Kintore Hydrogen Facility

Appendix 13.3: Drainage Impact Assessment

Kintore Hydrogen Ltd

Prepared by:

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Basis of Report

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Acronyms and Abbreviations

AEP	Annual Exceedance Probability
AOD	Above Ordnance Datum
BGS	British Geological Survey
CC	Climate Change
DIA	Drainage Impact Assessment
FRA	Flood Risk Assessment
NPF4, NPF3	National Planning Framework 4, 3
NGR	National Grid Reference
OS	Ordnance Survey
RCP	Representative Concentration Pathway
SEPA	Scottish Environment Protection Agency
SPP	Scottish Planning Policy
SuDS	Sustainable urban Drainage Systems
UKCP18	United Kingdom Climate Projections – 2018 dataset

1.0 Background

1.1 Introduction

SLR Consulting Limited (SLR) was commissioned by Kintore Hydrogen Ltd (the “Client”) to undertake a Drainage Impact Assessment (DIA) at the proposed Kintore electrolysis plant, water abstraction and treatment plant and the gas injection location (the “Sites”).

This DIA report has been prepared to outline the proposed drainage strategy to manage surface water runoff and foul water disposal from the Proposed Development and has been completed in accordance with best practice guidance and legislation including National Planning Framework 4 (NPF4) and the Aberdeenshire Council’s Local Development Plan.

A separate report considers flood risk to and from the Proposed Development and should be read in conjunction with this report.

1.2 Site location

The electrolysis plant site is located on land to the west of the existing Kintore Substation, approximately 2.8 km to the southwest of Kintore, Aberdeenshire, 0.3 km northwest of Leylodge and 0.5 km to the west of the B977.

The existing National Grid Gas high-pressure natural gas pipelines runs from north to south, 1.3 km to the west of the A96 and close to Broomhill Plantation. The proposed connection point would be in farmland around 1 km southwest of the A96 and Kinellar.

The consented water abstraction point is located on the south bank of the River Don off Rushlach Road, approximately 1.5 km southeast of the edge of Kintore.

The location of the Sites is presented on Figure 1-1 and illustrative development plans of the Sites is included in Annex A.

Figure 1-1 : Site location

1.3 Flood risk terminology

Flood risks are typically expressed by the probability of occurrence of an event (maximum rainfall amount, flood flow or other such indicator) of stated magnitude or greater in any one year – termed the Annual Exceedance Probability (AEP). This may be expressed as a percentage (such as 1%, 0.5%, etc.) by the equivalent chance of occurrence (1:100, 1:200, etc.). For convenience, the latter approach is used in this report.

Where storm or flood events have a climate change factor included, the event is denoted in this report by “+CC”. For example, the 1:200 AEP storm event with climate change included is denoted “1:200+CC”.

1.4 Baseline conditions

1.4.1 Topography

1.4.1.1 Electrolysis plant site

Ground elevations at the electrolysis plant site decrease from a high within the centre of the site, situated at approximately 130 m AOD. Elevations decrease northwards towards the Dewsford Burn to an elevation of approximately 100m AOD and southwards to an elevation of approximately 110 m AOD towards the Park Burn.

1.4.1.2 Gas injection site

Ground elevations within the gas injection site generally decrease south eastward towards Park Burn. Levels across the gas injection site range from approximately 78 m AOD to the northwest of the development area to approximately 75m AOD near the Park Burn.

1.4.1.3 Water abstraction, treatment and discharge site

Ground levels at the water abstraction, treatment and discharge site generally range from 60 m AOD within the southern extent of the water abstraction, treatment and discharge site to approximately 53m AOD near the existing Network Rail infrastructure.

1.4.2 Geological and hydrogeological features

1.4.2.1 Geology

British Geological Survey (BGS)[1] bedrock geological mapping shows that the western extent of the application site, including the electrolysis plant site and gas injection site, is underlain by Kemnay Pluton Formation (comprising granite) whilst the eastern extent of the application site, including the water abstraction, treatment and discharge site, is underlain by Aberdeen Formation (comprising psammite and semipelite).

The majority of the bedrock geology within the electrolysis plant site is overlain by superficial deposits of Banchory Till Formation which comprises of glacial till. An area of glaciofluvial sheet deposits is noted within the northern extent of the electrolysis plant site near the Dewsford Burn. The gas injection site is underlain by superficial deposits of the Banchory Till Formation to the north and lacustrine deposits to the south, with an area of glaciofluvial deposits across the centre of the gas injection site.

[1] British Geological Survey, Geoindex Onshore, available online, https://mapapps2.bgs.ac.uk/geoindex/home.html [Last Accessed July 2024]

Alluvium and glaciofluvial deposits are noted within the northern extent of the water abstraction, treatment and effluent discharge site, near the River Don and existing Network Rail infrastructure respectively, whilst the southern extent of the water abstraction, treatment and discharge site is underlain by superficial deposits of the Banchory Till Formation.

The bedrock is considered to be a low and very low productivity aquifer generally without groundwater except at shallow depths and with flow almost entirely through fractures and other discontinuities.

The superficial glacial till and lacustrine deposits are not considered significant aquifers whilst the alluvium, glaciofluvial sheet deposits and river terrace deposits are considered to be a moderate to high productivity aquifer with intergranular flow; groundwater within these deposits is likely to be in hydraulic conductivity with adjacent watercourses and perched above the lower permeability Till and bedrock.

1.4.3 Hydrological features

The Proposed Development lies entirely within the surface water catchment of the River Don which flows generally eastwards to the north of the water abstraction, treatment and discharge site.

The western and central extent of the application site, including the electrolysis plant site and gas injection site, is located within the Tuach Burn sub-catchment, which is a tributary of the River Don. Several tributaries of the Tuach Burn cross the application site including the Dewsford Burn, Park Burn, Tillakae Burn and Sheriff Burn.

The Dewsford Burn flows north eastwards through the northern extent of the electrolysis plant site, whilst the Park Burn flows generally eastwards to the south of the electrolysis plant site and gas injection site. The Park Burn turns northwards approximately 450 m east of the gas injection site before discharging into the Tuach Burn approximately 1.3 km northeast of the gas injection site.

The water abstraction, treatment and effluent discharge site is located approximately 90 m east of the Silver Burn, which is also tributary of the River Don. The burn is culverted under the existing Aberdeen to Inverness rail line before it discharges into the River Don.

1.4.4 Existing drainage regime

Aside from limited existing infrastructure, such as access tracks serving the existing farmland, the Sites comprises entirely of greenfield land. Pluvial and surface water flows across the Sites are therefore expected to follow existing topography.

Within the electrolysis plant site, site elevations decrease north and southwards from a high within the centre of the site. Any excess flows resulting from direct rainfall or surface water flows would be expected to migrate primarily north towards the Dewsford Burn or southward towards the Park Burn. Approximately one third of the electrolysis plant site area drains towards the Park Burn.

Within the gas injection site, any pluvial or surface water runoff will flow a south easterly direction before being intercepted by a series of open field drainage ditches which convey flows towards the Park Burn. Any flows not captured by the drainage ditches will also flow overground towards Park Burn.

Within the water abstraction, treatment and discharge site, any pluvial or surface water runoff will flow in a north westerly direction towards the Silver Burn before it is culverted under the existing Network Rail infrastructure which conveys water to the River Don. To the north of the railway line ground elevations fall northwards towards the River Don.

2.0 Planning context and regulatory guidance

2.1 National Planning Framework 4 (NPF4)

National Planning Framework 4 (NPF4)[2] was introduced in February 2023 and supersedes National Planning Framework 3 (NPF3) and Scottish Planning Policy (SPP) 2014. Flood risk is addressed in Policy 22 of NPF4, which states the following:-

a) Development proposals at risk of flooding or in a flood risk area will only be supported if they are for:

   i. essential infrastructure where the location is required for operational reasons;

   ii. water compatible uses;

   iii. redevelopment of an existing building or site for an equal or less vulnerable use; or,

   iv. redevelopment of previously used sites in built up areas where the LDP has identified a need to bring these into positive use and where proposals demonstrate that long term safety and resilience can be secured in accordance with relevant SEPA advice.

The protection offered by an existing formal flood protection scheme or one under construction can be taken into account when determining flood risk. In such cases, it will be demonstrated by the applicant that:

- all risks of flooding are understood and addressed;
- there is no reduction in floodplain capacity, increased risk for others, or a need for future flood protection schemes;
- the development remains safe and operational during floods;
- flood resistant and resilient materials and construction methods are used; and
- future adaptations can be made to accommodate the effects of climate change.

Additionally, for development proposals meeting criteria part iv), where flood risk is managed at the site rather than avoided these will also require:

- the first occupied/utilised floor, and the underside of the development if relevant, to be above the flood risk level and have an additional allowance for freeboard; and
- that the proposal does not create an island of development and that safe access/ egress can be achieved.

b) Small scale extensions and alterations to existing buildings will only be supported where they will not significantly increase flood risk.

c) Development proposals will:

   i. not increase the risk of surface water flooding to others, or itself be at risk.

   ii. manage all rain and surface water through sustainable urban drainage systems (SUDS), which should form part of and integrate with proposed and existing blue green infrastructure. All proposals should presume no surface water connection to the combined sewer; and

   iii. seek to minimise the area of impermeable surface.

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[2] Scottish Government (2023) National Planning Framework 4 (NPF4)

d) Development proposals will be supported if they can be connected to the public water mains. If connection is not feasible, the applicant will need to demonstrate that water for drinking water purposes will be sourced from a sustainable water source that is resilient to periods of water scarcity.

e) Development proposals which create, expand or enhance opportunities for natural flood risk management, including blue and green infrastructure, will be supported.

NPF4 defines an area at risk of flooding as follows:

"For planning purposes, at risk of flooding or in a flood risk area means land or built form with an annual probability of being flooded of greater than 0.5% (1:200 AEP) which must include an appropriate allowance for future climate change.

This risk of flooding is indicated on SEPA's future flood maps or may need to be assessed in a flood risk assessment. An appropriate allowance for climate change should be taken from the latest available guidance and evidence available for application in Scotland. The calculated risk of flooding can take account of any existing, formal flood protection schemes in determining the risk to the site.

Where the risk of flooding is less than this threshold, areas will not be considered 'at risk of flooding' for planning purposes, but this does not mean there is no risk at all, just that the risk is sufficiently low to be acceptable for the purpose of planning. This includes areas where the risk of flooding is reduced below this threshold due to a formal flood protection scheme".

2.2 Aberdeenshire Local Development Plan[3]

2.2.1 Policy C4: Flooding

C4.1 Flood Risk Assessments should be undertaken in accordance with SEPA Technical Flood Risk Guidance and will be required for development in the indicative medium to high category of flood risk of 0.5% or greater annual probability (1 in 200 years or more frequent).

Assessments may also be required in areas of lower annual probability (0.1%- 0.5% annual probability) in circumstances where other factors indicate a potentially heightened risk or there are multiple sources of potential flooding. Assessments should include an allowance for freeboard and climate change. Development should not increase flood risk vulnerability and should avoid areas of medium to high risk, functional floodplain or other areas where the risks are otherwise assessed as heightened or unacceptable except where:

- It is a development to alleviate flooding or erosion of riverbanks or the coast;
- It is consistent with the flood storage and conveyance function of a floodplain;
- It would otherwise be less affected by flooding (such as a play area or car park);
- It is essential infrastructure. The location is essential for operational reasons for example for water-based navigation, agriculture, transport or utilities infrastructure and an alternative lower risk location is not available.

C4.2 If development is to be permitted on land assessed as at a medium to high risk of flooding it should be designed to be flood resilient for the lifetime of the development (this is normally a minimum of 100 years for residential development) and use construction methods to assist in the evacuation of people and minimise damage. It must not result in increased severity of flood risk elsewhere through altering flood storage capacity or the pattern and flow of flood waters.

[3] Aberdeenshire Council (2023) Aberdeenshire Local Development Plan

C4.3 Buffer strips, for enhancement of the watercourse and necessary maintenance, must also be provided for any water body.

C4.4 These measures may also be required in areas of potentially lower risk of flooding (annual probability of more than 1:1000 years) or in coastal areas below the 10 metre contour should evidence demonstrate a heightened risk.

C4.5 In such areas land raising and/or excavations will only be permitted if it is for a flood alleviation measure, it is linked to the provision and maintenance of direct or indirect compensatory flood water storage to replace the lost capacity of the functional floodplain, and it will not create any inaccessible islands of development during flood events or result in the need for flood prevention measures elsewhere.

