hydrological characteristics for the catchment have been incorporated into the runoff modelling and results are presented below in Table 1 for a range of AEP storm events.

- Site Area: Substation Platform – 1.06ha; Turbine hardstanding – 0.22ha
- Average Annual Rainfall (SAAR): 2000
- Soil Index: 0.4
- UK Hydrological Region: No.1
- Urban Extent: 0

**Table 1 Estimation of Greenfield (pre-development) Rate of Runoff**

| AEP (%) | Return Period | Greenfield Runoff Rate (l/s/ha) |
|---|---|---|
| 50 | 2 | 10.6 |
| | QBAR | 11.6 |
| 3.3 | 30 | 22 |
| 1 | 100 | 28.8 |
| 0.5 | 200 | 32.7 |
| 0.1 | 1000 | 42.2 |

The QBAR 'Unit Greenfield Runoff Rate' for the Site, and thus the limiting post development peak runoff rate for all storm events up to and including the design 0.5% AEP plus climate change, has been estimated to be 11.6l/s/ha.

Therefore, the Greenfield runoff rate for Site Compound, assuming 80% impermeability is **9.84l/s** for the substation platform and **1.86l/s** for a wind turbine hardstanding.

### Proposed Attenuation and SuDS Features

Based on the attenuation calculations, undertaken in MicroDrainage (Annex D), a volume of 620m$^3$ need to be attenuated for the substation platform for the 0.5% AEP + uplift for climate change. It is proposed that this is attenuated via a SuDS attenuation pond with the following parameters:

- 1.5m total depth
- 835m$^3$ total volume
- 302mm freeboard allowance
- 1 in 3 side slope
- Outflow controlled via a Hydro-brake

For the turbine hardstanding areas, it is proposed that interception drains are placed at the downslope of the wind turbine platforms, intercepting and attenuating runoff. Discharge of surface water would be achieved by water spilling over a designed weir section along the crest of the drain with appropriate erosion protection. This attenuation method is considered most suitable for the rural upland area of the Site. The required attenuation volume per turbine hardstanding area for the 0.5% AEP + uplift for climate change is 75m$^3$ and was calculated through Innovyze MicroDrainage (shown in Annex D).

It is recommended that emergency spillway IS designed within the detailed design stage for the proposed SuDS pond to accommodate for a storm event exceeding 0.5% AEP + climate change.

The latest guidance on climate change impacts on peak rainfall intensities has been published by SEPA, with an updated approach based on regional estimates across river management catchments. The site falls within the Argyll Catchment, which suggests for the 2080s epoch the climate change allowance is 46%.

## Summary & Recommendations

Summary of outline drainage strategy for the site:

- The Site contains 6.6km of access tracks. The proposed access tracks will be served by a network of surface water drainage ditches adjacent to the tracks. The trackside drainage will utilise relief drains crossing the access track longitudinally to ensure the drainage ditches do not surcharge.
- The proposed drains should utilise silt traps/catch pits at the inlet of all cross drains to prevent the pipes becoming blocked.
- The proposed trackside drainage should be designed so that it allows wildlife to cross safely.
- Erosion protection should be utilised at all inlets and outlets
- 74 proposed watercourse crossings have been sized and specified on the basis of hydrological assessment undertaken by KC, OS terrain 5 data and the proposed infrastructure layout.
- 8 proposed watercourse crossing are bridges.
- 66 proposed watercourse crossings are conventional piped culverts.
- 4 proposed watercourse crossings are diverted through drainage ditches around the proposed wind turbine hardstandings.
- 31 existing watercourse crossings have been assessed for capacity, based on available information at the time of writing of this report.
- It is proposed that runoff from the proposed substation platform and the wind turbine hardstandings is attenuated by cut-off drains at the downslope side of the platforms. Runoff would then be discharged overland towards the downstream catchment.







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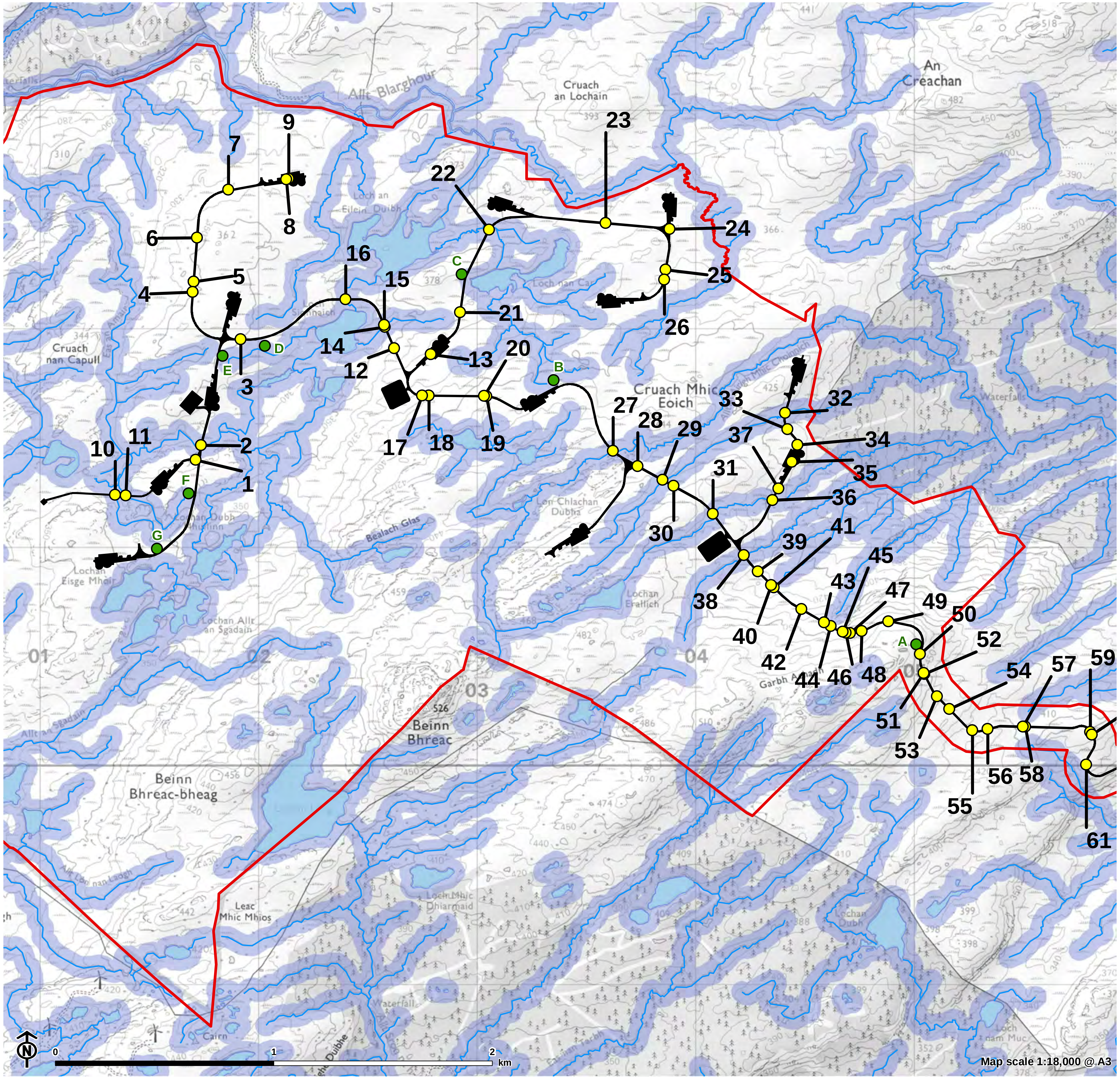
| | | | | | | |
| | | | | | | |

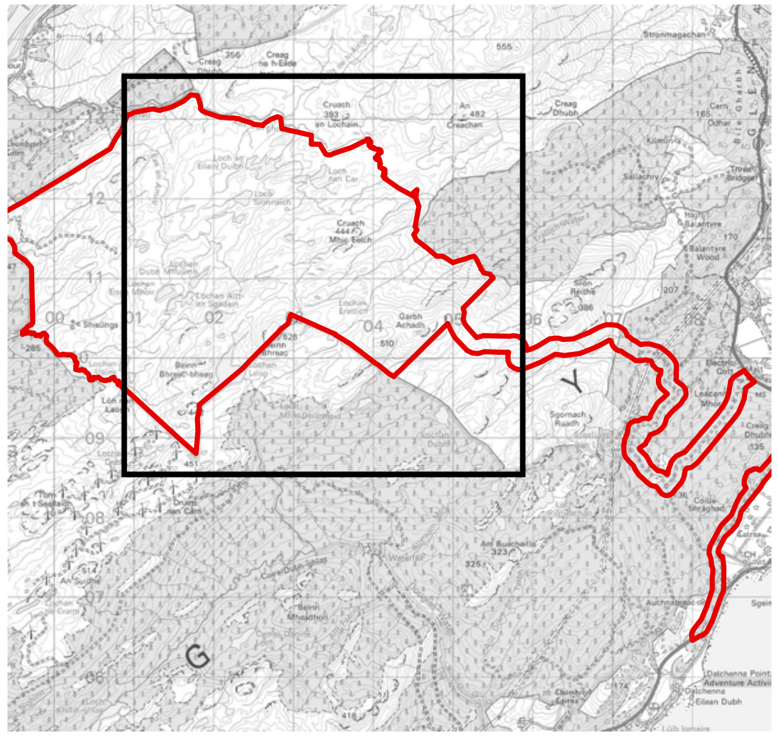
Ref. reference. Rev revision. Suit suitability.

# Annex A Initial Watercourse Crossing Location

An Càrr Dubh Wind Farm
for Car Duibh Wind Farm Ltd

**Figure 7.2.1: Watercourses and Crossings**



- Site boundary
- Infrastructure footprint
- Watercourse
- Waterbody
- 50m watercourse and waterbody buffer
- Watercourse buffer encroachment