C4.6 We will not approve development that may contribute to flooding issues elsewhere. Sustainable Urban Drainage principles apply to all sites. C4.7 We are opposed to the enclosed culverting of watercourses for land gain and will actively seek to discourage such proposals. We encourage the daylighting (or de-culverting) of existing culverted watercourses.

2.3 Climate change allowance

The SEPA climate change allowances[4] for flood risk assessment in land use planning version 4, November 2023 was used to inform the appropriate climate change allowances. SEPA allowances are based on the climate predictions (UKCP18). The SEPA guidance is based upon UKCP18 data, using Representative Concentration Pathway 8.5 (RCP 8.5), which assumes limited efforts to mitigate climate change, so that greenhouse gas levels in the atmosphere will continue to increase.

The most recent SEPA guidance recommends a 37% uplift to peak rainfall intensities for surface water catchments in the North East Scotland river basin region, within which the Sites lies. A factor of 37% has therefore been assumed in assessing the surface water management requirements in this report.

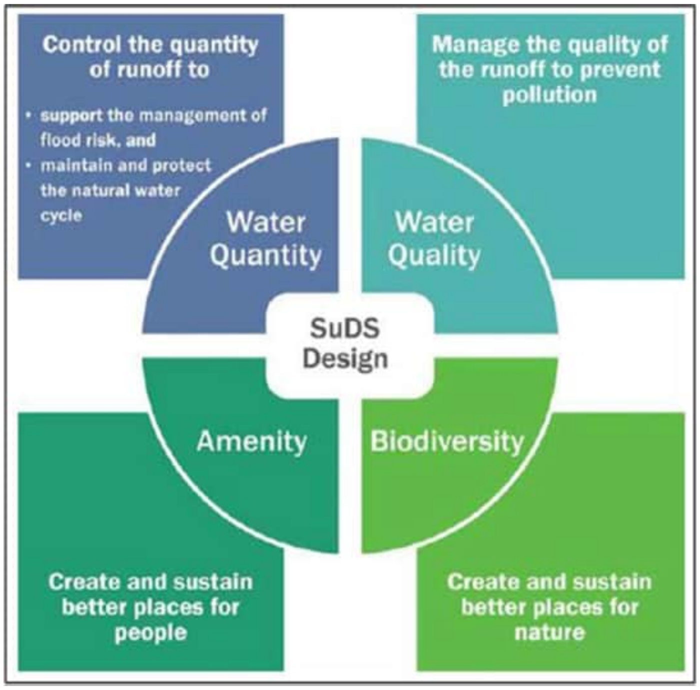
[4] Scottish Environment Protection Agency (2022) , Climate Change Allowances for Flood Risk Assessment in Land Use Planning, available online at https://www.sepa.org.uk/media/gq3c2xyb/climate-change-allowances-guidance-v4-final_nov23.pdf, Version 4 [Last accessed July 2024]

3.0 Outline surface water drainage strategy

3.1 Sustainable drainage systems

Current best practice guidance document 'The SuDS Manual' (CIRIA Report C753)[5], promotes sustainable water management through the use of SuDS. There are four main categories of SuDS which are referred to as the 'four pillars of SuDS' as shown in Figure 3-1.

Figure 3-1 : Four pillars of SuDS (after CIRIA Report C753)

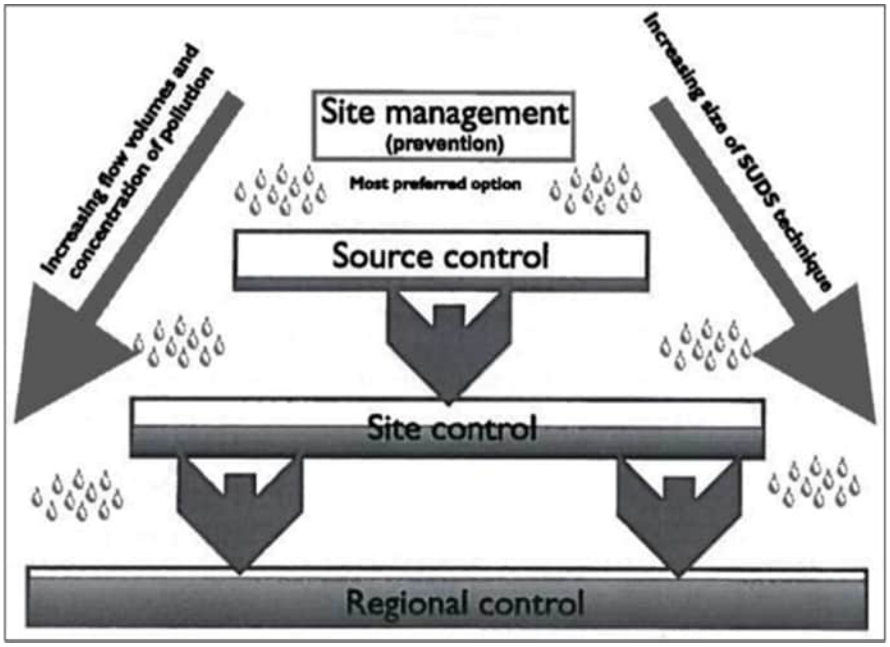


The SuDS Manual identifies a hierarchy of SuDS for managing runoff, which is commonly referred to as a 'management train' and is depicted in Figure 3-2.

- 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).
- Site control – management of water from several sub-catchments (including routing water from roofs and car parks to one/several large soakaways for the whole site).
- Regional control – management of runoff from several sites, typically in a retention pond or wetland.

[5] CIRIA (2015) The SuDS Manual, CIRIA Report C753

Figure 3-2 : SuDS management train



It is generally accepted that the 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 from developed sites.
- 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 wildlife habitat; and replicating natural drainage patterns, including the recharge of groundwater so that base flows are maintained.

3.2 Drainage hierarchy

With reference to The SuDS Manual, the hierarchy of preferred disposal options for surface water runoff from development sites in decreasing order of sustainability is as follows:

1 Harvest and Reuse;

2 Infiltration to Ground;

3 Discharge to Surface Waters; or

4 Discharge to Sewer.

Table 3-1 summarises the suitability of disposal methods suitability in the context of the Sites.

Table 3-1 : Suitability of Surface Water Disposal Methods

Surface Water Disposal Method (in Order of Preference)	Suitability Description	Method Suitable? (Y / N)
Harvest and Reuse	Given the variability in rainfall and the water requirement of the hydrogen production site, rainwater harvesting and reuse is not considered viable. There may be limited opportunity for collection and use of storm water for secondary uses at site and these would be identified and confirmed during the detailed design stage of the project.	N
Infiltration to Ground	The Sites are underlain by metamorphic or igneous bedrock which are considered to be a low and very low productivity aquifer. Site investigation of the glaciofluvial deposits on the northern boundary of the electrolyser area was undertaken but only low permeability soils and infiltration rates were proven. It is unlikely that the drainage of surface water runoff to formal infiltration components will be feasible. The drainage scheme, for the electrolyser area, also needs to contain firewater and infiltration to ground is not compatible with containment of water.	N
Discharge to Surface Waters	All of the Sites are situated within proximity to an open watercourse (Dewsford Burn, Park Burn and Silver Burn) which can be used for discharge of surface water.	Y
Discharge to Sewer	The Sites are located on existing greenfield land remote from existing developments.	N

3.3 Water quantity design standard

Current best practice for surface water management and SuDS Design states the following with respect to control of post development 'Peak Runoff Rates' and 'Runoff Volume' from 'greenfield' sites.

The SuDS Manual (CIRIA Report C753) – Section 24.10.1:

"Additional runoff volumes from developments can cause increases in flood risk downstream of the site, even where peak flows from the site are controlled to greenfield rates.

Therefore, for extreme events, in addition to the standard for controlling the peak rate of runoff, there is also a standard that requires runoff volume control for the 1:100 year, 6 hour event. This is particularly critical for catchments that are susceptible to flooding downstream of the proposed development.

The difference in runoff volume between the development state and the equivalent greenfield (or possibly pre-development state where this is considered to be acceptable) is termed the Long-Term Storage Volume. It is this volume that should be prevented from leaving the site (via rainwater harvesting and/or infiltration) or, where this is not possible, controlled so that it discharges at very low rates that will have negligible impact on downstream flood risk. Only the greenfield (or pre-developed) runoff volume should be allowed to discharge at greenfield (or pre-developed) rates.

Where there is extra volume generated by the development that has to be discharged (because there are no opportunities for it to be infiltrated and/or used on site), this volume should be released at a very low rate (e.g. <2/l/s/ha or as agreed with the local drainage approving body *and/or environmental regulator) and the 1:100 year greenfield allowable runoff rate reduced to take account of this extra discharge (Kellagher, 2002).*

An alternative approach to managing the extra runoff volumes from extreme events separately from the main drainage system is to release all runoff (above the 1 year event) from the site at a maximum rate of 2 l/s/ha or Q_{BAR}, whichever is the higher value (or as agreed with the drainage approving body and/or environmental regulator). This avoids the need to undertake more detailed calculations and modelling.

Kellagher (2002) demonstrates that if discharges are not limited to less than 3 l/s/ha, the drainage system will generally not be effective at retaining sufficient water on the site to prevent an increase in flood risk in the receiving catchment. A discharge limit of 2 l/s/ha (or $Q_{BAR,}$ which allows for higher discharge rates for specific soil types) has generally been accepted as an appropriate industry standard in the UK, unless alternative site or catchment specific limits are agreed based on local risk evaluation."

In line with the above and based upon local planning guidance and that provided within NPF4, the peak surface water runoff rate from the proposed development will be restricted to 2 l/s/ha for all events up to and including the 1:200 AEP event + 37%CC.

3.4 Proposed surface water drainage strategy

3.4.1 Impermeable areas

Impermeable areas for each of the Sites have, at this stage, been based upon an estimate of 65% of the overall site area. This allows for reasonable estimates for surface water runoff to be made. However, the details regarding flow restrictions, impermeable areas and attenuation volumes will need to be finalised at the detailed design phase once the layout has been fixed for each site.

Due to the topography present within the electrolysis plant site, as elevations decrease to the north and south, this area has been split into two.

Table 3-2 below summarises the estimated impermeable areas based upon the overall site area for each part of the development, together with the calculated flow restriction based upon 2 l/s/ha:

Table 3-2 : Assumed impermeable areas and greenfield runoff estimate

Development area	Site area (ha)	Estimated impermeable area (65% of overall area) (ha)	Flow restriction (2 l/s/ha)
Electrolysis plant site (North)	38	24.7	49.4
Electrolysis plant site (South)	18	11.7	23.4
Water abstraction, treatment and discharge site	0.6	0.39	1
Gas injection site	1.6	1.04	2.1

While the calculated discharge rate for the water abstraction site, based upon 2 l/s/ha, is 0.8 l/s, a minimum flow restriction rate of 1 l/s has been applied to reduce the risk of blockage and ensure that the drainage system remains operational. To facilitate this discharge rate and to prevent blockage of the outflow it is likely a Hydro-Brake (or similar) will be specified at the detailed design stage.

3.5 Proposed drainage methods

The proposed drainage systems for each of the Sites are detailed below.

Initial modelling of each development area has been completed in order to estimate the required storm water attenuation volumes. The results of the initial modelling of attenuation volumes have been included in Annex B.

The proposed drainage strategy and the calculations presented with this report will be subject to change during detailed design of the site layout and the accompanying surface water drainage systems. Notwithstanding this, details of the provision that is likely to be made for each element of the Proposed Development is given in the sections that follow. It is shown that there is space, within the application boundary, to collect, treat and attenuate storm water runoff.

3.5.1 Electrolysis plant site

As noted in Table 3-2, the electrolysis plant site comprises a total development area of approximately 56 ha (excluding areas such as retained vegetation, landscaping, underground services etc within the overall larger application boundary). Due to the existing topography in this area, the area has been split into two (north and south) to facilitate effective drainage under gravity.

The northern part of the electrolysis plant site comprises a total developable area of 38 ha, with an estimated impermeable area of 24.7 ha. Based upon a maximum discharge rate of 2 l/s/ha, this results in a total flow restriction of 24.4 l/s for all events up to and including the 1:200+CC event. In order to maintain this rate, surface water attenuation of approximately 46,125 m^3 will be required.

It is proposed to drain surface water runoff from the northern part of the electrolysis plant site to a detention basin to the north of the proposed infrastructure before a restricted discharge to Dewsford Burn.

The southern part of the electrolysis plant site comprises a total developable area of 18 ha, with an estimated impermeable area of 11.7 ha. This subsequently results in an allowable discharge rate of 23.4 l/s for all events up to and including the 1:200+CC event. In order to maintain this rate, surface water attenuation of approximately 22,356 m^3 will be required, which, similarly to the northern part of the electrolysis plant site, is proposed to be achieved through the inclusion of a detention basin. This detention basin is to be situated to the south of the development, receiving flows under gravity before a restricted discharge to Park Burn. If, as part of the detailed design stage of the project, and subject to site investigation data that confirms infiltration rates are suitable, some or all of the collected runoff could be discharged to ground

This configuration will maintain existing surface water catchments and water contributions to the Dewsford Burn and Park Burn.

It is noted that both attenuation volumes are large, and, if it is confirmed at the detailed design stage, that water storage of more than 10,000 m^3 is required above existing ground levels, then advice will need to be sought from a registered Reservoirs Panel Engineer. However, studies undertaken to inform the proposed site layout suggest it may be possible to provide the required attenuation volumes without exceeding 10,000 m^3 above ground level.

As part of the detailed design, elements of the proposed detention ponds (and if adopted soakaways) will be provided, and include, for example: details of impermeable lining, erosion protection and placement of rip-rap to dissipate flows and prevent erosion, headwall structures and flow limiting devices, such as Hydro-Brakes.

3.5.2 Gas injection site

The gas injection site comprises a total developable area of 1.6 ha with an estimated impermeable area of 1.04 ha. Based upon a maximum discharge rate of 2 l/s/ha, this results in a flow restriction of 2.1 l/s for the development for all events up to and including the 1:200+CC event. In order to maintain this rate, surface water attenuation of approximately 1,864 m^3 will be required.

Due to the proximity of the Park Burn to the south, it is proposed to drain surface water runoff from the impermeable areas via gravity to a detention basin before a restricted discharge to the watercourse.

Again, this will maintain existing water contribution to the Park Burn.

3.5.3 Water abstraction, treatment and discharge site

The water abstraction, treatment and discharge site comprises a developable area of approximately 0.6 ha, with an estimated impermeable area of 0.39 ha. Following the same methodology as the other development areas, this results in a calculated flow rate of 0.8 l/s and a minimum flow restriction of 1 l/s for the development for all events up to and including the 1:200+CC event. In order to maintain this rate, surface water attenuation of approximately 641 m^3 will be required.

It is proposed to attenuate surface water runoff from this area with a detention basin before a restricted discharge to Silver Burn to the west of the water abstraction, treatment and discharge site.

3.6 Surface water drainage systems exceedance

Given that each of the proposed development areas within the Sites will be designed to attenuate rainfall for the 1:200+CC event, the likelihood of exceedance flows occurring is low. Furthermore, the risk of exceedance flow occurring in the event of a system failure is also considered to be minimal as the proposed drainage networks and their associated components will be regularly inspected and maintained.

In the unlikely event that the drainage system is overcome on any part of the application site, any exceedance flows would be expected to follow prevailing topography in each area. Within the northern electrolysis plant site extent, flows would continue north before being intercepted by Dewsford Burn, before following the natural route of the watercourse in an easterly direction. Within the southern electrolysis plant site and gas injection site, exceedance flows would be expected to run south before being intercepted by Park Burn, which would then convey flows in an easterly direction.

At the gas injection site any overland flow resulting from exceedance of the drainage system would pass eastward to the Park Burn.

Finally, within the water abstraction, treatment and discharge site flows would be expected to run northwest before being intercepted by the Silver Burn.

3.7 Water quality design standard

SuDS provide a number of water quality benefits by reducing pollutant levels in runoff through the interception/filtering of fine sediments, metals, hydrocarbons, and other pollutants.

The simple index method, as outlined within the SuDS manual, provides a way of quantifying the benefit to water quality of the SuDS management train. The pollution hazard from the land use and the mitigation from the SUDS component are each assigned an index. The total mitigation index must be greater than the pollution hazard index for adequate treatment to be delivered.

Total SuDS mitigation index ≥ pollution hazard index

(for each contaminant type) (for each containment type)

The total SuDS mitigation is the summation of the first components mitigation index and half the mitigation index of any subsequent component.

With reference to the SuDS manual, post development surface water runoff generated from the impermeable areas of under normal operating condition of the facility is considered to lie within the 'Low' Pollution Hazard Level as set out within Table 3-3:

Table 3-3 : Pollution hazard potential for the Proposed Development

Land use	Pollution hazard level	Pollution hazard indices		
		Total suspended Solids (TSS)	Metals	Hydrocarbons
Other roofs (typically commercial/industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Low traffic roads and non-residential car parking/yards with infrequent change	Low	0.5	0.4	0.4

The SuDS Mitigation Indices, provided by each individual detention basin prior to discharging to a waterbody, are outlined in Table 3-4:

Table 3-4 : SuDS mitigation indices for proposed drainage system

SuDS feature	SuDS mitigation indices		
	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Detention Basin	0.5	0.5	0.6

The SuDS Mitigation Indices are compared to the Pollution Hazard Indices in Table 3-5 to determine the level of treatment provided.

Table 3-5 : SuDS performance: water quality indices assessment

Land use	Pollution hazard level	Pollution hazard and SuDS mitigation indices comparison					
		Total Suspended Solids (TSS)		Metals		Hydrocarbons	
		Pollution Index	SuDS Mitigation Index	Pollution Index	SuDS Mitigation Index	Pollution Index	SuDS Mitigation Index
Other roofs (typically commercial / industrial roofs)	Low	0.3	0.5	0.2	0.5	0.05	0.6
Low traffic roads and non-	Low	0.5	0.5	0.5	0.5	0.5	0.6

Land use	Pollution hazard level	Pollution hazard and SuDS mitigation indices comparison					
		Total Suspended Solids (TSS)		Metals		Hydrocarbons	
		Pollution Index	SuDS Mitigation Index	Pollution Index	SuDS Mitigation Index	Pollution Index	SuDS Mitigation Index
residential car parking/yards with infrequent change							

As the SuDS mitigation index provided by the proposed SuDS measures are greater than or equal to the pollution hazard index for discharge to surface waters, the water quality assessment criteria are deemed to be satisfied.

3.8 Firewater management

Notwithstanding the SuDS mitigation index, provision will be made for firewater containment in the electrolyser area of the site. It is expected that this will be provided by lining the proposed detention ponds (north and, if a pond is required, south) with a low permeability liner and provision of a shutoff valve which can be used in the unlikely event of a fire to contain firewater in the pond(s) thus preventing a discharge from site to the Dewsford Burn or Park Burn. Details of this will be provided during the detailed design stage of the project.

Should a soakaway be confirmed at the detailed design stage in the south of the site a lined pond will be provided upstream of the soakaway that would incorporate a emergency shut-off valve and which will contain firewater prior to discharge to the soakaway (and therefore to ground). The size of the pond would be agreed with SEPA and AC.

3.9 Process water

No process water would be discharged to the storm water drainage system.

All process water will be collected and either be recirculated and used in the process (with or without treatment), tankered from site for disposal at an appropriately licensed facility or be treated on site and discharged with authorisation from SEPA in accordance with the site PPC Permit.

Details of the process water management, including volume and composition, will be confirmed as part of the detailed site design and will be a primary part of the site PPC Permit application to SEPA.

3.10 Foul drainage

Foul water generated at site, from welfare and kitchen facilities etc., will drain to an on-site package waste water treatment plant. The discharge from the treatment plant will be agreed with SEPA, as required by the PPC and Controlled Activity Regulations, and will include limits regarding volume and rate of discharge and limits on the quality of the discharge water. Again, the design of the treatment plant will be confirmed as part of the detailed design stage of the project.

4.0 Principal operation and maintenance requirements

All surface water drainage and pollution control features associated with the Sites will remain under private ownership and will be maintained privately for their lifetime. Table 4-1 outlines the recommended inspection and maintenance requirements for the proposed detention basins. If necessary, this outline operation and maintenance plan will be refined as part of the detailed design phase of the project.

Table 4-1 : Detention basin general maintenance requirements

Maintenance schedule	Required action	Minimum frequency
Regular maintenance	Remove litter and debris removal.	Monthly.
	Cut grass.	Half yearly (spring – before nesting season, and autumn).
	Manage other vegetation and remove nuisance plants.	Monthly (or as required).
	Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly.
	Inspect banksides, liner, structures, pipework etc. for evidence of physical damage.	Monthly.
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Monthly (for first year), then annually or as required.
	Check any penstocks and other mechanical devices.	Annually.
	Tidy all dead growth before start of growing season.	Annually.
	Remove sediment from inlet, outlets and forebay.	Annually (or as required).
	Manage wetland plants in outlet pool – where provided.	Annually.
	Removing sedimentation that has become entrained into the outflow	Six monthly, or as required
	Ensure there are no leakage issues associated with the HydroBrake	Six monthly, or as required
	Check HydroBrake for sedimentation, or other blockages and flow bypassing	Six monthly
Occasional maintenance	Re-seed areas of poor vegetation growth.	As required.
	Prune and trim any trees and remove cuttings.	Every 2 years, or as required.
	Remove sediment from inlets, outlets, forebay and main basin when required.	Every 5 years, or as required.

Maintenance schedule	Required action	Minimum frequency
	Periodic measuring of the bore size	Every 3 years, or as required.
Remedial actions	Repair erosion or other damage by reseeding or re-turfing.	As required.
	Realignment of rip-rap.	As required.
	Repair/rehabilitation of inlets, outlets and overflows.	As required.
	Relevel uneven surfaces and reinstate design levels.	As required.

5.0 Conclusions

SLR Consulting Ltd (SLR) has been appointed by Kintore Hydrogen Ltd to prepare a Drainage Impact Assessment (DIA) for the proposed Kintore Hydrogen Plant.

This DIA sets out high level principles for managing surface water runoff from the Proposed Development and demonstrates that the scheme is feasible and compliant with best practice and regulatory requirements. It has been shown that there is space within land in the application boundary to provide the required water attenuation and treatment features.

It has been confirmed that discharge to open watercourses for each development area is the preferred management option. Due to the scale of the Proposed Development, different areas of the development are proposed to discharge to the nearest of three watercourses: Dewsford Burn; Park Burn; and Silver Burn.

The Proposed Development surface water runoff will be restricted to the equivalent greenfield runoff rate of 2 l/s/ha for all events up to and including the 1:200 + 37% CC rainfall event.

Attenuation for each of the development areas will be achieved via the use of detention basins. These detention basins will also ensure that surface water runoff is sufficiently treated and water quality is maintained in line with the relevant guidance.

It has also been confirmed that firewater attenuation will be provided for in the electrolyser area of the site, and that as part of the detailed design stage of the project details will be confirmed regarding required firewater attenuation.

The drainage principles set out within this DIA will be developed further as part of the detailed design stage of the project.