**Watercourse crossing**

- Existing crossing
- Proposed crossing

KAYA CONSULTING

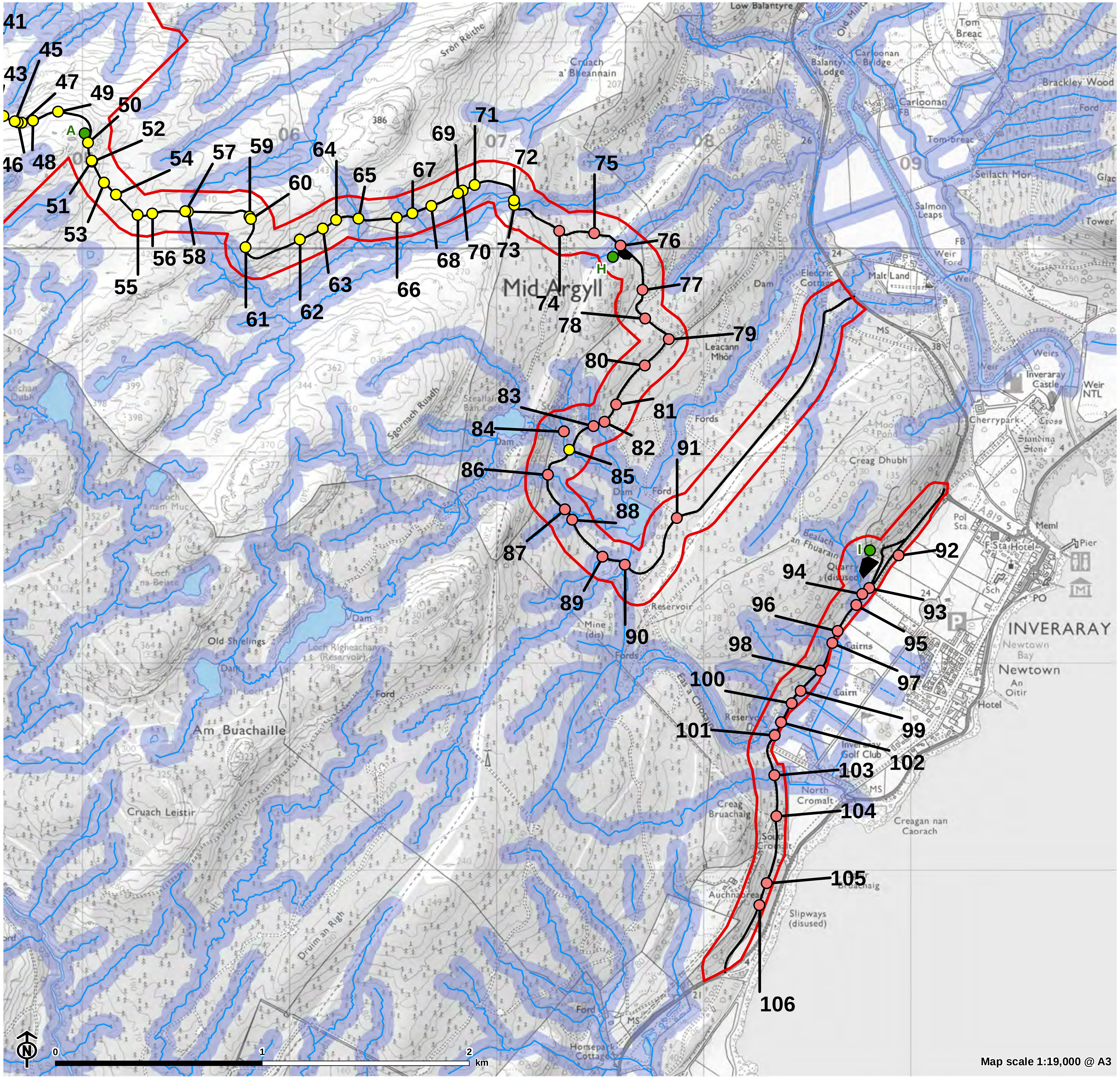
Statkraft

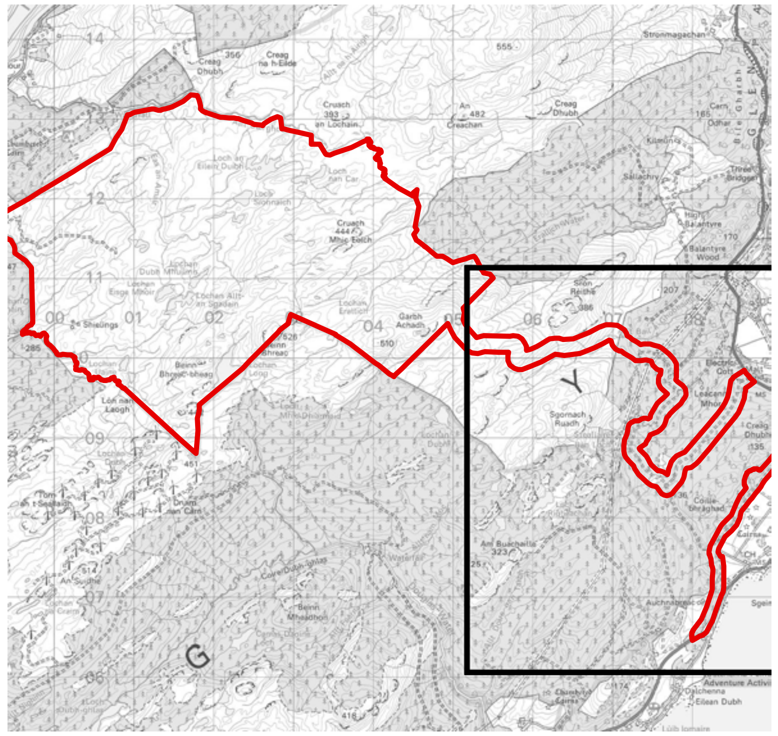


CB:JH EB:Harbich_J LUC FIG07-02_11260_r0_WatercoursesDrainage_A3L 06/01/2023
Source: LUC, Statkraft, Kaya Consulting

**An Càrr Dubh Wind Farm**
for Car Duibh Wind Farm Ltd

## Figure 7.2.2: Watercourses and Crossings



- Site boundary
- Infrastructure footprint
- Watercourse
- Waterbody
- 50m watercourse and waterbody buffer
- Watercourse buffer encroachment

**Watercourse crossing**

- Existing crossing
- Proposed crossing

Map scale 1:19,000 @ A3

KAYA CONSULTING

Statkraft



CB:JH EB:Harbich_J LUC FIG07-02_11260_r0_WatercoursesDrainage_A3L 06/01/2023
Source: LUC, Statkraft, Kaya Consulting

# Annex B Watercourse Crossing Specification

## STORM SEWER DESIGN by the Modified Rational Method

### Network Design Table for Storm

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S1.000 | 21.675 | 0.100 | 216.8 | 0.000 | 10.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | |
| S3.000 | 16.962 | 0.760 | 22.3 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S4.000 | 20.168 | 3.370 | 6.0 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S5.000 | 26.323 | 2.510 | 10.5 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S6.000 | 16.279 | 0.440 | 37.0 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S7.000 | 31.000 | 3.410 | 9.1 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S10.000 | 10.247 | 0.950 | 10.8 | 0.000 | 10.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| S11.000 | 21.422 | 0.080 | 267.8 | 0.000 | 10.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |

### Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S1.000 | 50.00 | 10.24 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 1.52 | 328.5 | 0.0 |
| S3.000 | 50.00 | 10.08 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 3.34 | 236.3 | 0.0 |
| S4.000 | 50.00 | 10.05 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 6.47 | 457.1 | 0.0 |
| S5.000 | 50.00 | 10.09 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 4.88 | 345.1 | 0.0 |
| S6.000 | 50.00 | 10.10 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 2.59 | 183.3 | 0.0 |
| S7.000 | 50.00 | 10.10 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 5.24 | 370.7 | 0.0 |
| S10.000 | 50.00 | 10.03 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 6.22 | 988.8 | 0.0 |
| S11.000 | 50.00 | 10.29 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 1.24 | 196.8 | 0.0 |





## STORM SEWER DESIGN by the Modified Rational Method

### Network Design Table for Storm

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S12.000 | 29.194 | 2.070 | 14.1 | 0.000 | 10.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| S14.000 | 28.641 | 0.840 | 34.1 | 0.000 | 10.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | |
| S15.000 | 28.641 | 0.820 | 34.9 | 0.000 | 10.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | |
| S17.000 | 25.186 | 2.310 | 10.9 | 0.000 | 10.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | |
| S18.000 | 28.838 | 4.250 | 6.8 | 0.000 | 10.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | |
| S19.000 | 22.407 | 0.980 | 22.9 | 0.000 | 10.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| S20.000 | 24.284 | 0.990 | 24.5 | 0.000 | 10.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| S21.000 | 10.850 | 0.450 | 24.1 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |

### Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S12.000 | 50.00 | 10.09 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 5.44 | 864.5 | 0.0 |
| S14.000 | 50.00 | 10.12 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 3.85 | 832.4 | 0.0 |
| S15.000 | 50.00 | 10.13 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 3.80 | 822.4 | 0.0 |
| S17.000 | 50.00 | 10.06 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 6.81 | 1474.3 | 0.0 |
| S18.000 | 50.00 | 10.06 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 8.64 | 1869.6 | 0.0 |
| S19.000 | 50.00 | 10.09 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 4.27 | 678.5 | 0.0 |
| S20.000 | 50.00 | 10.10 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 4.12 | 655.0 | 0.0 |
| S21.000 | 50.00 | 10.06 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 3.22 | 227.3 | 0.0 |

## STORM SEWER DESIGN by the Modified Rational Method

### Network Design Table for Storm

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S23.000 | 15.879 | 0.280 | 56.7 | 0.000 | 10.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | |
| S25.000 | 29.222 | 1.500 | 19.5 | 0.000 | 10.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| S26.000 | 17.969 | 1.790 | 10.0 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S28.000 | 36.344 | 2.430 | 15.0 | 0.000 | 10.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| S30.000 | 20.729 | 0.440 | 47.1 | 0.000 | 10.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| S31.000 | 35.812 | 4.070 | 8.8 | 0.000 | 10.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | |
| S32.000 | 30.955 | 2.680 | 11.6 | 0.000 | 10.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | |

### Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S23.000 | 50.00 | 10.09 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 2.98 | 644.8 | 0.0 |
| S25.000 | 50.00 | 10.11 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 4.62 | 735.2 | 0.0 |
| S26.000 | 50.00 | 10.06 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 4.99 | 352.7 | 0.0 |
| S28.000 | 50.00 | 10.11 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 5.28 | 839.4 | 0.0 |
| S30.000 | 50.00 | 10.12 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 2.97 | 472.0 | 0.0 |
| S31.000 | 50.00 | 10.08 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 7.58 | 1641.4 | 0.0 |
| S32.000 | 50.00 | 10.08 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 6.62 | 1432.3 | 0.0 |





## STORM SEWER DESIGN by the Modified Rational Method

### Network Design Table for Storm

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S33.000 | 20.796 | 1.980 | 10.5 | 0.000 | 10.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| S34.000 | 1.000 | 1.000 | 1.0 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S35.000 | 1.000 | 1.000 | 1.0 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S37.000 | 23.733 | 3.570 | 6.6 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S38.000 | 16.079 | 1.860 | 8.6 | 0.000 | 10.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | |
| S39.000 | 27.941 | 3.160 | 8.8 | 0.000 | 10.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| S40.000 | 28.380 | 3.070 | 9.2 | 0.000 | 10.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| S41.000 | 27.112 | 2.460 | 11.0 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S42.000 | 17.510 | 2.580 | 6.8 | 0.000 | 10.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |

### Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S33.000 | 50.00 | 10.06 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 6.30 | 1002.1 | 0.0 |
| S34.000 | 50.00 | 10.00 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 15.84 | 1119.6 | 0.0 |
| S35.000 | 50.00 | 10.00 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 15.84 | 1119.6 | 0.0 |
| S37.000 | 50.00 | 10.06 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 6.14 | 433.7 | 0.0 |
| S38.000 | 50.00 | 10.04 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 7.65 | 1656.0 | 0.0 |
| S39.000 | 50.00 | 10.07 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 6.87 | 1092.3 | 0.0 |
| S40.000 | 50.00 | 10.07 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 6.72 | 1068.2 | 0.0 |
| S41.000 | 50.00 | 10.09 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 4.76 | 336.6 | 0.0 |
| S42.000 | 50.00 | 10.04 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 7.84 | 1247.1 | 0.0 |

## STORM SEWER DESIGN by the Modified Rational Method

### Network Design Table for Storm

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S43.000 | 39.815 | 5.920 | 6.7 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S44.000 | 34.917 | 6.660 | 5.2 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S45.000 | 16.543 | 6.630 | 2.5 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S46.000 | 18.040 | 6.460 | 2.8 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S47.000 | 15.452 | 2.140 | 7.2 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S48.000 | 15.926 | 4.040 | 3.9 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S49.000 | 26.644 | 5.100 | 5.2 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S50.000 | 28.217 | 7.550 | 3.7 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S51.000 | 21.539 | 4.220 | 5.1 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S52.000 | 2.220 | 12.458 | 0.2 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S53.000 | 27.038 | 1.910 | 14.2 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |

### Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S43.000 | 50.00 | 10.11 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 6.10 | 431.2 | 0.0 |
| S44.000 | 50.00 | 10.08 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 6.91 | 488.5 | 0.0 |
| S45.000 | 50.00 | 10.03 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 10.02 | 708.5 | 0.0 |
| S46.000 | 50.00 | 10.03 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 9.47 | 669.6 | 0.0 |
| S47.000 | 50.00 | 10.04 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 5.89 | 416.1 | 0.0 |
| S48.000 | 50.00 | 10.03 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 7.97 | 563.4 | 0.0 |
| S49.000 | 50.00 | 10.06 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 6.92 | 489.3 | 0.0 |
| S50.000 | 50.00 | 10.06 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 8.19 | 578.7 | 0.0 |
| S51.000 | 50.00 | 10.05 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 7.00 | 495.1 | 0.0 |
| S52.000 | 50.00 | 10.00 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 37.54 | 2653.6 | 0.0 |
| S53.000 | 50.00 | 10.11 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 4.20 | 296.9 | 0.0 |





## STORM SEWER DESIGN by the Modified Rational Method

### Network Design Table for Storm

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S54.000 | 17.686 | 0.690 | 25.6 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S55.000 | 48.807 | 0.750 | 65.1 | 0.000 | 10.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| S56.000 | 13.236 | 0.800 | 16.5 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S57.000 | 28.363 | 2.020 | 14.0 | 0.000 | 10.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| S58.000 | 24.037 | 1.390 | 17.3 | 0.000 | 10.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| S59.000 | 17.990 | 1.200 | 15.0 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S60.000 | 17.061 | 0.980 | 17.4 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S61.000 | 15.808 | 1.280 | 12.4 | 0.000 | 10.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| S62.000 | 14.090 | 3.620 | 3.9 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S63.000 | 44.080 | 20.420 | 2.2 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |

### Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S54.000 | 50.00 | 10.09 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 3.12 | 220.4 | 0.0 |
| S55.000 | 50.00 | 10.32 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 2.52 | 401.3 | 0.0 |
| S56.000 | 50.00 | 10.06 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 3.88 | 274.6 | 0.0 |
| S57.000 | 50.00 | 10.09 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 5.45 | 866.4 | 0.0 |
| S58.000 | 50.00 | 10.08 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 4.91 | 780.5 | 0.0 |
| S59.000 | 50.00 | 10.07 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 4.08 | 288.5 | 0.0 |
| S60.000 | 50.00 | 10.08 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 3.79 | 267.6 | 0.0 |
| S61.000 | 50.00 | 10.05 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 5.81 | 923.9 | 0.0 |
| S62.000 | 50.00 | 10.03 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 8.02 | 567.0 | 0.0 |
| S63.000 | 50.00 | 10.07 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 10.78 | 761.7 | 0.0 |

## STORM SEWER DESIGN by the Modified Rational Method

### Network Design Table for Storm

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S64.000 | 17.081 | 5.810 | 2.9 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S65.000 | 12.781 | 3.080 | 4.1 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S66.000 | 26.711 | 7.160 | 3.7 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S67.000 | 25.469 | 7.890 | 3.2 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S68.000 | 23.457 | 5.490 | 4.3 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S69.000 | 19.083 | 5.620 | 3.4 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S70.000 | 25.440 | 8.140 | 3.1 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S71.000 | 20.575 | 7.610 | 2.7 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S73.000 | 13.364 | 1.430 | 9.3 | 1.000 | 10.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| S74.000 | 24.186 | 2.240 | 10.8 | 0.000 | 10.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |

### Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S64.000 | 50.00 | 10.03 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 9.23 | 652.6 | 0.0 |
| S65.000 | 50.00 | 10.03 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 7.77 | 549.2 | 0.0 |
| S66.000 | 50.00 | 10.05 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 8.19 | 579.2 | 0.0 |
| S67.000 | 50.00 | 10.05 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 8.81 | 622.8 | 0.0 |
| S68.000 | 50.00 | 10.05 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 7.66 | 541.2 | 0.0 |
| S69.000 | 50.00 | 10.04 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 8.59 | 607.2 | 0.0 |
| S70.000 | 50.00 | 10.05 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 8.95 | 632.9 | 0.0 |
| S71.000 | 50.00 | 10.04 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 9.63 | 680.6 | 0.0 |
| S73.000 | 50.00 | 10.03 | 0.000 | 1.000 | 0.0 | 0.0 | 0.0 | 6.68 | 1062.4 | 135.4 |
| S74.000 | 50.00 | 10.06 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 6.21 | 988.3 | 0.0 |





## STORM SEWER DESIGN by the Modified Rational Method

### Network Design Table for Storm

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S75.000 | 12.986 | 1.350 | 9.6 | 0.000 | 10.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| S76.000 | 14.050 | 1.100 | 12.8 | 0.000 | 10.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| S77.000 | 10.431 | 0.640 | 16.3 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S78.000 | 13.121 | 0.410 | 32.0 | 0.000 | 10.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| S80.000 | 17.656 | 4.090 | 4.3 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S81.000 | 19.211 | 6.850 | 2.8 | 0.000 | 10.00 | 0.0 | 0.600 | o | 250 | Pipe/Conduit | |
| S82.000 | 14.786 | 1.720 | 8.6 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S83.000 | 14.954 | 3.090 | 4.8 | 0.000 | 10.00 | 0.0 | 0.600 | o | 850 | Pipe/Conduit | |
| S84.000 | 1.000 | 1.000 | 1.0 | 0.000 | 10.00 | 0.0 | 0.600 | o | 100 | Pipe/Conduit | |

### Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S75.000 | 50.00 | 10.03 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 6.58 | 1047.2 | 0.0 |
| S76.000 | 50.00 | 10.04 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 5.71 | 908.5 | 0.0 |
| S77.000 | 50.00 | 10.04 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 3.91 | 276.6 | 0.0 |
| S78.000 | 50.00 | 10.06 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 3.60 | 573.2 | 0.0 |
| S80.000 | 50.00 | 10.04 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 7.62 | 538.4 | 0.0 |
| S81.000 | 50.00 | 10.04 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 8.42 | 413.3 | 0.0 |
| S82.000 | 50.00 | 10.05 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 5.39 | 381.3 | 0.0 |
| S83.000 | 50.00 | 10.02 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 13.80 | 7828.5 | 0.0 |
| S84.000 | 50.00 | 10.00 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 7.80 | 61.3 | 0.0 |

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Storm

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S87.000 | 15.881 | 0.960 | 16.5 | 0.000 | 10.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| S88.000 | 18.286 | 4.420 | 4.1 | 0.000 | 10.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| S90.000 | 17.344 | 0.820 | 21.2 | 0.000 | 10.00 | 0.0 | 0.600 | o | 1200 | Pipe/Conduit | |
| S91.000 | 11.983 | 0.270 | 44.4 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S92.000 | 17.291 | 2.890 | 6.0 | 0.000 | 10.00 | 0.0 | 0.600 | o | 250 | Pipe/Conduit | |
| S93.000 | 15.338 | 2.920 | 5.3 | 0.000 | 10.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| S94.000 | 14.764 | 1.630 | 9.1 | 0.000 | 10.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | |
| S95.000 | 15.358 | 1.150 | 13.4 | 0.000 | 10.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |

Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S87.000 | 50.00 | 10.05 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 5.02 | 798.0 | 0.0 |
| S88.000 | 50.00 | 10.03 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 10.05 | 1597.9 | 0.0 |
| S90.000 | 50.00 | 10.04 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 8.15 | 9218.7 | 0.0 |
| S91.000 | 50.00 | 10.08 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 2.37 | 167.3 | 0.0 |
| S92.000 | 50.00 | 10.05 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 5.76 | 282.7 | 0.0 |
| S93.000 | 50.00 | 10.03 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 8.91 | 1417.8 | 0.0 |
| S94.000 | 50.00 | 10.03 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 8.12 | 2296.5 | 0.0 |
| S95.000 | 50.00 | 10.05 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 5.59 | 888.4 | 0.0 |





STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Storm

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S96.000 | 12.738 | 1.800 | 7.1 | 0.000 | 10.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| S97.000 | 17.791 | 6.000 | 3.0 | 0.000 | 10.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| S98.000 | 15.182 | 4.170 | 3.6 | 0.000 | 10.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| S99.000 | 15.760 | 4.060 | 3.9 | 0.000 | 10.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| S100.000 | 14.448 | 2.810 | 5.1 | 0.000 | 10.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| S101.000 | 19.664 | 0.930 | 21.1 | 0.000 | 10.00 | 0.0 | 0.600 | o | 1000 | Pipe/Conduit | |
| S102.000 | 32.873 | 3.430 | 9.6 | 0.000 | 10.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| S103.000 | 16.089 | 3.360 | 4.8 | 0.000 | 10.00 | 0.0 | 0.600 | o | 800 | Pipe/Conduit | |
| S104.000 | 16.355 | 4.520 | 3.6 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S105.000 | 29.133 | 10.580 | 2.8 | 0.000 | 10.00 | 0.0 | 0.600 | o | 250 | Pipe/Conduit | |

Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S96.000 | 50.00 | 10.03 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 7.68 | 1221.2 | 0.0 |
| S97.000 | 50.00 | 10.02 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 11.87 | 1887.8 | 0.0 |
| S98.000 | 50.00 | 10.02 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 10.71 | 1703.5 | 0.0 |
| S99.000 | 50.00 | 10.03 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 10.37 | 1649.7 | 0.0 |
| S100.000 | 50.00 | 10.03 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 9.01 | 1433.1 | 0.0 |
| S101.000 | 50.00 | 10.04 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 7.29 | 5724.3 | 0.0 |
| S102.000 | 50.00 | 10.08 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 6.60 | 1049.1 | 0.0 |
| S103.000 | 50.00 | 10.02 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 13.36 | 6715.2 | 0.0 |
| S104.000 | 50.00 | 10.03 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 8.32 | 588.2 | 0.0 |
| S105.000 | 50.00 | 10.06 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 8.50 | 417.1 | 0.0 |

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Storm

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S106.000 | 24.499 | 7.760 | 3.2 | 0.000 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |

Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S106.000 | 50.00 | 10.05 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 8.91 | 629.7 | 0.0 |



| Crossing ID | US Level (mAOD) | DS Level (mAOD) | Fall (m) | Slope (1 in X) | Length (m) | 30-yr RP Flow (m3/s) | 30-yr RP Flow (l/s) | Culvert Capacity | Culvert Type | Culvert Size | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 339.19 | | 0.06 | 216.8 | 21.675 | 0.30 | 297.39 | 328.5 | CIRC | 525 | |
| 2 | 331.62 | 331.4 | 0.22 | 126 | 27.619 | 14.29 | 14291.24 | - | BRIDGE | | Bridge crossing required to maintain channel flow. Deck soffit to be determined during detailed design stage. |
| 3 | 352.33 | 351.57 | 0.76 | 22 | 16.962 | 0.12 | 116.76 | 236.3 | CIRC | 300 | |
| 4 | 348.73 | 345.36 | 3.37 | 6 | 20.168 | 0.21 | 210.61 | 457.1 | CIRC | 300 | |
| 5 | 347.13 | 344.62 | 2.51 | 10 | 26.323 | 0.21 | 210.61 | 345.1 | CIRC | 300 | |
| 6 | 346.82 | 346.38 | 0.44 | 37 | 16.279 | <0.12 | 120 | 183.3 | CIRC | 300 | |
| 7 | 338.37 | 334.96 | 3.41 | 9 | 31 | 0.12 | 116.76 | 370.7 | CIRC | 300 | |
| 8 | 338.83 | 338.83 | | | | 0.12 | 116.76 | | | | Watercourses to be intercepted by a cut-off ditch and to be discharged freely overland downstream |
| 9 | 339.21 | 339.21 | | | | 0.12 | 116.76 | | | | |
| 10 | 338.15 | 337.2 | 0.95 | 11 | 10.247 | 0.76 | 757.45 | 988.8 | CIRC | 450 | |
| 11 | 337.18 | 337.17 | 0.01 | 2142 | 21.422 | 0.30 | 297.39 | 23.4 | | | |
| 12 | 352.19 | 350.12 | 2.07 | 14 | 29.194 | 0.46 | 459.32 | 864.5 | CIRC | 450 | |
| 13 | 373.98 | 368.56 | 5.42 | 11 | 61.621 | 0.21 | 210.61 | 1119.6 | CIRC | 300 | |
| 14 | 338.26 | 337.42 | 0.84 | 35 | 28.641 | 0.83 | 828.51 | 832.4 | CIRC | 525 | |
| 15 | 338.26 | 337.44 | 0.82 | 35 | 28.641 | 0.76 | 757.45 | 822.4 | CIRC | 525 | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 16 | 336.41 | 334.85 | 1.56 | 15 | 22.819 | 5.22 | 5221.88 | - | BRIDGE | | Bridge crossing required to maintain channel flow. Deck soffit to be determined during detailed design stage. |
| 17 | 382.09 | 379.78 | 2.31 | 11 | 25.186 | 1.30 | 1301.39 | 1474.3 | CIRC | 525 | |
| 18 | 388.12 | 383.87 | 4.25 | 7 | 28.838 | 1.30 | 1301.39 | 1869.6 | CIRC | 525 | |
| 19 | 405.84 | 404.86 | 0.98 | 23 | 22.407 | 0.38 | 379.88 | 678.5 | CIRC | 450 | |
| 20 | 406.01 | 405.02 | 0.99 | 25 | 24.284 | 0.46 | 459.32 | 655.0 | CIRC | 450 | |
| 21 | 360.4 | 359.95 | 0.45 | 24 | 10.85 | <0.12 | 120 | 227.3 | CIRC | 300 | |
| 22 | 341.81 | 341.34 | 0.47 | 36 | 16.886 | 3.53 | 3534.64 | - | BRIDGE | | Bridge crossing required to maintain channel flow. Deck soffit to be determined during detailed design stage. |
| 23 | 363.1 | 362.82 | 0.28 | 57 | 15.879 | 0.54 | 536.42 | 644.8 | CIRC | 525 | |
| 24 | 363.01 | 358.06 | 4.95 | 12 | 60.408 | 0.76 | 757.45 | 1119.6 | CIRC | 300 | |
| 25 | 371.78 | 370.28 | 1.5 | 19 | 29.222 | 0.54 | 536.42 | 735.2 | CIRC | 450 | |
| 26 | 379.9 | 378.11 | 1.79 | 10 | 17.969 | <0.12 | 120 | 352.7 | CIRC | 300 | |