Annex A Indicative Development Plans

Kintore Hydrogen Facility

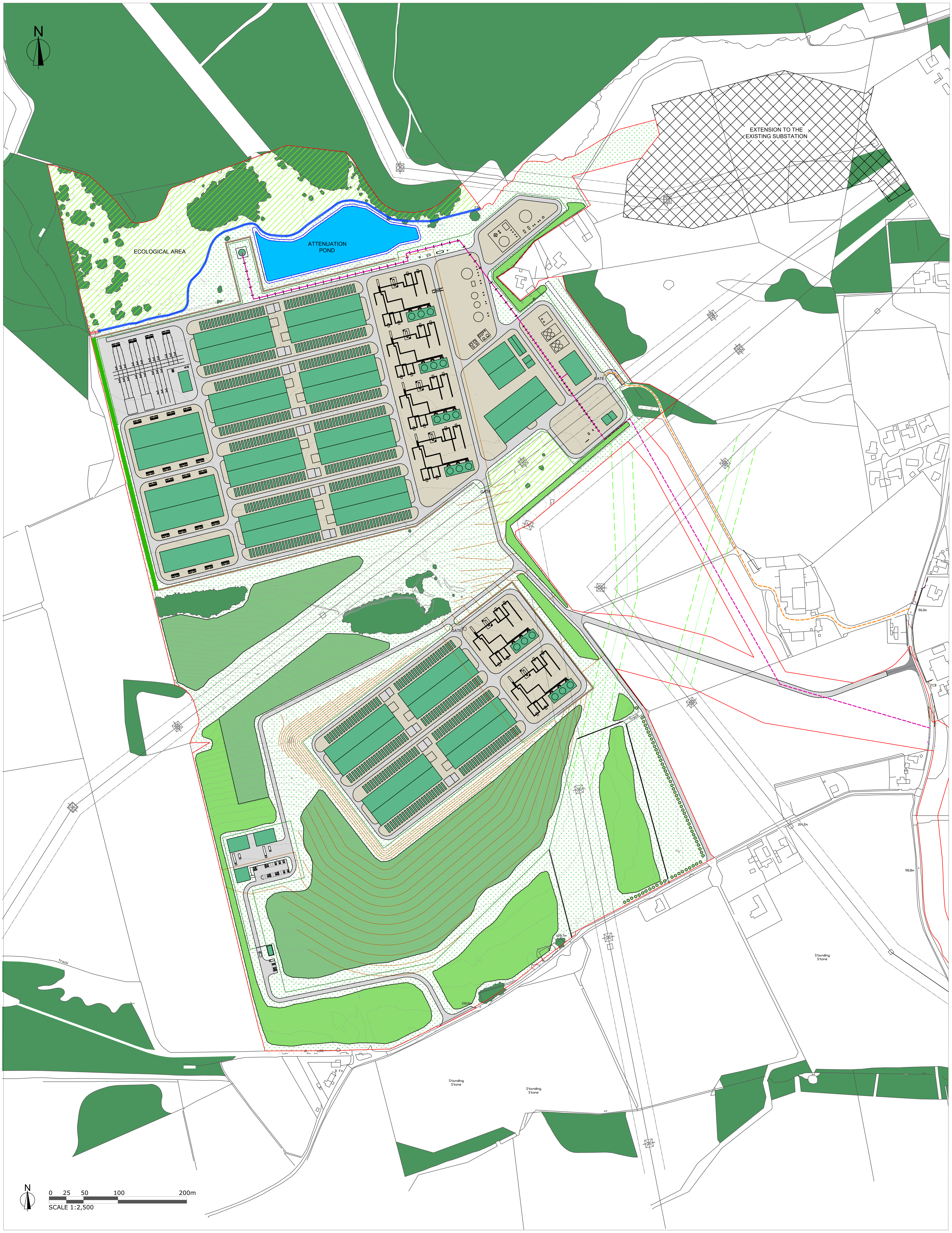
Appendix 13.3: Drainage Impact Assessment

Kintore Hydrogen Ltd

SLR Project No.: 428.013099.00001

5 September 2024

Note: this shows illustrative masterplans which are subject further design, within the envelope defined by the Planning Parameters Plan accompanying the planning application. Details such as building sizes and orientations, access road and landscape planting are indicative only.



STATERA
BALANCING THE GRID

Legend

- Site boundary
- Existing hedgerows and trees
- Extension to existing substation
- Bund
- Diverted line electricity clearance zone
- Diverted route of overhead electricity line*.
- Ecological area
- Fencing
- Stone access track
- Phase 1 planting
- Phase 2 planting
- Retaining wall
- Hydrogen pipeline
- Attenuation pond
- Watercourse reroute (if needed)
- Loose permeable gravel
- Other planting (e.g. wildflower grassland)
- Emergency access route
- Proposed 1m contours
- Specimen tree planting

*Estimated alignments - third party (Transmission Owner) works

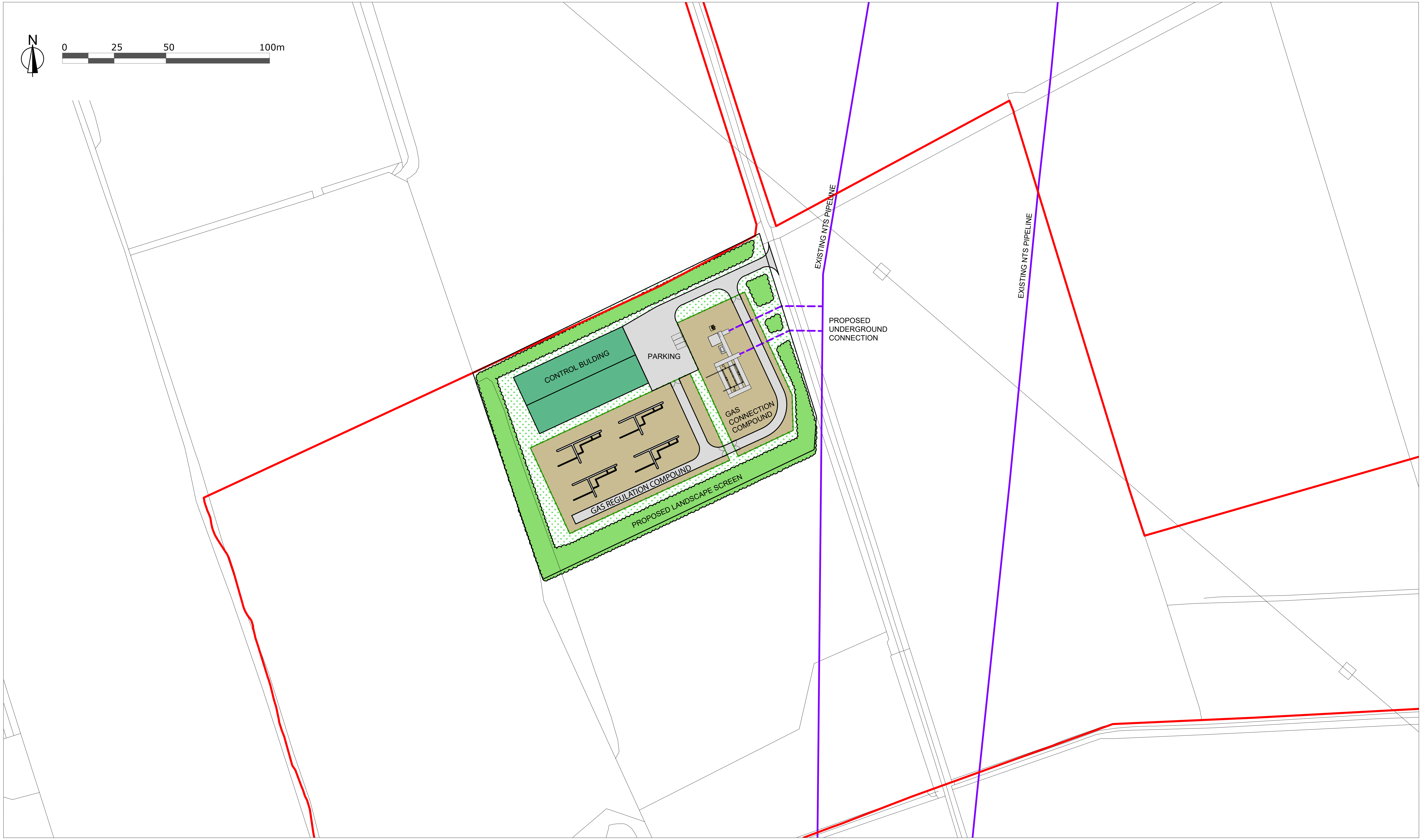
Revision	Date	Comment
A	22.05.24	Access arrangement altered

ON BEHALF
Statera Energy

PROJECT
Kintore Electrolysis

DATE	27th March 2024
SCALE	1 : 2,500 @ A1
DWG No	SL260__L__X__MP__2
APPROVED	CMcD

TITLE
Masterplan
Option 1



STATERA
BALANCING THE GRID

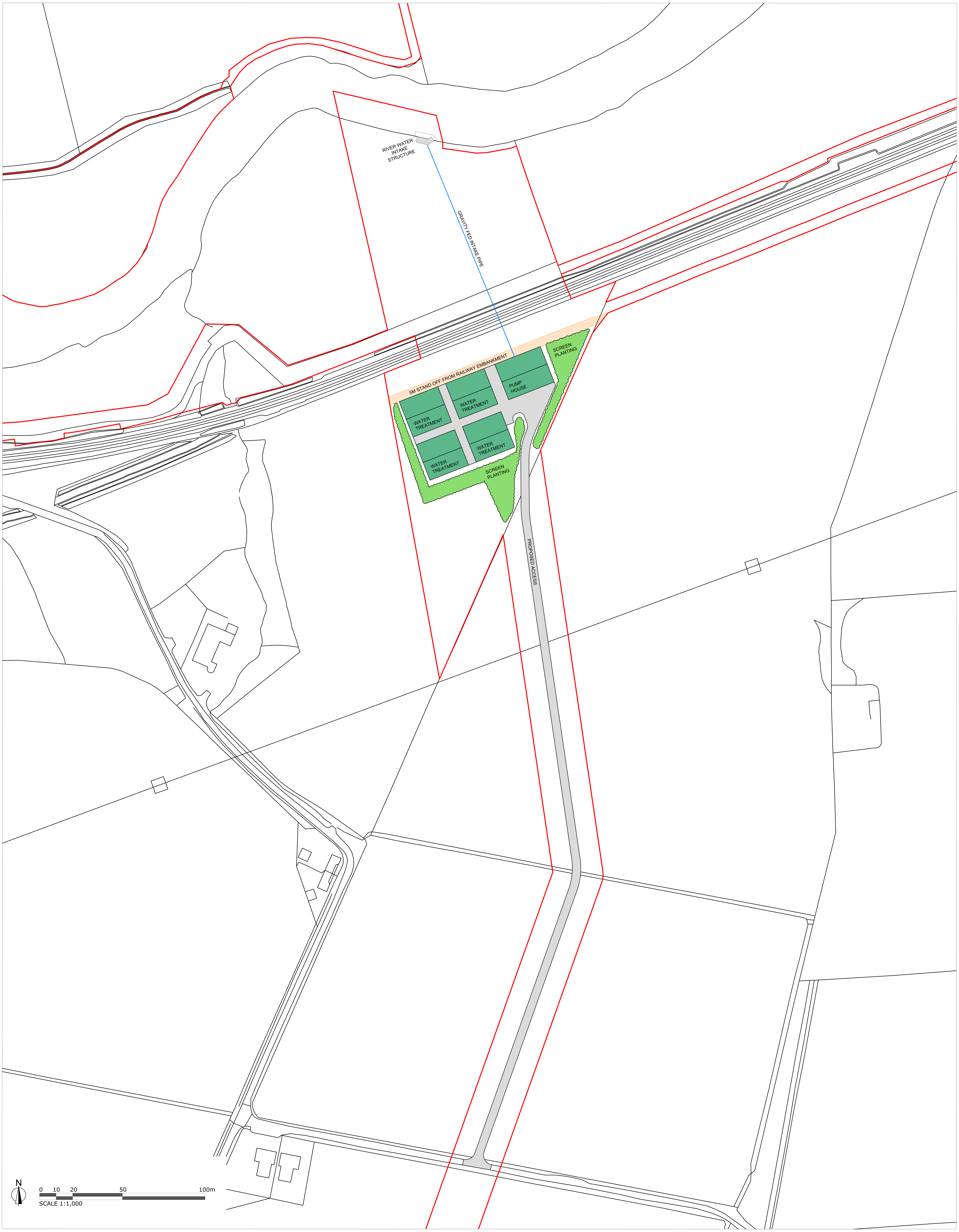
Revision	Date	Comment
-	-	-

ON BEHALF
Statera Energy

PROJECT
Kintore Electrolysis

DATE 27th March 2024
SCALE See scale bar @ A3
DWG No SL_L_X_WG_1
APPROVED CMcD

TITLE
Gas Connection Compound



STATERA
BALANCING THE GRID

Revision	Date	Comment
-	-	-

ON BEHALF
Statera Energy

PROJECT
Kintore Electrolysis

DATE	27th March 2024
SCALE	1 : 1,0000 @ A1
DWG No	SL260_L_X_WG_2
APPROVED	CMcD

TITLE
Water Treatment Works

Annex B Initial Drainage Calculations

Kintore Hydrogen Facility

Appendix 13.3: Drainage Impact Assessment

Kintore Hydrogen Ltd

SLR Project No.: 428.013099.00001

5 September 2024

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	1	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	Scotland and Ireland	Connection Type	Level Soffits
M5-60 (mm)	17.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.200	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	2.00	Enforce best practice design rules	✓

Simulation Settings

Rainfall Methodology	FSR	Drain Down Time (mins)	240
FSR Region	Scotland and Ireland	Additional Storage (m^3/ha)	20.0
M5-60 (mm)	17.000	Check Discharge Rate(s)	✓
Ratio-R	0.200	1 year (l/s)	0.0
Summer CV	0.750	2 year (l/s)	0.0
Winter CV	0.840	30 year (l/s)	0.0
Analysis Speed	Normal	100 year (l/s)	0.0
Skip Steady State	x	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
30	0	0	0
30	37	0	0
100	0	0	0
200	0	0	0
200	37	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.95
Greenfield Method	IH124	Growth Factor 100 year	2.48
Positively Drained Area (ha)		Betterment (%)	0
SAAR (mm)		QBar	
Soil Index	1	Q 1 year (l/s)	
SPR	0.10	Q 30 year (l/s)	
Region	1	Q 100 year (l/s)	
Growth Factor 1 year	0.85		

Node Basin Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	98.000	Product Number	CTL-SHE-0286-4940-1600-4940
Design Depth (m)	1.600	Min Outlet Diameter (m)	0.300
Design Flow (l/s)	49.4	Min Node Diameter (mm)	2100

Node Basin Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	98.000
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	27027.4	0.0	2.000	31253.6	0.0

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
1 year 15 minute summer	82.148	23.245
1 year 15 minute winter	57.648	23.245
1 year 30 minute summer	59.299	16.780
1 year 30 minute winter	41.614	16.780
1 year 60 minute summer	44.644	11.798
1 year 60 minute winter	29.660	11.798
1 year 120 minute summer	30.990	8.190
1 year 120 minute winter	20.589	8.190
1 year 180 minute summer	25.650	6.601
1 year 180 minute winter	16.673	6.601
1 year 240 minute summer	21.411	5.658
1 year 240 minute winter	14.225	5.658
1 year 360 minute summer	17.661	4.545
1 year 360 minute winter	11.480	4.545
1 year 480 minute summer	14.807	3.913
1 year 480 minute winter	9.838	3.913
1 year 600 minute summer	12.657	3.462
1 year 600 minute winter	8.648	3.462
1 year 720 minute summer	11.689	3.133
1 year 720 minute winter	7.856	3.133
1 year 960 minute summer	10.151	2.673
1 year 960 minute winter	6.724	2.673
1 year 1440 minute summer	7.983	2.139
1 year 1440 minute winter	5.365	2.139
1 year 2160 minute summer	6.191	1.711
1 year 2160 minute winter	4.266	1.711
1 year 2880 minute summer	5.435	1.457
1 year 2880 minute winter	3.653	1.457
1 year 4320 minute summer	4.438	1.160
1 year 4320 minute winter	2.923	1.160
1 year 5760 minute summer	3.852	0.986
1 year 5760 minute winter	2.493	0.986
1 year 7200 minute summer	3.407	0.869
1 year 7200 minute winter	2.199	0.869
1 year 8640 minute summer	3.075	0.784
1 year 8640 minute winter	1.984	0.784
1 year 10080 minute summer	2.819	0.719
1 year 10080 minute winter	1.820	0.719
30 year 15 minute summer	182.169	51.548
30 year 15 minute winter	127.838	51.548
30 year 30 minute summer	131.901	37.323
30 year 30 minute winter	92.562	37.323
30 year 60 minute summer	97.144	25.672

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year 60 minute winter	64.540	25.672
30 year 120 minute summer	65.121	17.210
30 year 120 minute winter	43.265	17.210
30 year 180 minute summer	52.556	13.524
30 year 180 minute winter	34.163	13.524
30 year 240 minute summer	43.046	11.376
30 year 240 minute winter	28.598	11.376
30 year 360 minute summer	34.569	8.896
30 year 360 minute winter	22.471	8.896
30 year 480 minute summer	28.244	7.464
30 year 480 minute winter	18.764	7.464
30 year 600 minute summer	23.808	6.512
30 year 600 minute winter	16.267	6.512
30 year 720 minute summer	21.733	5.825
30 year 720 minute winter	14.606	5.825
30 year 960 minute summer	18.543	4.883
30 year 960 minute winter	12.283	4.883
30 year 1440 minute summer	14.187	3.802
30 year 1440 minute winter	9.535	3.802
30 year 2160 minute summer	10.697	2.956
30 year 2160 minute winter	7.371	2.956
30 year 2880 minute summer	9.222	2.471
30 year 2880 minute winter	6.198	2.471
30 year 4320 minute summer	7.342	1.920
30 year 4320 minute winter	4.835	1.920
30 year 5760 minute summer	6.271	1.605
30 year 5760 minute winter	4.059	1.605
30 year 7200 minute summer	5.482	1.399
30 year 7200 minute winter	3.538	1.399
30 year 8640 minute summer	4.902	1.250
30 year 8640 minute winter	3.164	1.250
30 year 10080 minute summer	4.462	1.138
30 year 10080 minute winter	2.880	1.138
30 year +37% CC 15 minute summer	249.571	70.620
30 year +37% CC 15 minute winter	175.138	70.620
30 year +37% CC 30 minute summer	180.704	51.133
30 year +37% CC 30 minute winter	126.810	51.133
30 year +37% CC 60 minute summer	133.087	35.171
30 year +37% CC 60 minute winter	88.420	35.171
30 year +37% CC 120 minute summer	89.216	23.577
30 year +37% CC 120 minute winter	59.273	23.577
30 year +37% CC 180 minute summer	72.002	18.528
30 year +37% CC 180 minute winter	46.803	18.528
30 year +37% CC 240 minute summer	58.972	15.585
30 year +37% CC 240 minute winter	39.180	15.585
30 year +37% CC 360 minute summer	47.359	12.187
30 year +37% CC 360 minute winter	30.785	12.187
30 year +37% CC 480 minute summer	38.694	10.226
30 year +37% CC 480 minute winter	25.707	10.226
30 year +37% CC 600 minute summer	32.617	8.922
30 year +37% CC 600 minute winter	22.286	8.922
30 year +37% CC 720 minute summer	29.774	7.980

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year +37% CC 720 minute winter	20.010	7.980
30 year +37% CC 960 minute summer	25.404	6.690
30 year +37% CC 960 minute winter	16.828	6.690
30 year +37% CC 1440 minute summer	19.436	5.209
30 year +37% CC 1440 minute winter	13.062	5.209
30 year +37% CC 2160 minute summer	14.655	4.050
30 year +37% CC 2160 minute winter	10.098	4.050
30 year +37% CC 2880 minute summer	12.634	3.386
30 year +37% CC 2880 minute winter	8.491	3.386
30 year +37% CC 4320 minute summer	10.059	2.630
30 year +37% CC 4320 minute winter	6.624	2.630
30 year +37% CC 5760 minute summer	8.591	2.199
30 year +37% CC 5760 minute winter	5.561	2.199
30 year +37% CC 7200 minute summer	7.511	1.916
30 year +37% CC 7200 minute winter	4.847	1.916
30 year +37% CC 8640 minute summer	6.716	1.713
30 year +37% CC 8640 minute winter	4.334	1.713
30 year +37% CC 10080 minute summer	6.114	1.560
30 year +37% CC 10080 minute winter	3.946	1.560
100 year 15 minute summer	235.662	66.684
100 year 15 minute winter	165.377	66.684
100 year 30 minute summer	172.134	48.708
100 year 30 minute winter	120.796	48.708
100 year 60 minute summer	126.118	33.329
100 year 60 minute winter	83.790	33.329
100 year 120 minute summer	83.627	22.100
100 year 120 minute winter	55.560	22.100
100 year 180 minute summer	66.955	17.230
100 year 180 minute winter	43.522	17.230
100 year 240 minute summer	54.503	14.403
100 year 240 minute winter	36.210	14.403
100 year 360 minute summer	43.371	11.161
100 year 360 minute winter	28.192	11.161
100 year 480 minute summer	35.198	9.302
100 year 480 minute winter	23.385	9.302
100 year 600 minute summer	29.515	8.073
100 year 600 minute winter	20.167	8.073
100 year 720 minute summer	26.828	7.190
100 year 720 minute winter	18.030	7.190
100 year 960 minute summer	22.736	5.987
100 year 960 minute winter	15.061	5.987
100 year 1440 minute summer	17.216	4.614
100 year 1440 minute winter	11.571	4.614
100 year 2160 minute summer	12.838	3.548
100 year 2160 minute winter	8.846	3.548
100 year 2880 minute summer	10.977	2.942
100 year 2880 minute winter	7.377	2.942
100 year 4320 minute summer	8.639	2.259
100 year 4320 minute winter	5.689	2.259
100 year 5760 minute summer	7.320	1.874
100 year 5760 minute winter	4.738	1.874
100 year 7200 minute summer	6.364	1.623

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year 7200 minute winter	4.107	1.623
100 year 8640 minute summer	5.667	1.446
100 year 8640 minute winter	3.657	1.446
100 year 10080 minute summer	5.143	1.312
100 year 10080 minute winter	3.319	1.312
200 year 15 minute summer	273.315	77.339
200 year 15 minute winter	191.800	77.339
200 year 30 minute summer	200.647	56.776
200 year 30 minute winter	140.805	56.776
200 year 60 minute summer	146.569	38.734
200 year 60 minute winter	97.377	38.734
200 year 120 minute summer	96.580	25.523
200 year 120 minute winter	64.165	25.523
200 year 180 minute summer	76.970	19.807
200 year 180 minute winter	50.033	19.807
200 year 240 minute summer	62.434	16.499
200 year 240 minute winter	41.480	16.499
200 year 360 minute summer	49.421	12.718
200 year 360 minute winter	32.125	12.718
200 year 480 minute summer	39.953	10.558
200 year 480 minute winter	26.544	10.558
200 year 600 minute summer	33.402	9.136
200 year 600 minute winter	22.822	9.136
200 year 720 minute summer	30.287	8.117
200 year 720 minute winter	20.355	8.117
200 year 960 minute summer	25.568	6.733
200 year 960 minute winter	16.937	6.733
200 year 1440 minute summer	19.246	5.158
200 year 1440 minute winter	12.934	5.158
200 year 2160 minute summer	14.260	3.941
200 year 2160 minute winter	9.825	3.941
200 year 2880 minute summer	12.135	3.252
200 year 2880 minute winter	8.155	3.252
200 year 4320 minute summer	9.486	2.480
200 year 4320 minute winter	6.247	2.480
200 year 5760 minute summer	8.002	2.049
200 year 5760 minute winter	5.180	2.049
200 year 7200 minute summer	6.934	1.769
200 year 7200 minute winter	4.475	1.769
200 year 8640 minute summer	6.160	1.571
200 year 8640 minute winter	3.976	1.571
200 year 10080 minute summer	5.581	1.424
200 year 10080 minute winter	3.602	1.424
200 year +37% CC 15 minute summer	374.442	105.954
200 year +37% CC 15 minute winter	262.766	105.954
200 year +37% CC 30 minute summer	274.886	77.783
200 year +37% CC 30 minute winter	192.903	77.783
200 year +37% CC 60 minute summer	200.800	53.066
200 year +37% CC 60 minute winter	133.407	53.066
200 year +37% CC 120 minute summer	132.314	34.967
200 year +37% CC 120 minute winter	87.907	34.967
200 year +37% CC 180 minute summer	105.449	27.136

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
200 year +37% CC 180 minute winter	68.545	27.136
200 year +37% CC 240 minute summer	85.535	22.604
200 year +37% CC 240 minute winter	56.827	22.604
200 year +37% CC 360 minute summer	67.707	17.423
200 year +37% CC 360 minute winter	44.011	17.423
200 year +37% CC 480 minute summer	54.736	14.465
200 year +37% CC 480 minute winter	36.365	14.465
200 year +37% CC 600 minute summer	45.761	12.517
200 year +37% CC 600 minute winter	31.267	12.517
200 year +37% CC 720 minute summer	41.493	11.121
200 year +37% CC 720 minute winter	27.886	11.121
200 year +37% CC 960 minute summer	35.028	9.224
200 year +37% CC 960 minute winter	23.203	9.224
200 year +37% CC 1440 minute summer	26.367	7.067
200 year +37% CC 1440 minute winter	17.720	7.067
200 year +37% CC 2160 minute summer	19.536	5.399
200 year +37% CC 2160 minute winter	13.461	5.399
200 year +37% CC 2880 minute summer	16.624	4.456
200 year +37% CC 2880 minute winter	11.173	4.456
200 year +37% CC 4320 minute summer	12.996	3.398
200 year +37% CC 4320 minute winter	8.559	3.398
200 year +37% CC 5760 minute summer	10.963	2.806
200 year +37% CC 5760 minute winter	7.096	2.806
200 year +37% CC 7200 minute summer	9.500	2.423
200 year +37% CC 7200 minute winter	6.131	2.423
200 year +37% CC 8640 minute summer	8.439	2.153
200 year +37% CC 8640 minute winter	5.447	2.153
200 year +37% CC 10080 minute summer	7.646	1.951
200 year +37% CC 10080 minute winter	4.935	1.951

Results for 1 year Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
8640 minute winter	Basin	5880	98.428	0.428	114.4	11871.0200	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
8640 minute winter	Basin	Hydro-Brake®	49.0	16342.9