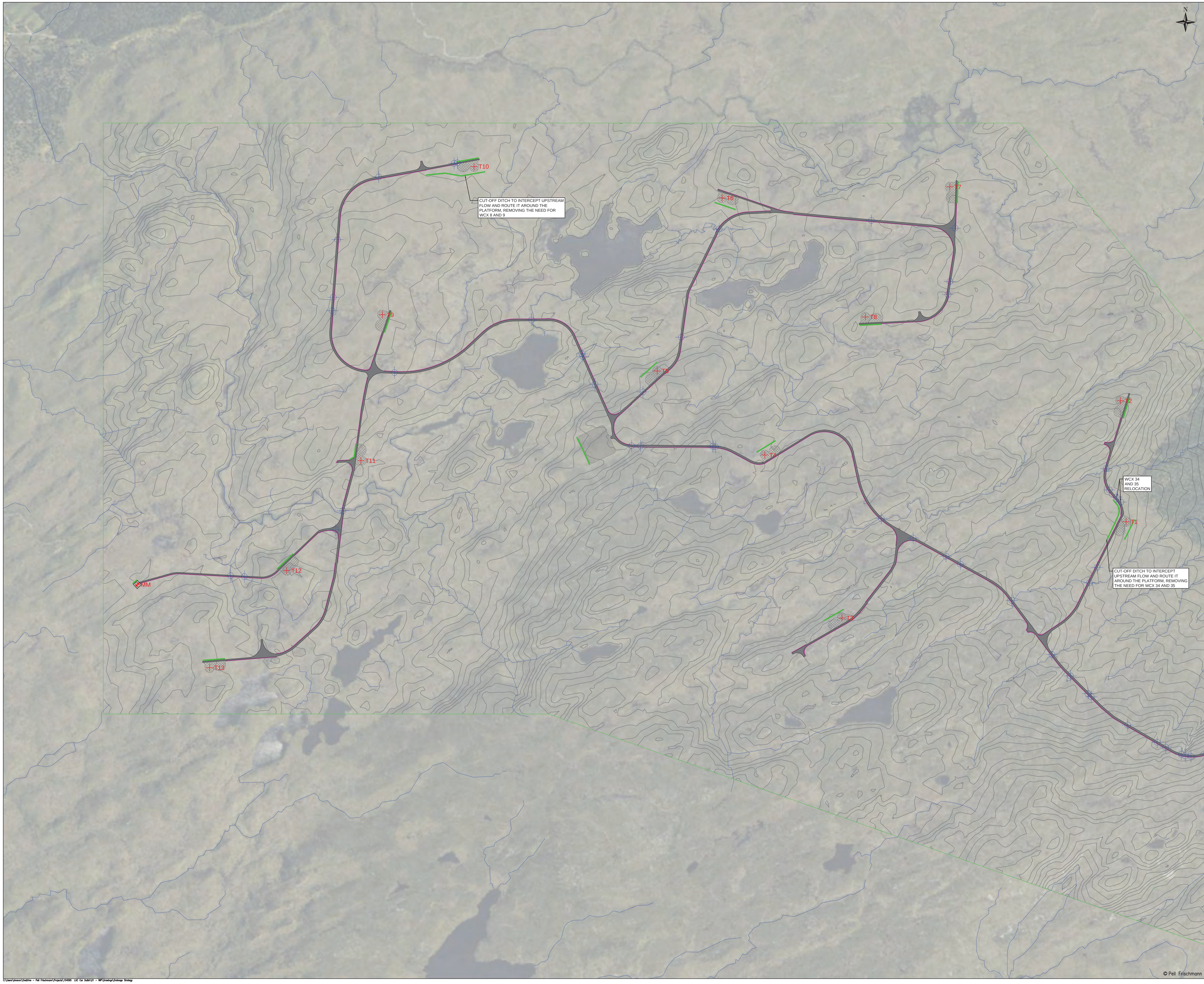
| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 27 | 424.76 | 423.88 | 0.88 | 32 | 28.141 | 3.70 | 3698.05 | - | BRIDGE | | Bridge crossing required to maintain channel flow. Deck soffit to be determined during detailed design stage. |
| 28 | 423.04 | 420.61 | 2.43 | 15 | 36.344 | 0.38 | 379.88 | 839.4 | CIRC | 450 | |
| 29 | 420.84 | 420.79 | 0.05 | 706 | 35.31 | 0.69 | 685.21 | - | BRIDGE | | Bridge crossing required to maintain channel flow. Deck soffit to be determined during detailed design stage. |
| 30 | 426.97 | 426.53 | 0.44 | 47 | 20.729 | <0.12 | 120 | 472 | CIRC | 450 | |
| 31 | 423.95 | 419.88 | 4.07 | 9 | 35.812 | 1.56 | 1557.77 | 1647.4 | CIRC | 525 | |
| 32 | 390.04 | 387.52 | 2.52 | 12 | 30.955 | 1.43 | 1430.59 | 1432.2 | CIRC | 525 | |
| 33 | 388.33 | 386.35 | 1.98 | 11 | 20.796 | 0.38 | 379.88 | 1002.1 | CIRC | 450 | |
| 34 | 391.82 | 376.77 | 15.1 | 7 | 100.687 | <0.12 | 120 | 1119.6 | CIRC | 300 | Crossing location relocated via cut-off ditch upstream to avoid crossing underneath T1 platform |
| 35 | 398.28 | 381.44 | 16.8 | 6 | 104.271 | <0.12 | 120 | 1119.6 | CIRC | 300 | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 36 | 397.57 | 395.62 | 1.95 | 7 | 13.93 | 1.93 | 1929.24 | - | BRIDGE | | Bridge crossing required to maintain channel flow. Deck soffit to be determined during detailed design stage. |
| 37 | 398.81 | 395.24 | 3.57 | 7 | 23.733 | 0.12 | 116.76 | 433.7 | CIRC | 300 | |
| 38 | 416.21 | 414.35 | 1.86 | 9 | 16.079 | 1.56 | 1557.77 | 1656 | CIRC | 525 | |
| 39 | 409.33 | 406.17 | 3.16 | 9 | 27.941 | 0.61 | 611.61 | 1092.3 | CIRC | 450 | |
| 40 | 412.32 | 409.25 | 3.07 | 9 | 28.38 | 0.38 | 379.88 | 1068.2 | CIRC | 450 | |
| 41 | 411.97 | 409.51 | 2.46 | 11 | 27.112 | <0.12 | 120 | 336.6 | CIRC | 300 | |
| 42 | 430.31 | 427.73 | 2.58 | 7 | 17.51 | 0.69 | 685.21 | 1247.1 | CIRC | 450 | |
| 43 | 438.89 | 432.97 | 5.92 | 7 | 39.815 | 0.12 | 116.76 | 431.2 | CIRC | 300 | |
| 44 | 439.63 | 432.97 | 6.66 | 5 | 34.917 | 0.38 | 379.88 | 488.5 | CIRC | 300 | |
| 45 | 453.47 | 446.84 | 6.63 | 2 | 16.543 | 0.38 | 379.88 | 708.5 | CIRC | 300 | |
| 46 | 453.49 | 447.03 | 6.46 | 3 | 18.04 | <0.12 | 120 | 669.6 | CIRC | 300 | |
| 47 | 451.87 | 449.73 | 2.14 | 7 | 15.452 | 0.12 | 116.76 | 416.1 | CIRC | 300 | |
| 48 | 461.13 | 457.09 | 4.04 | 4 | 15.926 | <0.12 | 120 | 563.4 | CIRC | 300 | |
| 49 | 468.9 | 463.8 | 5.1 | 5 | 26.644 | <0.12 | 120 | 489.3 | CIRC | 300 | |
| 50 | 463.01 | 455.46 | 7.55 | 4 | 28.217 | <0.12 | 120 | 578.7 | CIRC | 300 | |
| 51 | 455.79 | 451.57 | 4.22 | 5 | 21.539 | 0.21 | 210.61 | 495.1 | CIRC | 300 | |
| 52 | 455.15 | 452.93 | 2.22 | 6 | 12.458 | <0.12 | 120 | 2653.6 | CIRC | 300 | |
| 53 | 440.81 | 438.9 | 1.91 | 14 | 27.038 | <0.12 | 120 | 296.9 | CIRC | 300 | |
| 54 | 434.72 | 434.03 | 0.69 | 26 | 17.686 | <0.12 | 120 | 220.4 | CIRC | 300 | |
| 55 | 415.44 | 414.69 | 0.75 | 65 | 48.807 | 0.38 | 379.88 | 401.3 | CIRC | 450 | |
| 56 | 413.93 | 413.13 | 0.8 | 17 | 13.236 | <0.12 | 120 | 274.6 | CIRC | 300 | |
| 57 | 395.5 | 393.48 | 2.02 | 14 | 28.363 | 0.46 | 459.32 | 866.4 | CIRC | 450 | |
| 58 | 395.22 | 393.83 | 1.39 | 17 | 24.037 | 0.46 | 459.32 | 780.5 | CIRC | 450 | |
| 59 | 395.12 | 393.92 | 1.2 | 15 | 17.99 | <0.12 | 120 | 288.5 | CIRC | 300 | |
| 60 | 394.17 | 393.19 | 0.98 | 17 | 17.061 | <0.12 | 120 | 267.6 | CIRC | 300 | |
| 61 | 371.89 | 370.61 | 1.28 | 12 | 15.808 | 0.61 | 611.61 | 923.9 | CIRC | 450 | |
| 62 | 330.77 | 327.15 | 3.62 | 4 | 14.09 | 0.21 | 210.61 | 567.0 | CIRC | 300 | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 63 | 322.16 | 301.74 | 20.4 | 2 | 44.08 | <0.12 | 120 | 761.7 | CIRC | 300 | |
| 64 | 307.56 | 301.75 | 5.81 | 3 | 17.081 | <0.12 | 120 | 652.6 | CIRC | 300 | |
| 65 | 295.32 | 292.24 | 3.08 | 4 | 12.781 | 0.30 | 297.39 | 549.2 | CIRC | 300 | |
| 66 | 271.55 | 264.39 | 7.16 | 4 | 26.711 | <0.12 | 120 | 579.2 | CIRC | 300 | |
| 67 | 263.1 | 255.21 | 7.89 | 3 | 25.469 | 0.46 | 459.32 | 622.8 | CIRC | 300 | |
| 68 | 251.76 | 246.27 | 5.49 | 4 | 23.457 | <0.12 | 120 | 541.2 | CIRC | 300 | |
| 69 | 236.79 | 231.17 | 5.62 | 3 | 19.083 | <0.12 | 120 | 607.2 | CIRC | 300 | |
| 70 | 229.01 | 220.87 | 8.14 | 3 | 25.44 | <0.12 | 120 | 632.9 | CIRC | 300 | |
| 71 | 216.39 | 208.78 | 7.61 | 3 | 20.575 | <0.12 | 120 | 680.6 | CIRC | 300 | |
| 72 | 194.94 | 193.24 | 1.7 | 15 | 25.706 | 9.51 | 9511.02 | - | BRIDGE | | Bridge crossing required to maintain channel flow. Deck soffit to be determined during detailed design stage. |
| 73 | 194.46 | 193.03 | 1.43 | | | 0.83 | 828.51 | 1062.4 | CIRC | 450 | |
| 85 | 115.21 | 115.21 | | | | 4.55 | 4550.01 | - | BRIDGE | | Bridge crossing required to maintain channel flow. Deck soffit to be determined during detailed design stage. |
| **Existing watercourse crossings** | | | | | | | | | | | |
| 74 | 176.23 | 173.99 | 2.24 | 11 | 24.186 | 0.38 | 379.88 | 988.3 | CIRC | 450 | |
| 75 | 162.34 | 160.99 | 1.35 | 10 | 12.986 | <0.12 | 120 | 1047.2 | CIRC | 450 | |
| 76 | 158.79 | 157.69 | 1.1 | 13 | 14.05 | 0.38 | 379.88 | 908.5 | CIRC | 450 | |
| 77 | 141.74 | 141.1 | 0.64 | 16 | 10.431 | <0.12 | 120 | 276.6 | CIRC | 300 | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 78 | 126.42 | 126.42 | | | | 0.61 | 611.61 | 573.2 | | 450 | |
| 79 | | -0.41 | 0.41 | 32 | 13.121 | 0.12 | 116.76 | 1119.6 | CIRC | 300 | |
| 80 | 115.16 | 111.07 | 4.09 | 4 | 17.656 | <0.12 | 120 | 538.4 | CIRC | 300 | |
| 81 | 119.25 | 112.4 | 6.85 | 3 | 19.211 | <0.12 | 120 | 413.3 | CIRC | 250 | |
| 82 | 118.09 | 116.37 | 1.72 | 9 | 14.786 | <0.12 | 120 | 381.3 | CIRC | 300 | |
| 83 | 120.95 | 117.86 | 3.09 | 5 | 14.954 | 0.83 | 828.51 | 7828.5 | CIRC | 850 | |
| 84 | | | | | | | | | | | Water crossing is not along the latest proposed alignment |
| 86 | 121.82 | 117.98 | 3.84 | 4 | 15.646 | 8.96 | 8956.29 | 9564.7 | ARCH | Arch height 150cm Bridge sides 200cm wide | |
| 87 | 109.61 | 108.65 | 0.96 | 17 | 15.881 | 0.46 | 459.32 | 798.0 | CIRC | 450 | |
| 88 | 109.28 | 104.86 | 4.42 | 4 | 18.286 | 0.30 | 297.39 | 1597.9 | CIRC | 450 | |
| 89 | 98.54 | 97.89 | 0.65 | 18 | 11.911 | 1.56 | 1557.77 | 1852.5 | SQUARE | 70X70 | |
| 90 | 90.77 | 89.95 | 0.82 | 21 | 17.344 | 3.86 | 3860.22 | 9218.7 | CIRC | 1200 | |
| 91 | 107.74 | 107.47 | 0.27 | 44 | 11.983 | 0.12 | 116.76 | 167.3 | CIRC | 300 | |
| 92 | 33.7 | 30.81 | 2.89 | 6 | 17.291 | <0.12 | 120 | 282.7 | CIRC | 250 | |
| 93 | 35.18 | 32.26 | 2.92 | 5 | 15.338 | <0.12 | 120 | 1417.8 | CIRC | 450 | |
| 94 | 34.57 | 32.94 | 1.63 | 9 | 14.764 | <0.12 | 120 | 2296.95 | CIRC | 600 | |
| 95 | 31.55 | 30.4 | 1.15 | 13 | 15.358 | <0.12 | 120 | 888.4 | CIRC | 600 | |
| 96 | 28.73 | 26.93 | 1.8 | 7 | 12.738 | 0.30 | 297.39 | 1221.2 | CIRC | 450 | |
| 97 | 31.74 | 25.74 | 6 | 3 | 17.791 | 0.38 | 379.88 | 1887.8 | CIRC | 450 | |
| 98 | 30.94 | 26.77 | 4.17 | 4 | 15.182 | 0.21 | 210.61 | 1703.5 | CIRC | 450 | |
| 99 | 36.46 | 32.4 | 4.06 | 4 | 15.76 | <0.12 | 120 | 1649.7 | CIRC | 450 | |
| 100 | 31.39 | 28.58 | 2.81 | 5 | 14.448 | 0.12 | 116.76 | 1433.1 | CIRC | 450 | |
| 101 | 27.23 | 26.3 | 0.93 | 21 | 19.664 | 6.03 | 6028.65 | 5724.3 | CIRC | 1000 | |
| 102 | 26.86 | 23.43 | 3.43 | 10 | 32.873 | 1.24 | 1235.95 | 1049.1 | CIRC | 450 | |
| 103 | 27.91 | 24.55 | 3.36 | 5 | 16.089 | 1.87 | 1868.26 | 6715.2 | CIRC | 800 | |
| 104 | 26.83 | 22.31 | 4.52 | 4 | 16.355 | 0.12 | 116.76 | 588.2 | CIRC | 300 | |
| 105 | 30.22 | 19.64 | 10.6 | 3 | 29.133 | <0.12 | 120 | 417.1 | CIRC | 250 | |
| 106 | 23.82 | 16.06 | 7.76 | 3 | 24.499 | <0.12 | 120 | 629.7 | CIRC | 300 | |

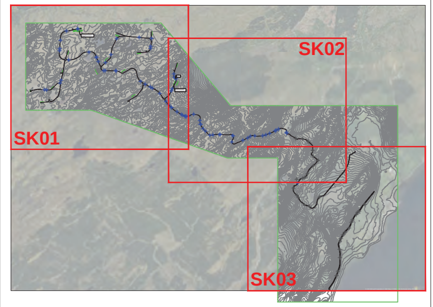
# Annex C Drawings




NOTE:

1. ALL DRAWINGS ARE TO BE READ IN CONJUNCTION WITH THE SPECIFICATION FOR HIGHWAY WORKS AND THE TURBINE MANUFACTURERS STANDARDS AND ALL RELEVANT DRAWINGS WITHIN THE PROJECT DESIGN PACKAGE.
2. ALL WORKS TO BE EXECUTED IN ACCORDANCE WITH THE DMRB, THE MANUAL OF CONTRACT DOCUMENTS FOR HIGHWAY WORKS, DESIGN MANUAL FOR ROADS AND BRIDGES, AND TRAFFIC SIGNS MANUAL.
3. ALL DIMENSIONS ARE IN METERS UNLESS STATED OTHERWISE. ALL LEVELS ARE IN METERS AND RELATE TO ORDNANCE DATUM.
4. DO NOT SCALE FROM ANY DRAWING. WORK TO FIGURED DIMENSIONS ONLY. ANY DISCREPANCIES IN DIMENSIONS ARE TO BE REFERRED TO THE DESIGNER BEFORE WORK IS PUT TO HAND.
5. ALL WORKS BY THE CONTRACTOR MUST BE CARRIED OUT IS SUCH A WAY THAT ALL REQUIREMENTS UNDER THE HEALTH AND SAFETY AT WORK ACT ARE SATISFIED.
6. ALL WORKS ARE TO BE CARRIED OUT IN COMPLIANCE WITH THE REQUIREMENT OF THE STATUTORY AUTHORITIES AND CONSTRUCTION DESIGN MANAGEMENT REGULATIONS.

KEY PLAN:




KEY:

- EXISTING WATERCOURSE
- EXISTING 5m CONTOUR
- T12 PROPOSED TURBINE
- MM PROPOSED MET MAST
- PROPOSED WATERCOURSE CROSSING
- EXISTING WATERCOURSE CROSSING
- PROPOSED ACCESS TRACK
- PROPOSED HARDSTANDING (PERMANENT)
- PROPOSED CONSTRUCTION COMPOUND (PERMANENT)
- PROPOSED TRACKSIDE DRAINAGE
- INDICATIVE SETTLEMENT/ DISPERSAL BASIN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www.pellfrischmann.com


Client

LUC

Project

AN CARR DUIBH WIND FARM

Drawing Title

DRAINAGE STRATEGY
SHEET 1 OF 3

| | Name | Date | |
|---|---|---|---|
| | | | Scale 1:6000 @ A1 |
| Designed | RL | 02.02.2023 | File 230202_DrainageStrategy |
| Checked | KI | 06.02.2023 | Drawing Status DRAFT |

Drawing No. SK01

Revision P1


NOTE:

1. ALL DRAWINGS ARE TO BE READ IN CONJUNCTION WITH THE SPECIFICATION FOR HIGHWAY WORKS AND THE TURBINE MANUFACTURERS STANDARDS AND ALL RELEVANT DRAWINGS WITHIN THE PROJECT DESIGN PACKAGE.
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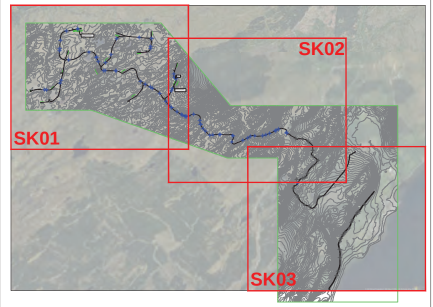
KEY PLAN:




KEY:

- EXISTING WATERCOURSE
- EXISTING 5m CONTOUR
- T12 PROPOSED TURBINE
- MM PROPOSED MET MAST
- PROPOSED WATERCOURSE CROSSING
- EXISTING WATERCOURSE CROSSING
- PROPOSED ACCESS TRACK
- PROPOSED HARDSTANDING (PERMANENT)
- PROPOSED CONSTRUCTION COMPOUND (PERMANENT)
- PROPOSED TRACKSIDE DRAINAGE
- INDICATIVE SETTLEMENT/ DISPERSAL BASIN

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Client

LUC

Project

AN CARR DUIBH WIND FARM

Drawing Title

DRAINAGE STRATEGY
SHEET 2 OF 3

| | Name | Date |
|---|---|---|
| Designed | RL | 02.02.2023 |
| Checked | KI | 06.02.2023 |

Scale: 1:6000 @ A1

File: 230202_DrainageStrategy

Drawing Status: DRAFT

Drawing No.: SK02

Revision: P1


NOTE:

1. ALL DRAWINGS ARE TO BE READ IN CONJUNCTION WITH THE SPECIFICATION FOR HIGHWAY WORKS AND THE TURBINE MANUFACTURERS STANDARDS AND ALL RELEVANT DRAWINGS WITHIN THE PROJECT DESIGN PACKAGE.
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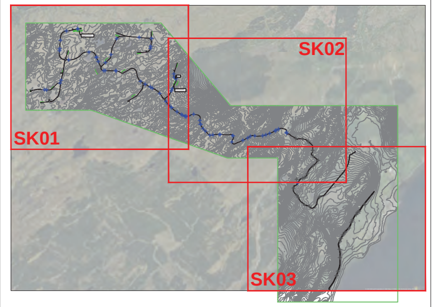
KEY PLAN:




KEY:

- EXISTING WATERCOURSE
- EXISTING 5m CONTOUR
- T12 PROPOSED TURBINE
- MM PROPOSED MET MAST
- PROPOSED WATERCOURSE CROSSING
- EXISTING WATERCOURSE CROSSING
- PROPOSED ACCESS TRACK
- PROPOSED HARDSTANDING (PERMANENT)
- PROPOSED CONSTRUCTION COMPOUND (PERMANENT)
- PROPOSED TRACKSIDE DRAINAGE
- INDICATIVE SETTLEMENT/ DISPERSAL BASIN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Client

LUC

Project

AN CARR DUIBH WIND FARM

Drawing Title

DRAINAGE STRATEGY
SHEET 3 OF 3

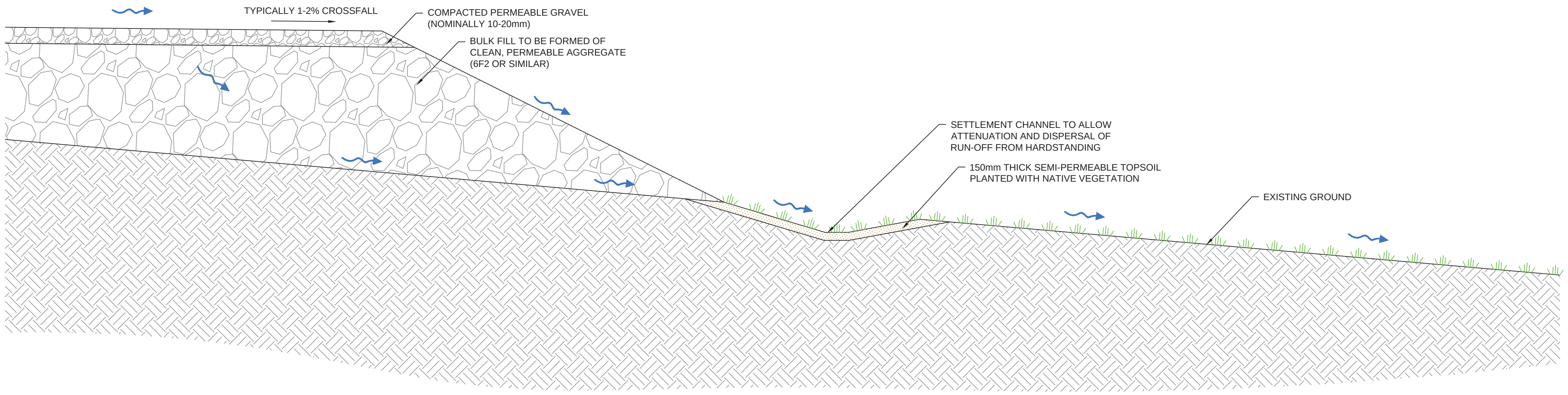
| | Name | Date | |
|---|---|---|---|
| | | | Scale 1:6000 @ A1 |
| Designed | RL | 02.02.2023 | File 230202_DrainageStrategy |
| Checked | KI | 06.02.2023 | Drawing Status DRAFT |