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
10080 minute winter	Basin	7380	98.793	0.793	166.0	22294.9100	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
10080 minute winter	Basin	Hydro-Brake®	49.4	21300.9

Results for 30 year +37% CC Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
10080 minute winter	Basin	8100	99.219	1.219	227.4	34825.1200	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
10080 minute winter	Basin	Hydro-Brake®	49.4	21210.3

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
10080 minute winter	Basin	7620	98.963	0.963	191.3	27238.6100	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
10080 minute winter	Basin	Hydro-Brake®	49.4	21445.6

Results for 200 year Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
10080 minute winter	Basin	7860	99.079	1.079	207.6	30655.6200	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m^3)
10080 minute winter	Basin	Hydro-Brake®	49.3	21129.1

Results for 200 year +37% CC Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
10080 minute winter	Basin	9180	99.593	1.593	284.4	46124.5300	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
10080 minute winter	Basin	Hydro-Brake®	49.4	23410.5

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	1	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	Scotland and Ireland	Connection Type	Level Soffits
M5-60 (mm)	17.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.200	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	2.00	Enforce best practice design rules	✓

Simulation Settings

Rainfall Methodology	FSR	Drain Down Time (mins)	240
FSR Region	Scotland and Ireland	Additional Storage (m³/ha)	20.0
M5-60 (mm)	17.000	Check Discharge Rate(s)	✓
Ratio-R	0.200	1 year (l/s)	0.0
Summer CV	0.750	2 year (l/s)	0.0
Winter CV	0.840	30 year (l/s)	0.0
Analysis Speed	Normal	100 year (l/s)	0.0
Skip Steady State	x	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
30	0	0	0
30	37	0	0
100	0	0	0
200	0	0	0
200	37	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.95
Greenfield Method	IH124	Growth Factor 100 year	2.48
Positively Drained Area (ha)		Betterment (%)	0
SAAR (mm)		QBar	
Soil Index	1	Q 1 year (l/s)	
SPR	0.10	Q 30 year (l/s)	
Region	1	Q 100 year (l/s)	
Growth Factor 1 year	0.85		

Node Basin Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	113.600	Product Number	CTL-SHE-0213-2340-1000-2340
Design Depth (m)	1.000	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	23.4	Min Node Diameter (mm)	1500

Node Basin Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	113.600
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	22641.4	0.0	1.400	25174.1	0.0

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
1 year 15 minute summer	82.148	23.245
1 year 15 minute winter	57.648	23.245
1 year 30 minute summer	59.299	16.780
1 year 30 minute winter	41.614	16.780
1 year 60 minute summer	44.644	11.798
1 year 60 minute winter	29.660	11.798
1 year 120 minute summer	30.990	8.190
1 year 120 minute winter	20.589	8.190
1 year 180 minute summer	25.650	6.601
1 year 180 minute winter	16.673	6.601
1 year 240 minute summer	21.411	5.658
1 year 240 minute winter	14.225	5.658
1 year 360 minute summer	17.661	4.545
1 year 360 minute winter	11.480	4.545
1 year 480 minute summer	14.807	3.913
1 year 480 minute winter	9.838	3.913
1 year 600 minute summer	12.657	3.462
1 year 600 minute winter	8.648	3.462
1 year 720 minute summer	11.689	3.133
1 year 720 minute winter	7.856	3.133
1 year 960 minute summer	10.151	2.673
1 year 960 minute winter	6.724	2.673
1 year 1440 minute summer	7.983	2.139
1 year 1440 minute winter	5.365	2.139
1 year 2160 minute summer	6.191	1.711
1 year 2160 minute winter	4.266	1.711
1 year 2880 minute summer	5.435	1.457
1 year 2880 minute winter	3.653	1.457
1 year 4320 minute summer	4.438	1.160
1 year 4320 minute winter	2.923	1.160
1 year 5760 minute summer	3.852	0.986
1 year 5760 minute winter	2.493	0.986
1 year 7200 minute summer	3.407	0.869
1 year 7200 minute winter	2.199	0.869
1 year 8640 minute summer	3.075	0.784
1 year 8640 minute winter	1.984	0.784
1 year 10080 minute summer	2.819	0.719
1 year 10080 minute winter	1.820	0.719
30 year 15 minute summer	182.169	51.548
30 year 15 minute winter	127.838	51.548
30 year 30 minute summer	131.901	37.323
30 year 30 minute winter	92.562	37.323
30 year 60 minute summer	97.144	25.672

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year 60 minute winter	64.540	25.672
30 year 120 minute summer	65.121	17.210
30 year 120 minute winter	43.265	17.210
30 year 180 minute summer	52.556	13.524
30 year 180 minute winter	34.163	13.524
30 year 240 minute summer	43.046	11.376
30 year 240 minute winter	28.598	11.376
30 year 360 minute summer	34.569	8.896
30 year 360 minute winter	22.471	8.896
30 year 480 minute summer	28.244	7.464
30 year 480 minute winter	18.764	7.464
30 year 600 minute summer	23.808	6.512
30 year 600 minute winter	16.267	6.512
30 year 720 minute summer	21.733	5.825
30 year 720 minute winter	14.606	5.825
30 year 960 minute summer	18.543	4.883
30 year 960 minute winter	12.283	4.883
30 year 1440 minute summer	14.187	3.802
30 year 1440 minute winter	9.535	3.802
30 year 2160 minute summer	10.697	2.956
30 year 2160 minute winter	7.371	2.956
30 year 2880 minute summer	9.222	2.471
30 year 2880 minute winter	6.198	2.471
30 year 4320 minute summer	7.342	1.920
30 year 4320 minute winter	4.835	1.920
30 year 5760 minute summer	6.271	1.605
30 year 5760 minute winter	4.059	1.605
30 year 7200 minute summer	5.482	1.399
30 year 7200 minute winter	3.538	1.399
30 year 8640 minute summer	4.902	1.250
30 year 8640 minute winter	3.164	1.250
30 year 10080 minute summer	4.462	1.138
30 year 10080 minute winter	2.880	1.138
30 year +37% CC 15 minute summer	249.571	70.620
30 year +37% CC 15 minute winter	175.138	70.620
30 year +37% CC 30 minute summer	180.704	51.133
30 year +37% CC 30 minute winter	126.810	51.133
30 year +37% CC 60 minute summer	133.087	35.171
30 year +37% CC 60 minute winter	88.420	35.171
30 year +37% CC 120 minute summer	89.216	23.577
30 year +37% CC 120 minute winter	59.273	23.577
30 year +37% CC 180 minute summer	72.002	18.528
30 year +37% CC 180 minute winter	46.803	18.528
30 year +37% CC 240 minute summer	58.972	15.585
30 year +37% CC 240 minute winter	39.180	15.585
30 year +37% CC 360 minute summer	47.359	12.187
30 year +37% CC 360 minute winter	30.785	12.187
30 year +37% CC 480 minute summer	38.694	10.226
30 year +37% CC 480 minute winter	25.707	10.226
30 year +37% CC 600 minute summer	32.617	8.922
30 year +37% CC 600 minute winter	22.286	8.922
30 year +37% CC 720 minute summer	29.774	7.980

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year +37% CC 720 minute winter	20.010	7.980
30 year +37% CC 960 minute summer	25.404	6.690
30 year +37% CC 960 minute winter	16.828	6.690
30 year +37% CC 1440 minute summer	19.436	5.209
30 year +37% CC 1440 minute winter	13.062	5.209
30 year +37% CC 2160 minute summer	14.655	4.050
30 year +37% CC 2160 minute winter	10.098	4.050
30 year +37% CC 2880 minute summer	12.634	3.386
30 year +37% CC 2880 minute winter	8.491	3.386
30 year +37% CC 4320 minute summer	10.059	2.630
30 year +37% CC 4320 minute winter	6.624	2.630
30 year +37% CC 5760 minute summer	8.591	2.199
30 year +37% CC 5760 minute winter	5.561	2.199
30 year +37% CC 7200 minute summer	7.511	1.916
30 year +37% CC 7200 minute winter	4.847	1.916
30 year +37% CC 8640 minute summer	6.716	1.713
30 year +37% CC 8640 minute winter	4.334	1.713
30 year +37% CC 10080 minute summer	6.114	1.560
30 year +37% CC 10080 minute winter	3.946	1.560
100 year 15 minute summer	235.662	66.684
100 year 15 minute winter	165.377	66.684
100 year 30 minute summer	172.134	48.708
100 year 30 minute winter	120.796	48.708
100 year 60 minute summer	126.118	33.329
100 year 60 minute winter	83.790	33.329
100 year 120 minute summer	83.627	22.100
100 year 120 minute winter	55.560	22.100
100 year 180 minute summer	66.955	17.230
100 year 180 minute winter	43.522	17.230
100 year 240 minute summer	54.503	14.403
100 year 240 minute winter	36.210	14.403
100 year 360 minute summer	43.371	11.161
100 year 360 minute winter	28.192	11.161
100 year 480 minute summer	35.198	9.302
100 year 480 minute winter	23.385	9.302
100 year 600 minute summer	29.515	8.073
100 year 600 minute winter	20.167	8.073
100 year 720 minute summer	26.828	7.190
100 year 720 minute winter	18.030	7.190
100 year 960 minute summer	22.736	5.987
100 year 960 minute winter	15.061	5.987
100 year 1440 minute summer	17.216	4.614
100 year 1440 minute winter	11.571	4.614
100 year 2160 minute summer	12.838	3.548
100 year 2160 minute winter	8.846	3.548
100 year 2880 minute summer	10.977	2.942
100 year 2880 minute winter	7.377	2.942
100 year 4320 minute summer	8.639	2.259
100 year 4320 minute winter	5.689	2.259
100 year 5760 minute summer	7.320	1.874
100 year 5760 minute winter	4.738	1.874
100 year 7200 minute summer	6.364	1.623

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year 7200 minute winter	4.107	1.623
100 year 8640 minute summer	5.667	1.446
100 year 8640 minute winter	3.657	1.446
100 year 10080 minute summer	5.143	1.312
100 year 10080 minute winter	3.319	1.312
200 year 15 minute summer	273.315	77.339
200 year 15 minute winter	191.800	77.339
200 year 30 minute summer	200.647	56.776
200 year 30 minute winter	140.805	56.776
200 year 60 minute summer	146.569	38.734
200 year 60 minute winter	97.377	38.734
200 year 120 minute summer	96.580	25.523
200 year 120 minute winter	64.165	25.523
200 year 180 minute summer	76.970	19.807
200 year 180 minute winter	50.033	19.807
200 year 240 minute summer	62.434	16.499
200 year 240 minute winter	41.480	16.499
200 year 360 minute summer	49.421	12.718
200 year 360 minute winter	32.125	12.718
200 year 480 minute summer	39.953	10.558
200 year 480 minute winter	26.544	10.558
200 year 600 minute summer	33.402	9.136
200 year 600 minute winter	22.822	9.136
200 year 720 minute summer	30.287	8.117
200 year 720 minute winter	20.355	8.117
200 year 960 minute summer	25.568	6.733
200 year 960 minute winter	16.937	6.733
200 year 1440 minute summer	19.246	5.158
200 year 1440 minute winter	12.934	5.158
200 year 2160 minute summer	14.260	3.941
200 year 2160 minute winter	9.825	3.941
200 year 2880 minute summer	12.135	3.252
200 year 2880 minute winter	8.155	3.252
200 year 4320 minute summer	9.486	2.480
200 year 4320 minute winter	6.247	2.480
200 year 5760 minute summer	8.002	2.049
200 year 5760 minute winter	5.180	2.049
200 year 7200 minute summer	6.934	1.769
200 year 7200 minute winter	4.475	1.769
200 year 8640 minute summer	6.160	1.571
200 year 8640 minute winter	3.976	1.571
200 year 10080 minute summer	5.581	1.424
200 year 10080 minute winter	3.602	1.424
200 year +37% CC 15 minute summer	374.442	105.954
200 year +37% CC 15 minute winter	262.766	105.954
200 year +37% CC 30 minute summer	274.886	77.783
200 year +37% CC 30 minute winter	192.903	77.783
200 year +37% CC 60 minute summer	200.800	53.066
200 year +37% CC 60 minute winter	133.407	53.066
200 year +37% CC 120 minute summer	132.314	34.967
200 year +37% CC 120 minute winter	87.907	34.967
200 year +37% CC 180 minute summer	105.449	27.136

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
200 year +37% CC 180 minute winter	68.545	27.136
200 year +37% CC 240 minute summer	85.535	22.604
200 year +37% CC 240 minute winter	56.827	22.604
200 year +37% CC 360 minute summer	67.707	17.423
200 year +37% CC 360 minute winter	44.011	17.423
200 year +37% CC 480 minute summer	54.736	14.465
200 year +37% CC 480 minute winter	36.365	14.465
200 year +37% CC 600 minute summer	45.761	12.517
200 year +37% CC 600 minute winter	31.267	12.517
200 year +37% CC 720 minute summer	41.493	11.121
200 year +37% CC 720 minute winter	27.886	11.121
200 year +37% CC 960 minute summer	35.028	9.224
200 year +37% CC 960 minute winter	23.203	9.224
200 year +37% CC 1440 minute summer	26.367	7.067
200 year +37% CC 1440 minute winter	17.720	7.067
200 year +37% CC 2160 minute summer	19.536	5.399
200 year +37% CC 2160 minute winter	13.461	5.399
200 year +37% CC 2880 minute summer	16.624	4.456
200 year +37% CC 2880 minute winter	11.173	4.456
200 year +37% CC 4320 minute summer	12.996	3.398
200 year +37% CC 4320 minute winter	8.559	3.398
200 year +37% CC 5760 minute summer	10.963	2.806
200 year +37% CC 5760 minute winter	7.096	2.806
200 year +37% CC 7200 minute summer	9.500	2.423
200 year +37% CC 7200 minute winter	6.131	2.423
200 year +37% CC 8640 minute summer	8.439	2.153
200 year +37% CC 8640 minute winter	5.447	2.153
200 year +37% CC 10080 minute summer	7.646	1.951
200 year +37% CC 10080 minute winter	4.935	1.951

Results for 1 year Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
10080 minute winter	Basin	6780	113.864	0.264	49.7	6076.1500	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
10080 minute winter	Basin	Hydro-Brake®	23.0	8242.2

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
10080 minute winter	Basin	7320	114.072	0.472	78.6	10973.6500	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
10080 minute winter	Basin	Hydro-Brake®	23.4	9723.3

Results for 30 year +37% CC Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
10080 minute winter	Basin	8100	114.317	0.717	107.7	16816.3300	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
10080 minute winter	Basin	Hydro-Brake®	23.4	9757.8

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
10080 minute winter	Basin	7560	114.169	0.569	90.6	13275.1600	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
10080 minute winter	Basin	Hydro-Brake®	23.4	9885.6

Results for 200 year Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
10080 minute winter	Basin	7740	114.234	0.634	98.3	14820.4000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
10080 minute winter	Basin	Hydro-Brake®	23.4	9911.0

Results for 200 year +37% CC Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
10080 minute winter	Basin	9240	114.545	0.945	134.7	22355.8300	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
10080 minute winter	Basin	Hydro-Brake®	23.4	10544.3

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	1	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	Scotland and Ireland	Connection Type	Level Soffits
M5-60 (mm)	17.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.200	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	2.00	Enforce best practice design rules	✓

Simulation Settings

Rainfall Methodology	FSR	Drain Down Time (mins)	240
FSR Region	Scotland and Ireland	Additional Storage (m³/ha)	20.0
M5-60 (mm)	17.000	Check Discharge Rate(s)	✓
Ratio-R	0.200	1 year (l/s)	0.0
Summer CV	0.750	2 year (l/s)	0.0
Winter CV	0.840	30 year (l/s)	0.0
Analysis Speed	Normal	100 year (l/s)	0.0
Skip Steady State	x	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
30	0	0	0
30	37	0	0
100	0	0	0
200	0	0	0
200	37	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.95
Greenfield Method	IH124	Growth Factor 100 year	2.48
Positively Drained Area (ha)		Betterment (%)	0
SAAR (mm)		QBar	
Soil Index	1	Q 1 year (l/s)	
SPR	0.10	Q 30 year (l/s)	
Region	1	Q 100 year (l/s)	
Growth Factor 1 year	0.85		

Node Basin Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	75.600	Product Number	CTL-SHE-0069-2100-1000-2100
Design Depth (m)	1.000	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	2.1	Min Node Diameter (mm)	1200

Node Basin Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	75.600
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1567.1	0.0	1.400	2437.6	0.0

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
1 year 15 minute summer	82.148	23.245
1 year 15 minute winter	57.648	23.245
1 year 30 minute summer	59.299	16.780
1 year 30 minute winter	41.614	16.780
1 year 60 minute summer	44.644	11.798
1 year 60 minute winter	29.660	11.798
1 year 120 minute summer	30.990	8.190
1 year 120 minute winter	20.589	8.190
1 year 180 minute summer	25.650	6.601
1 year 180 minute winter	16.673	6.601
1 year 240 minute summer	21.411	5.658
1 year 240 minute winter	14.225	5.658
1 year 360 minute summer	17.661	4.545
1 year 360 minute winter	11.480	4.545
1 year 480 minute summer	14.807	3.913
1 year 480 minute winter	9.838	3.913
1 year 600 minute summer	12.657	3.462
1 year 600 minute winter	8.648	3.462
1 year 720 minute summer	11.689	3.133
1 year 720 minute winter	7.856	3.133
1 year 960 minute summer	10.151	2.673
1 year 960 minute winter	6.724	2.673
1 year 1440 minute summer	7.983	2.139
1 year 1440 minute winter	5.365	2.139
1 year 2160 minute summer	6.191	1.711
1 year 2160 minute winter	4.266	1.711
1 year 2880 minute summer	5.435	1.457
1 year 2880 minute winter	3.653	1.457
1 year 4320 minute summer	4.438	1.160
1 year 4320 minute winter	2.923	1.160
1 year 5760 minute summer	3.852	0.986
1 year 5760 minute winter	2.493	0.986
1 year 7200 minute summer	3.407	0.869
1 year 7200 minute winter	2.199	0.869
1 year 8640 minute summer	3.075	0.784
1 year 8640 minute winter	1.984	0.784
1 year 10080 minute summer	2.819	0.719
1 year 10080 minute winter	1.820	0.719
30 year 15 minute summer	182.169	51.548
30 year 15 minute winter	127.838	51.548
30 year 30 minute summer	131.901	37.323
30 year 30 minute winter	92.562	37.323
30 year 60 minute summer	97.144	25.672

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year 60 minute winter	64.540	25.672
30 year 120 minute summer	65.121	17.210
30 year 120 minute winter	43.265	17.210
30 year 180 minute summer	52.556	13.524
30 year 180 minute winter	34.163	13.524
30 year 240 minute summer	43.046	11.376
30 year 240 minute winter	28.598	11.376
30 year 360 minute summer	34.569	8.896
30 year 360 minute winter	22.471	8.896
30 year 480 minute summer	28.244	7.464
30 year 480 minute winter	18.764	7.464
30 year 600 minute summer	23.808	6.512
30 year 600 minute winter	16.267	6.512
30 year 720 minute summer	21.733	5.825
30 year 720 minute winter	14.606	5.825
30 year 960 minute summer	18.543	4.883
30 year 960 minute winter	12.283	4.883
30 year 1440 minute summer	14.187	3.802
30 year 1440 minute winter	9.535	3.802
30 year 2160 minute summer	10.697	2.956
30 year 2160 minute winter	7.371	2.956
30 year 2880 minute summer	9.222	2.471
30 year 2880 minute winter	6.198	2.471
30 year 4320 minute summer	7.342	1.920
30 year 4320 minute winter	4.835	1.920
30 year 5760 minute summer	6.271	1.605
30 year 5760 minute winter	4.059	1.605
30 year 7200 minute summer	5.482	1.399
30 year 7200 minute winter	3.538	1.399
30 year 8640 minute summer	4.902	1.250
30 year 8640 minute winter	3.164	1.250
30 year 10080 minute summer	4.462	1.138
30 year 10080 minute winter	2.880	1.138
30 year +37% CC 15 minute summer	249.571	70.620
30 year +37% CC 15 minute winter	175.138	70.620
30 year +37% CC 30 minute summer	180.704	51.133
30 year +37% CC 30 minute winter	126.810	51.133
30 year +37% CC 60 minute summer	133.087	35.171
30 year +37% CC 60 minute winter	88.420	35.171
30 year +37% CC 120 minute summer	89.216	23.577
30 year +37% CC 120 minute winter	59.273	23.577
30 year +37% CC 180 minute summer	72.002	18.528
30 year +37% CC 180 minute winter	46.803	18.528
30 year +37% CC 240 minute summer	58.972	15.585
30 year +37% CC 240 minute winter	39.180	15.585
30 year +37% CC 360 minute summer	47.359	12.187
30 year +37% CC 360 minute winter	30.785	12.187
30 year +37% CC 480 minute summer	38.694	10.226
30 year +37% CC 480 minute winter	25.707	10.226
30 year +37% CC 600 minute summer	32.617	8.922
30 year +37% CC 600 minute winter	22.286	8.922
30 year +37% CC 720 minute summer	29.774	7.980

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year +37% CC 720 minute winter	20.010	7.980
30 year +37% CC 960 minute summer	25.404	6.690
30 year +37% CC 960 minute winter	16.828	6.690
30 year +37% CC 1440 minute summer	19.436	5.209
30 year +37% CC 1440 minute winter	13.062	5.209
30 year +37% CC 2160 minute summer	14.655	4.050
30 year +37% CC 2160 minute winter	10.098	4.050
30 year +37% CC 2880 minute summer	12.634	3.386
30 year +37% CC 2880 minute winter	8.491	3.386
30 year +37% CC 4320 minute summer	10.059	2.630
30 year +37% CC 4320 minute winter	6.624	2.630
30 year +37% CC 5760 minute summer	8.591	2.199
30 year +37% CC 5760 minute winter	5.561	2.199
30 year +37% CC 7200 minute summer	7.511	1.916
30 year +37% CC 7200 minute winter	4.847	1.916
30 year +37% CC 8640 minute summer	6.716	1.713
30 year +37% CC 8640 minute winter	4.334	1.713
30 year +37% CC 10080 minute summer	6.114	1.560
30 year +37% CC 10080 minute winter	3.946	1.560
100 year 15 minute summer	235.662	66.684
100 year 15 minute winter	165.377	66.684
100 year 30 minute summer	172.134	48.708
100 year 30 minute winter	120.796	48.708
100 year 60 minute summer	126.118	33.329
100 year 60 minute winter	83.790	33.329
100 year 120 minute summer	83.627	22.100
100 year 120 minute winter	55.560	22.100
100 year 180 minute summer	66.955	17.230
100 year 180 minute winter	43.522	17.230
100 year 240 minute summer	54.503	14.403
100 year 240 minute winter	36.210	14.403
100 year 360 minute summer	43.371	11.161
100 year 360 minute winter	28.192	11.161
100 year 480 minute summer	35.198	9.302
100 year 480 minute winter	23.385	9.302
100 year 600 minute summer	29.515	8.073
100 year 600 minute winter	20.167	8.073
100 year 720 minute summer	26.828	7.190
100 year 720 minute winter	18.030	7.190
100 year 960 minute summer	22.736	5.987
100 year 960 minute winter	15.061	5.987
100 year 1440 minute summer	17.216	4.614
100 year 1440 minute winter	11.571	4.614
100 year 2160 minute summer	12.838	3.548
100 year 2160 minute winter	8.846	3.548
100 year 2880 minute summer	10.977	2.942
100 year 2880 minute winter	7.377	2.942
100 year 4320 minute summer	8.639	2.259
100 year 4320 minute winter	5.689	2.259
100 year 5760 minute summer	7.320	1.874
100 year 5760 minute winter	4.738	1.874
100 year 7200 minute summer	6.364	1.623