Drawing No. SK03

Revision P1


INDICATIVE HARDSTAND DRAINAGE ARRANGEMENT - PLAN VIEW

1:500




SECTION A-A'

1:50

NOTE:

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KEY:

- EXISTING WATERCOURSE
- EXISTING 5m CONTOUR
- PROPOSED WATERCOURSE CROSSING
- PROPOSED ACCESS TRACK
- PROPOSED HARDSTANDING (PERMANENT)
- PROPOSED TRACKSIDE DRAINAGE
- INDICATIVE SETTLEMENT/ DISPERSAL BASIN

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Client: LUC

Project: AN CARR DUIBH WIND FARM

Drawing Title: INDICATIVE HARDSTAND DRAINAGE ARRANGEMENT

| | Name | Date |
|---|---|---|
| Designed | RL | 02.02.2023 |
| Checked | KI | 09.03.2023 |

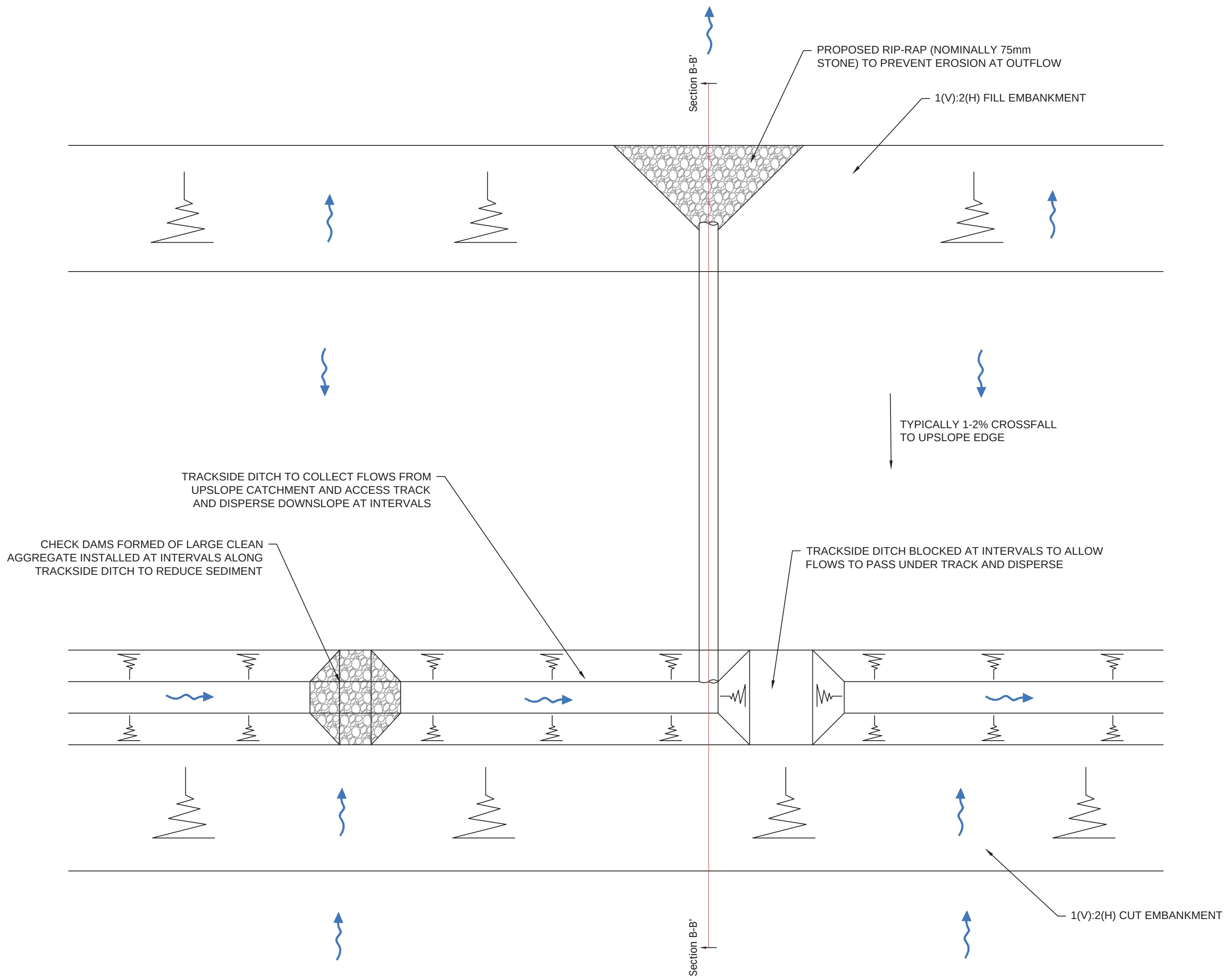
Scale: 1:500 @ A1

File: 230202_DrainageStrategy

Drawing Status: DRAFT

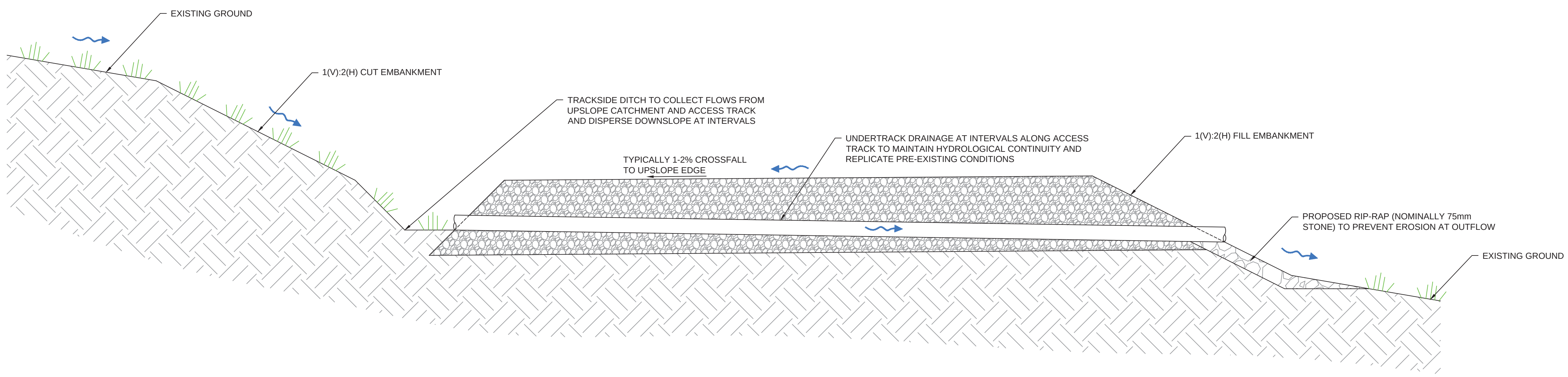
Drawing No.: SK04

Revision: P1




INDICATIVE TRACKSIDE DRAINAGE ARRANGEMENT - PLAN VIEW

1:50




SECTION B-B'

1:25

NOTE:

1. ALL DRAWINGS ARE TO BE READ IN CONJUNCTION WITH THE SPECIFICATION FOR HIGHWAY WORKS AND THE TURBINE MANUFACTURERS STANDARDS AND ALL RELEVANT DRAWINGS WITHIN THE PROJECT DESIGN PACKAGE.
2. ALL WORKS TO BE EXECUTED IN ACCORDANCE WITH THE DMRB, THE MANUAL OF CONTRACT DOCUMENTS FOR HIGHWAY WORKS, DESIGN MANUAL FOR ROADS AND BRIDGES, AND TRAFFIC SIGNS MANUAL.
3. ALL DIMENSIONS ARE IN METERS UNLESS STATED OTHERWISE. ALL LEVELS ARE IN METERS AND RELATE TO ORDNANCE DATUM.
4. DO NOT SCALE FROM ANY DRAWING. WORK TO FIGURED DIMENSIONS ONLY. ANY DISCREPANCIES IN DIMENSIONS ARE TO BE REFERRED TO THE DESIGNER BEFORE WORK IS PUT TO HAND.
5. ALL WORKS BY THE CONTRACTOR MUST BE CARRIED OUT IS SUCH A WAY THAT ALL REQUIREMENTS UNDER THE HEALTH AND SAFETY AT WORK ACT ARE SATISFIED.
6. ALL WORKS ARE TO BE CARRIED OUT IN COMPLIANCE WITH THE REQUIREMENT OF THE STATUTORY AUTHORITIES AND CONSTRUCTION DESIGN MANAGEMENT REGULATIONS.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Client: LUC

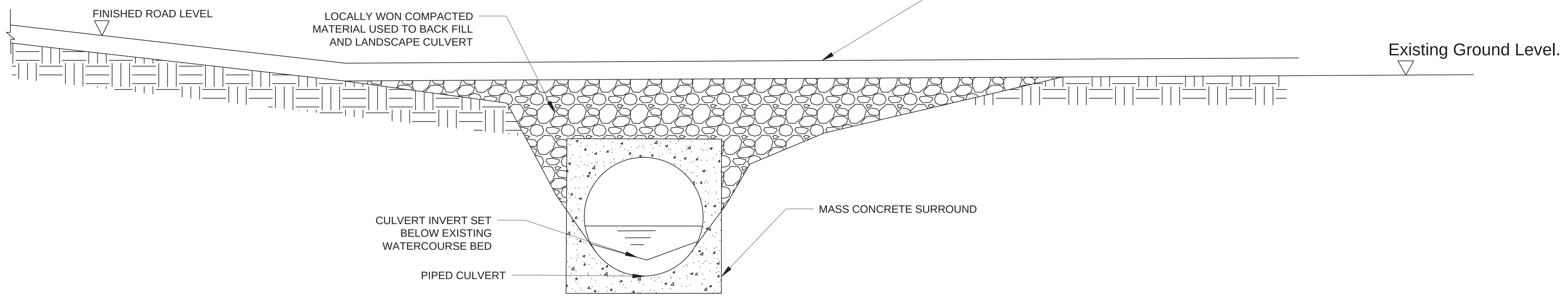
Project: AN CARR DUIBH WIND FARM

Drawing Title: INDICATIVE TRACKSIDE DRAINAGE ARRANGEMENT

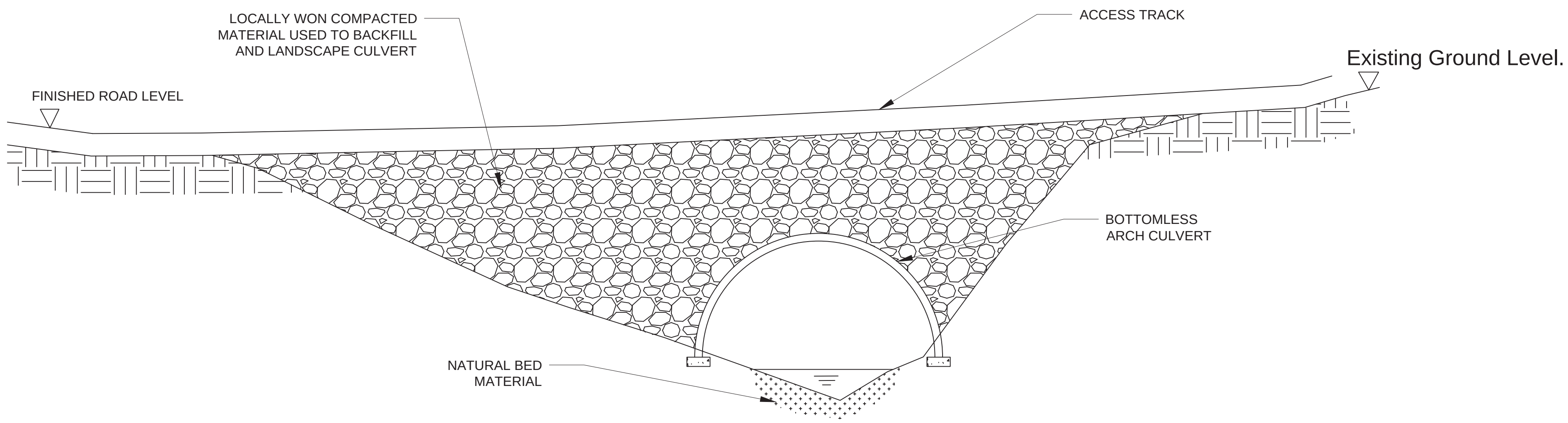
| | Name | Date | |
|---|---|---|---|
| | | | Scale: AS SHOWN @ A1 |
| Designed | RL | 02.02.2023 | File: 230202_DrainageStrategy |
| Checked | KI | 09.03.2023 | Drawing Status: DRAFT |

Drawing No.: SK05

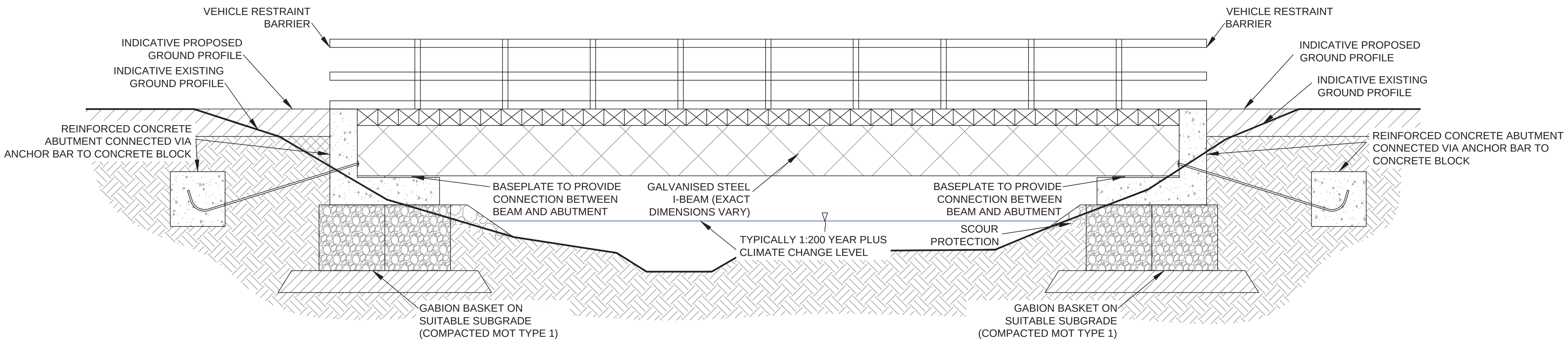
Revision: P1




INDICATIVE CLOSED CULVERT WATERCOURSE CROSSING
NTS




INDICATIVE BOTTOMLESS ARCH WATERCOURSE CROSSING
NTS




INDICATIVE TYPICAL OPEN-SPAN WATERCOURSE CROSSING
NTS

NOTE:

1. ALL DRAWINGS ARE TO BE READ IN CONJUNCTION WITH THE SPECIFICATION FOR HIGHWAY WORKS AND THE TURBINE MANUFACTURERS STANDARDS AND ALL RELEVANT DRAWINGS WITHIN THE PROJECT DESIGN PACKAGE.
2. ALL WORKS TO BE EXECUTED IN ACCORDANCE WITH THE DMRB, THE MANUAL OF CONTRACT DOCUMENTS FOR HIGHWAY WORKS, DESIGN MANUAL FOR ROADS AND BRIDGES, AND TRAFFIC SIGNS MANUAL.
3. ALL DIMENSIONS ARE IN METERS UNLESS STATED OTHERWISE. ALL LEVELS ARE IN METERS AND RELATE TO ORDNANCE DATUM.
4. DO NOT SCALE FROM ANY DRAWING. WORK TO FIGURED DIMENSIONS ONLY. ANY DISCREPANCIES IN DIMENSIONS ARE TO BE REFERRED TO THE DESIGNER BEFORE WORK IS PUT TO HAND.
5. ALL WORKS BY THE CONTRACTOR MUST BE CARRIED OUT IS SUCH A WAY THAT ALL REQUIREMENTS UNDER THE HEALTH AND SAFETY AT WORK ACT ARE SATISFIED.
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Client
LUC

Project
AN CARR DUIBH WIND FARM

Drawing Title
TYPICAL WATERCOURSE CROSSING DETAILS

| | Name | Date | |
|---|---|---|---|
| | | | Scale: AS SHOWN @ A1 |
| Designed | RL | 02.02.2023 | File: 230202_DrainageStrategy |
| Checked | KI | 09.03.2023 | Drawing Status: DRAFT |

Drawing No. SK06
Revision P1


PROPOSED SUBSTATION PLATFORM SUDS DRAINAGE POND - PLAN VIEW

1:500

NOTE:

1. ALL DRAWINGS ARE TO BE READ IN CONJUNCTION WITH THE SPECIFICATION FOR HIGHWAY WORKS AND THE TURBINE MANUFACTURERS STANDARDS AND ALL RELEVANT DRAWINGS WITHIN THE PROJECT DESIGN PACKAGE.
2. ALL WORKS TO BE EXECUTED IN ACCORDANCE WITH THE DMRB, THE MANUAL OF CONTRACT DOCUMENTS FOR HIGHWAY WORKS, DESIGN MANUAL FOR ROADS AND BRIDGES, AND TRAFFIC SIGNS MANUAL.
3. ALL DIMENSIONS ARE IN METERS UNLESS STATED OTHERWISE. ALL LEVELS ARE IN METERS AND RELATE TO ORDNANCE DATUM.
4. DO NOT SCALE FROM ANY DRAWING. WORK TO FIGURED DIMENSIONS ONLY. ANY DISCREPANCIES IN DIMENSIONS ARE TO BE REFERRED TO THE DESIGNER BEFORE WORK IS PUT TO HAND.
5. ALL WORKS BY THE CONTRACTOR MUST BE CARRIED OUT IS SUCH A WAY THAT ALL REQUIREMENTS UNDER THE HEALTH AND SAFETY AT WORK ACT ARE SATISFIED.
6. ALL WORKS ARE TO BE CARRIED OUT IN COMPLIANCE WITH THE REQUIREMENT OF THE STATUTORY AUTHORITIES AND CONSTRUCTION DESIGN MANAGEMENT REGULATIONS.

KEY:

- EXISTING WATERCOURSE
- EXISTING 5m CONTOUR
- PROPOSED WATERCOURSE CROSSING
- PROPOSED ACCESS TRACK
- PROPOSED HARDSTANDING (PERMANENT)
- PROPOSED TRACKSIDE DRAINAGE
- INDICATIVE SETTLEMENT/ DISPERSAL BASIN
- INDICATIVE SUDS POND
- PROPOSED HYDRO-BRAKE


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Client: LUC

Project: AN CARR DUIBH WIND FARM

Drawing Title: INDICATIVE SUBSTATION PLAFORM DRAINAGE ARRANGEMENT

| | Name | Date |
|---|---|---|
| Designed | RL | 02.02.2023 |
| Checked | KI | 24.02.2023 |

Scale: 1:500 @ A1

File: 230202_DrainageStrategy

Drawing Status: DRAFT

Drawing No.: SK07

Revision: P1

# Annex D MicroDrainage Attenuation

Summary of Results for 200 year Return Period (+46%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 15 min Summer | 0.366 | 0.366 | 9.7 | 153.3 | O K |
| 30 min Summer | 0.512 | 0.512 | 9.7 | 223.2 | O K |
| 60 min Summer | 0.664 | 0.664 | 9.7 | 300.7 | O K |
| 120 min Summer | 0.810 | 0.810 | 9.7 | 380.7 | O K |
| 180 min Summer | 0.890 | 0.890 | 9.7 | 427.2 | O K |
| 240 min Summer | 0.946 | 0.946 | 9.7 | 459.9 | O K |
| 360 min Summer | 1.007 | 1.007 | 9.7 | 497.1 | O K |
| 480 min Summer | 1.035 | 1.035 | 9.7 | 514.7 | O K |
| 600 min Summer | 1.050 | 1.050 | 9.7 | 524.3 | O K |
| 720 min Summer | 1.060 | 1.060 | 9.7 | 530.7 | O K |
| 960 min Summer | 1.070 | 1.070 | 9.7 | 537.1 | O K |
| 1440 min Summer | 1.069 | 1.069 | 9.7 | 536.1 | O K |
| 2160 min Summer | 1.039 | 1.039 | 9.7 | 517.3 | O K |
| 2880 min Summer | 0.993 | 0.993 | 9.7 | 488.8 | O K |
| 4320 min Summer | 0.859 | 0.859 | 9.7 | 408.6 | O K |
| 5760 min Summer | 0.718 | 0.718 | 9.7 | 329.8 | O K |
| 7200 min Summer | 0.595 | 0.595 | 9.7 | 264.8 | O K |
| 8640 min Summer | 0.492 | 0.492 | 9.7 | 213.2 | O K |
| 10080 min Summer | 0.408 | 0.408 | 9.7 | 172.9 | O K |
| 15 min Winter | 0.407 | 0.407 | 9.7 | 172.3 | O K |
| 30 min Winter | 0.568 | 0.568 | 9.7 | 251.1 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 100.516 | 0.0 | 156.9 | 18 |
| 30 min Summer | 74.176 | 0.0 | 232.6 | 33 |
| 60 min Summer | 51.335 | 0.0 | 325.0 | 62 |
| 120 min Summer | 33.993 | 0.0 | 430.8 | 122 |
| 180 min Summer | 26.412 | 0.0 | 502.2 | 182 |
| 240 min Summer | 22.041 | 0.0 | 558.9 | 242 |
| 360 min Summer | 17.010 | 0.0 | 647.0 | 360 |
| 480 min Summer | 14.129 | 0.0 | 716.6 | 474 |
| 600 min Summer | 12.227 | 0.0 | 775.1 | 524 |
| 720 min Summer | 10.862 | 0.0 | 826.3 | 592 |
| 960 min Summer | 9.012 | 0.0 | 913.7 | 724 |
| 1440 min Summer | 6.917 | 0.0 | 1050.7 | 998 |
| 2160 min Summer | 5.293 | 0.0 | 1210.6 | 1428 |
| 2880 min Summer | 4.371 | 0.0 | 1332.9 | 1844 |
| 4320 min Summer | 3.333 | 0.0 | 1524.0 | 2636 |
| 5760 min Summer | 2.750 | 0.0 | 1678.7 | 3352 |
| 7200 min Summer | 2.371 | 0.0 | 1808.9 | 4040 |
| 8640 min Summer | 2.103 | 0.0 | 1924.4 | 4760 |
| 10080 min Summer | 1.901 | 0.0 | 2029.2 | 5448 |
| 15 min Winter | 100.516 | 0.0 | 176.0 | 18 |
| 30 min Winter | 74.176 | 0.0 | 260.8 | 33 |





Summary of Results for 200 year Return Period (+46%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 60 min Winter | 0.736 | 0.736 | 9.7 | 339.6 | O K |
| 120 min Winter | 0.901 | 0.901 | 9.7 | 433.2 | O K |
| 180 min Winter | 0.993 | 0.993 | 9.7 | 488.7 | O K |
| 240 min Winter | 1.053 | 1.053 | 9.7 | 526.0 | O K |
| 360 min Winter | 1.124 | 1.124 | 9.7 | 571.6 | O K |
| 480 min Winter | 1.162 | 1.162 | 9.7 | 596.4 | O K |
| 600 min Winter | 1.182 | 1.182 | 9.7 | 609.5 | O K |
| 720 min Winter | 1.191 | 1.191 | 9.7 | 615.5 | O K |
| 960 min Winter | 1.198 | 1.198 | 9.7 | 620.0 | O K |
| 1440 min Winter | 1.186 | 1.186 | 9.7 | 612.5 | O K |
| 2160 min Winter | 1.129 | 1.129 | 9.7 | 574.5 | O K |
| 2880 min Winter | 1.048 | 1.048 | 9.7 | 522.8 | O K |
| 4320 min Winter | 0.811 | 0.811 | 9.7 | 381.2 | O K |
| 5760 min Winter | 0.585 | 0.585 | 9.7 | 259.4 | O K |
| 7200 min Winter | 0.410 | 0.410 | 9.7 | 174.0 | O K |
| 8640 min Winter | 0.293 | 0.293 | 9.5 | 120.7 | O K |
| 10080 min Winter | 0.220 | 0.220 | 9.0 | 88.7 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 60 min Winter | 51.335 | 0.0 | 364.1 | 62 |
| 120 min Winter | 33.993 | 0.0 | 482.6 | 120 |
| 180 min Winter | 26.412 | 0.0 | 562.5 | 178 |
| 240 min Winter | 22.041 | 0.0 | 626.0 | 236 |
| 360 min Winter | 17.010 | 0.0 | 724.7 | 350 |
| 480 min Winter | 14.129 | 0.0 | 802.6 | 462 |
| 600 min Winter | 12.227 | 0.0 | 868.1 | 570 |
| 720 min Winter | 10.862 | 0.0 | 925.3 | 670 |
| 960 min Winter | 9.012 | 0.0 | 1023.2 | 762 |
| 1440 min Winter | 6.917 | 0.0 | 1175.7 | 1080 |
| 2160 min Winter | 5.293 | 0.0 | 1356.0 | 1540 |
| 2880 min Winter | 4.371 | 0.0 | 1492.9 | 1992 |
| 4320 min Winter | 3.333 | 0.0 | 1707.3 | 2808 |
| 5760 min Winter | 2.750 | 0.0 | 1880.2 | 3512 |
| 7200 min Winter | 2.371 | 0.0 | 2026.1 | 4112 |
| 8640 min Winter | 2.103 | 0.0 | 2155.6 | 4760 |
| 10080 min Winter | 1.901 | 0.0 | 2273.1 | 5352 |

## Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 200 | Cv (Summer) | 0.750 |
| Region | Scotland and Ireland | Cv (Winter) | 0.840 |
| M5-60 (mm) | 15.300 | Shortest Storm (mins) | 15 |
| Ratio R | 0.200 | Longest Storm (mins) | 10080 |
| Summer Storms | Yes | Climate Change % | +46 |

## Time Area Diagram

Total Area (ha) 0.848

| Time (mins) From: | To: | Area (ha) |
|---|---|---|
| 0 | 4 | 0.848 |

## Time Area Diagram

Total Area (ha) 0.000

| Time (mins) From: | To: | Area (ha) |
|---|---|---|
| 0 | 4 | 0.000 |





## Model Details

Storage is Online Cover Level (m) 1.500

## Tank or Pond Structure

Invert Level (m) 0.000

| Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|---|---|---|---|
| 0.000 | 380.0 | 0.500 | 490.7 | 1.000 | 615.6 | 1.500 | 754.6 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0137-9800-1500-9800 |
| Design Head (m) | 1.500 |
| Design Flow (l/s) | 9.8 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 137 |
| Invert Level (m) | 0.000 |
| Minimum Outlet Pipe Diameter (mm) | 150 |
| Suggested Manhole Diameter (mm) | 1200 |

| Control Points | Head (m) | Flow (l/s) |
|---|---|---|
| Design Point (Calculated) | 1.500 | 9.8 |
| Flush-Flo™ | 0.441 | 9.7 |
| Kick-Flo® | 0.929 | 7.8 |
| Mean Flow over Head Range | - | 8.5 |

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 | 4.9 | 1.200 | 8.8 | 3.000 | 13.6 | 7.000 | 20.4 |
| 0.200 | 8.8 | 1.400 | 9.5 | 3.500 | 14.6 | 7.500 | 21.1 |
| 0.300 | 9.5 | 1.600 | 10.1 | 4.000 | 15.6 | 8.000 | 21.7 |
| 0.400 | 9.7 | 1.800 | 10.7 | 4.500 | 16.5 | 8.500 | 22.4 |
| 0.500 | 9.7 | 2.000 | 11.2 | 5.000 | 17.3 | 9.000 | 23.0 |
| 0.600 | 9.6 | 2.200 | 11.7 | 5.500 | 18.1 | 9.500 | 23.6 |
| 0.800 | 8.9 | 2.400 | 12.2 | 6.000 | 18.9 | | |
| 1.000 | 8.1 | 2.600 | 12.7 | 6.500 | 19.7 | | |

Summary of Results for 200 year Return Period (+46%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 15 min Summer | 0.058 | 0.058 | 2.0 | 29.2 | O K |
| 30 min Summer | 0.081 | 0.081 | 3.5 | 41.5 | O K |
| 60 min Summer | 0.103 | 0.103 | 5.1 | 52.8 | O K |
| 120 min Summer | 0.120 | 0.120 | 6.3 | 61.6 | O K |
| 180 min Summer | 0.129 | 0.129 | 6.8 | 66.3 | O K |
| 240 min Summer | 0.134 | 0.134 | 7.1 | 69.0 | O K |
| 360 min Summer | 0.138 | 0.138 | 7.3 | 71.2 | O K |
| 480 min Summer | 0.138 | 0.138 | 7.3 | 71.3 | O K |
| 600 min Summer | 0.137 | 0.137 | 7.2 | 70.5 | O K |
| 720 min Summer | 0.134 | 0.134 | 7.1 | 69.3 | O K |
| 960 min Summer | 0.129 | 0.129 | 6.8 | 66.4 | O K |
| 1440 min Summer | 0.118 | 0.118 | 6.2 | 60.9 | O K |
| 2160 min Summer | 0.106 | 0.106 | 5.4 | 54.5 | O K |
| 2880 min Summer | 0.098 | 0.098 | 4.7 | 49.9 | O K |
| 4320 min Summer | 0.086 | 0.086 | 3.9 | 43.7 | O K |
| 5760 min Summer | 0.078 | 0.078 | 3.3 | 39.6 | O K |
| 7200 min Summer | 0.072 | 0.072 | 2.9 | 36.8 | O K |
| 8640 min Summer | 0.068 | 0.068 | 2.6 | 34.6 | O K |
| 10080 min Summer | 0.065 | 0.065 | 2.4 | 32.8 | O K |
| 15 min Winter | 0.064 | 0.064 | 2.4 | 32.7 | O K |
| 30 min Winter | 0.091 | 0.091 | 4.2 | 46.3 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 100.516 | 0.0 | 26.3 | 18 |
| 30 min Summer | 74.176 | 0.0 | 40.4 | 32 |
| 60 min Summer | 51.335 | 0.0 | 59.5 | 60 |
| 120 min Summer | 33.993 | 0.0 | 79.4 | 90 |
| 180 min Summer | 26.412 | 0.0 | 92.8 | 124 |
| 240 min Summer | 22.041 | 0.0 | 103.5 | 158 |
| 360 min Summer | 17.010 | 0.0 | 120.1 | 226 |
| 480 min Summer | 14.129 | 0.0 | 133.2 | 292 |
| 600 min Summer | 12.227 | 0.0 | 144.2 | 356 |
| 720 min Summer | 10.862 | 0.0 | 153.8 | 420 |
| 960 min Summer | 9.012 | 0.0 | 170.1 | 548 |
| 1440 min Summer | 6.917 | 0.0 | 195.6 | 794 |
| 2160 min Summer | 5.293 | 0.0 | 227.1 | 1148 |
| 2880 min Summer | 4.371 | 0.0 | 249.9 | 1524 |
| 4320 min Summer | 3.333 | 0.0 | 284.8 | 2248 |
| 5760 min Summer | 2.750 | 0.0 | 315.9 | 2952 |
| 7200 min Summer | 2.371 | 0.0 | 340.2 | 3680 |
| 8640 min Summer | 2.103 | 0.0 | 361.6 | 4408 |
| 10080 min Summer | 1.901 | 0.0 | 380.4 | 5144 |
| 15 min Winter | 100.516 | 0.0 | 29.8 | 18 |
| 30 min Winter | 74.176 | 0.0 | 45.7 | 32 |





Summary of Results for 200 year Return Period (+46%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 60 min Winter | 0.115 | 0.115 | 6.0 | 59.1 | O K |
| 120 min Winter | 0.133 | 0.133 | 7.0 | 68.6 | O K |
| 180 min Winter | 0.141 | 0.141 | 7.5 | 72.9 | O K |
| 240 min Winter | 0.144 | 0.144 | 7.6 | 74.8 | O K |
| 360 min Winter | 0.145 | 0.145 | 7.6 | 75.0 | O K |
| 480 min Winter | 0.142 | 0.142 | 7.5 | 73.3 | O K |
| 600 min Winter | 0.137 | 0.137 | 7.2 | 71.0 | O K |
| 720 min Winter | 0.133 | 0.133 | 7.0 | 68.5 | O K |
| 960 min Winter | 0.124 | 0.124 | 6.5 | 63.7 | O K |
| 1440 min Winter | 0.110 | 0.110 | 5.6 | 56.2 | O K |
| 2160 min Winter | 0.095 | 0.095 | 4.6 | 48.8 | O K |
| 2880 min Winter | 0.086 | 0.086 | 3.9 | 43.9 | O K |
| 4320 min Winter | 0.074 | 0.074 | 3.0 | 37.8 | O K |
| 5760 min Winter | 0.067 | 0.067 | 2.5 | 34.0 | O K |
| 7200 min Winter | 0.062 | 0.062 | 2.2 | 31.3 | O K |
| 8640 min Winter | 0.058 | 0.058 | 2.0 | 29.3 | O K |
| 10080 min Winter | 0.055 | 0.055 | 1.8 | 27.7 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 60 min Winter | 51.335 | 0.0 | 66.8 | 58 |
| 120 min Winter | 33.993 | 0.0 | 89.2 | 94 |
| 180 min Winter | 26.412 | 0.0 | 104.2 | 132 |
| 240 min Winter | 22.041 | 0.0 | 116.2 | 170 |
| 360 min Winter | 17.010 | 0.0 | 134.8 | 242 |
| 480 min Winter | 14.129 | 0.0 | 149.4 | 310 |
| 600 min Winter | 12.227 | 0.0 | 161.7 | 376 |
| 720 min Winter | 10.862 | 0.0 | 172.5 | 442 |
| 960 min Winter | 9.012 | 0.0 | 190.9 | 568 |
| 1440 min Winter | 6.917 | 0.0 | 219.5 | 810 |
| 2160 min Winter | 5.293 | 0.0 | 254.5 | 1188 |
| 2880 min Winter | 4.371 | 0.0 | 280.1 | 1532 |
| 4320 min Winter | 3.333 | 0.0 | 319.4 | 2252 |
| 5760 min Winter | 2.750 | 0.0 | 353.9 | 3000 |
| 7200 min Winter | 2.371 | 0.0 | 381.2 | 3744 |
| 8640 min Winter | 2.103 | 0.0 | 405.2 | 4488 |
| 10080 min Winter | 1.901 | 0.0 | 426.5 | 5152 |

## Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 200 | Cv (Summer) | 0.750 |
| Region | Scotland and Ireland | Cv (Winter) | 0.840 |
| M5-60 (mm) | 15.300 | Shortest Storm (mins) | 15 |
| Ratio R | 0.200 | Longest Storm (mins) | 10080 |
| Summer Storms | Yes | Climate Change % | +46 |

## Time Area Diagram

Total Area (ha) 0.160

| Time (mins) From: | To: | Area (ha) |
|---|---|---|
| 0 | 4 | 0.160 |

## Time Area Diagram

Total Area (ha) 0.000

| Time (mins) From: | To: | Area (ha) |
|---|---|---|
| 0 | 4 | 0.000 |





## Model Details

Storage is Online Cover Level (m) 1.500

## Tank or Pond Structure

Invert Level (m) 0.000

| Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|---|---|---|---|
| 0.000 | 500.0 | 0.500 | 626.0 | 1.000 | 766.1 | 1.500 | 920.3 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0136-9700-1500-9700 |
| Design Head (m) | 1.500 |
| Design Flow (l/s) | 9.7 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 136 |
| Invert Level (m) | 0.000 |
| Minimum Outlet Pipe Diameter (mm) | 150 |
| Suggested Manhole Diameter (mm) | 1200 |

| Control Points | Head (m) | Flow (l/s) |
|---|---|---|
| Design Point (Calculated) | 1.500 | 9.7 |
| Flush-Flo™ | 0.441 | 9.7 |
| Kick-Flo® | 0.933 | 7.8 |
| Mean Flow over Head Range | - | 8.5 |

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 | 4.9 | 1.200 | 8.7 | 3.000 | 13.5 | 7.000 | 20.2 |
| 0.200 | 8.7 | 1.400 | 9.4 | 3.500 | 14.5 | 7.500 | 20.8 |
| 0.300 | 9.4 | 1.600 | 10.0 | 4.000 | 15.4 | 8.000 | 21.5 |
| 0.400 | 9.7 | 1.800 | 10.6 | 4.500 | 16.3 | 8.500 | 22.1 |
| 0.500 | 9.7 | 2.000 | 11.1 | 5.000 | 17.2 | 9.000 | 22.8 |
| 0.600 | 9.5 | 2.200 | 11.6 | 5.500 | 18.0 | 9.500 | 23.4 |
| 0.800 | 8.9 | 2.400 | 12.1 | 6.000 | 18.7 | | |
| 1.000 | 8.0 | 2.600 | 12.6 | 6.500 | 19.5 | | |