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year 7200 minute winter	4.107	1.623
100 year 8640 minute summer	5.667	1.446
100 year 8640 minute winter	3.657	1.446
100 year 10080 minute summer	5.143	1.312
100 year 10080 minute winter	3.319	1.312
200 year 15 minute summer	273.315	77.339
200 year 15 minute winter	191.800	77.339
200 year 30 minute summer	200.647	56.776
200 year 30 minute winter	140.805	56.776
200 year 60 minute summer	146.569	38.734
200 year 60 minute winter	97.377	38.734
200 year 120 minute summer	96.580	25.523
200 year 120 minute winter	64.165	25.523
200 year 180 minute summer	76.970	19.807
200 year 180 minute winter	50.033	19.807
200 year 240 minute summer	62.434	16.499
200 year 240 minute winter	41.480	16.499
200 year 360 minute summer	49.421	12.718
200 year 360 minute winter	32.125	12.718
200 year 480 minute summer	39.953	10.558
200 year 480 minute winter	26.544	10.558
200 year 600 minute summer	33.402	9.136
200 year 600 minute winter	22.822	9.136
200 year 720 minute summer	30.287	8.117
200 year 720 minute winter	20.355	8.117
200 year 960 minute summer	25.568	6.733
200 year 960 minute winter	16.937	6.733
200 year 1440 minute summer	19.246	5.158
200 year 1440 minute winter	12.934	5.158
200 year 2160 minute summer	14.260	3.941
200 year 2160 minute winter	9.825	3.941
200 year 2880 minute summer	12.135	3.252
200 year 2880 minute winter	8.155	3.252
200 year 4320 minute summer	9.486	2.480
200 year 4320 minute winter	6.247	2.480
200 year 5760 minute summer	8.002	2.049
200 year 5760 minute winter	5.180	2.049
200 year 7200 minute summer	6.934	1.769
200 year 7200 minute winter	4.475	1.769
200 year 8640 minute summer	6.160	1.571
200 year 8640 minute winter	3.976	1.571
200 year 10080 minute summer	5.581	1.424
200 year 10080 minute winter	3.602	1.424
200 year +37% CC 15 minute summer	374.442	105.954
200 year +37% CC 15 minute winter	262.766	105.954
200 year +37% CC 30 minute summer	274.886	77.783
200 year +37% CC 30 minute winter	192.903	77.783
200 year +37% CC 60 minute summer	200.800	53.066
200 year +37% CC 60 minute winter	133.407	53.066
200 year +37% CC 120 minute summer	132.314	34.967
200 year +37% CC 120 minute winter	87.907	34.967
200 year +37% CC 180 minute summer	105.449	27.136

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
200 year +37% CC 180 minute winter	68.545	27.136
200 year +37% CC 240 minute summer	85.535	22.604
200 year +37% CC 240 minute winter	56.827	22.604
200 year +37% CC 360 minute summer	67.707	17.423
200 year +37% CC 360 minute winter	44.011	17.423
200 year +37% CC 480 minute summer	54.736	14.465
200 year +37% CC 480 minute winter	36.365	14.465
200 year +37% CC 600 minute summer	45.761	12.517
200 year +37% CC 600 minute winter	31.267	12.517
200 year +37% CC 720 minute summer	41.493	11.121
200 year +37% CC 720 minute winter	27.886	11.121
200 year +37% CC 960 minute summer	35.028	9.224
200 year +37% CC 960 minute winter	23.203	9.224
200 year +37% CC 1440 minute summer	26.367	7.067
200 year +37% CC 1440 minute winter	17.720	7.067
200 year +37% CC 2160 minute summer	19.536	5.399
200 year +37% CC 2160 minute winter	13.461	5.399
200 year +37% CC 2880 minute summer	16.624	4.456
200 year +37% CC 2880 minute winter	11.173	4.456
200 year +37% CC 4320 minute summer	12.996	3.398
200 year +37% CC 4320 minute winter	8.559	3.398
200 year +37% CC 5760 minute summer	10.963	2.806
200 year +37% CC 5760 minute winter	7.096	2.806
200 year +37% CC 7200 minute summer	9.500	2.423
200 year +37% CC 7200 minute winter	6.131	2.423
200 year +37% CC 8640 minute summer	8.439	2.153
200 year +37% CC 8640 minute winter	5.447	2.153
200 year +37% CC 10080 minute summer	7.646	1.951
200 year +37% CC 10080 minute winter	4.935	1.951

Results for 1 year Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
5760 minute winter	Basin	4080	75.857	0.257	6.0	426.8009	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m^3)
5760 minute winter	Basin	Hydro-Brake®	2.1	522.9

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
8640 minute winter	Basin	6480	76.094	0.494	7.7	858.0388	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
8640 minute winter	Basin	Hydro-Brake®	2.1	839.8

Results for 30 year +37% CC Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
10080 minute winter	Basin	8040	76.362	0.762	9.6	1386.4600	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
10080 minute winter	Basin	Hydro-Brake®	2.1	978.6

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
10080 minute winter	Basin	7800	76.208	0.608	8.1	1076.1750	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
10080 minute winter	Basin	Hydro-Brake®	2.1	942.4

Results for 200 year Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
10080 minute winter	Basin	7920	76.281	0.681	8.7	1220.7360	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m^3)
10080 minute winter	Basin	Hydro-Brake®	2.1	945.8

Results for 200 year +37% CC Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
10080 minute winter	Basin	9180	76.587	0.987	12.0	1863.5460	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m^3)
10080 minute winter	Basin	Hydro-Brake®	2.1	1068.6

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	1	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	Scotland and Ireland	Connection Type	Level Soffits
M5-60 (mm)	17.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.200	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	2.00	Enforce best practice design rules	✓

Simulation Settings

Rainfall Methodology	FSR	Drain Down Time (mins)	240
FSR Region	Scotland and Ireland	Additional Storage (m³/ha)	20.0
M5-60 (mm)	17.000	Check Discharge Rate(s)	✓
Ratio-R	0.200	1 year (l/s)	0.0
Summer CV	0.750	2 year (l/s)	0.0
Winter CV	0.840	30 year (l/s)	0.0
Analysis Speed	Normal	100 year (l/s)	0.0
Skip Steady State	x	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
30	0	0	0
30	37	0	0
100	0	0	0
200	0	0	0
200	37	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.95
Greenfield Method	IH124	Growth Factor 100 year	2.48
Positively Drained Area (ha)		Betterment (%)	0
SAAR (mm)		QBar	
Soil Index	1	Q 1 year (l/s)	
SPR	0.10	Q 30 year (l/s)	
Region	1	Q 100 year (l/s)	
Growth Factor 1 year	0.85		

Node Basin Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	48.600	Product Number	CTL-SHE-0047-1000-1000-1000
Design Depth (m)	1.000	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	1.0	Min Node Diameter (mm)	1200

Node Basin Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	48.600
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	489.0	0.0	1.400	956.7	0.0

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
1 year 15 minute summer	82.148	23.245
1 year 15 minute winter	57.648	23.245
1 year 30 minute summer	59.299	16.780
1 year 30 minute winter	41.614	16.780
1 year 60 minute summer	44.644	11.798
1 year 60 minute winter	29.660	11.798
1 year 120 minute summer	30.990	8.190
1 year 120 minute winter	20.589	8.190
1 year 180 minute summer	25.650	6.601
1 year 180 minute winter	16.673	6.601
1 year 240 minute summer	21.411	5.658
1 year 240 minute winter	14.225	5.658
1 year 360 minute summer	17.661	4.545
1 year 360 minute winter	11.480	4.545
1 year 480 minute summer	14.807	3.913
1 year 480 minute winter	9.838	3.913
1 year 600 minute summer	12.657	3.462
1 year 600 minute winter	8.648	3.462
1 year 720 minute summer	11.689	3.133
1 year 720 minute winter	7.856	3.133
1 year 960 minute summer	10.151	2.673
1 year 960 minute winter	6.724	2.673
1 year 1440 minute summer	7.983	2.139
1 year 1440 minute winter	5.365	2.139
1 year 2160 minute summer	6.191	1.711
1 year 2160 minute winter	4.266	1.711
1 year 2880 minute summer	5.435	1.457
1 year 2880 minute winter	3.653	1.457
1 year 4320 minute summer	4.438	1.160
1 year 4320 minute winter	2.923	1.160
1 year 5760 minute summer	3.852	0.986
1 year 5760 minute winter	2.493	0.986
1 year 7200 minute summer	3.407	0.869
1 year 7200 minute winter	2.199	0.869
1 year 8640 minute summer	3.075	0.784
1 year 8640 minute winter	1.984	0.784
1 year 10080 minute summer	2.819	0.719
1 year 10080 minute winter	1.820	0.719
30 year 15 minute summer	182.169	51.548
30 year 15 minute winter	127.838	51.548
30 year 30 minute summer	131.901	37.323
30 year 30 minute winter	92.562	37.323
30 year 60 minute summer	97.144	25.672

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year 60 minute winter	64.540	25.672
30 year 120 minute summer	65.121	17.210
30 year 120 minute winter	43.265	17.210
30 year 180 minute summer	52.556	13.524
30 year 180 minute winter	34.163	13.524
30 year 240 minute summer	43.046	11.376
30 year 240 minute winter	28.598	11.376
30 year 360 minute summer	34.569	8.896
30 year 360 minute winter	22.471	8.896
30 year 480 minute summer	28.244	7.464
30 year 480 minute winter	18.764	7.464
30 year 600 minute summer	23.808	6.512
30 year 600 minute winter	16.267	6.512
30 year 720 minute summer	21.733	5.825
30 year 720 minute winter	14.606	5.825
30 year 960 minute summer	18.543	4.883
30 year 960 minute winter	12.283	4.883
30 year 1440 minute summer	14.187	3.802
30 year 1440 minute winter	9.535	3.802
30 year 2160 minute summer	10.697	2.956
30 year 2160 minute winter	7.371	2.956
30 year 2880 minute summer	9.222	2.471
30 year 2880 minute winter	6.198	2.471
30 year 4320 minute summer	7.342	1.920
30 year 4320 minute winter	4.835	1.920
30 year 5760 minute summer	6.271	1.605
30 year 5760 minute winter	4.059	1.605
30 year 7200 minute summer	5.482	1.399
30 year 7200 minute winter	3.538	1.399
30 year 8640 minute summer	4.902	1.250
30 year 8640 minute winter	3.164	1.250
30 year 10080 minute summer	4.462	1.138
30 year 10080 minute winter	2.880	1.138
30 year +37% CC 15 minute summer	249.571	70.620
30 year +37% CC 15 minute winter	175.138	70.620
30 year +37% CC 30 minute summer	180.704	51.133
30 year +37% CC 30 minute winter	126.810	51.133
30 year +37% CC 60 minute summer	133.087	35.171
30 year +37% CC 60 minute winter	88.420	35.171
30 year +37% CC 120 minute summer	89.216	23.577
30 year +37% CC 120 minute winter	59.273	23.577
30 year +37% CC 180 minute summer	72.002	18.528
30 year +37% CC 180 minute winter	46.803	18.528
30 year +37% CC 240 minute summer	58.972	15.585
30 year +37% CC 240 minute winter	39.180	15.585
30 year +37% CC 360 minute summer	47.359	12.187
30 year +37% CC 360 minute winter	30.785	12.187
30 year +37% CC 480 minute summer	38.694	10.226
30 year +37% CC 480 minute winter	25.707	10.226
30 year +37% CC 600 minute summer	32.617	8.922
30 year +37% CC 600 minute winter	22.286	8.922
30 year +37% CC 720 minute summer	29.774	7.980

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year +37% CC 720 minute winter	20.010	7.980
30 year +37% CC 960 minute summer	25.404	6.690
30 year +37% CC 960 minute winter	16.828	6.690
30 year +37% CC 1440 minute summer	19.436	5.209
30 year +37% CC 1440 minute winter	13.062	5.209
30 year +37% CC 2160 minute summer	14.655	4.050
30 year +37% CC 2160 minute winter	10.098	4.050
30 year +37% CC 2880 minute summer	12.634	3.386
30 year +37% CC 2880 minute winter	8.491	3.386
30 year +37% CC 4320 minute summer	10.059	2.630
30 year +37% CC 4320 minute winter	6.624	2.630
30 year +37% CC 5760 minute summer	8.591	2.199
30 year +37% CC 5760 minute winter	5.561	2.199
30 year +37% CC 7200 minute summer	7.511	1.916
30 year +37% CC 7200 minute winter	4.847	1.916
30 year +37% CC 8640 minute summer	6.716	1.713
30 year +37% CC 8640 minute winter	4.334	1.713
30 year +37% CC 10080 minute summer	6.114	1.560
30 year +37% CC 10080 minute winter	3.946	1.560
100 year 15 minute summer	235.662	66.684
100 year 15 minute winter	165.377	66.684
100 year 30 minute summer	172.134	48.708
100 year 30 minute winter	120.796	48.708
100 year 60 minute summer	126.118	33.329
100 year 60 minute winter	83.790	33.329
100 year 120 minute summer	83.627	22.100
100 year 120 minute winter	55.560	22.100
100 year 180 minute summer	66.955	17.230
100 year 180 minute winter	43.522	17.230
100 year 240 minute summer	54.503	14.403
100 year 240 minute winter	36.210	14.403
100 year 360 minute summer	43.371	11.161
100 year 360 minute winter	28.192	11.161
100 year 480 minute summer	35.198	9.302
100 year 480 minute winter	23.385	9.302
100 year 600 minute summer	29.515	8.073
100 year 600 minute winter	20.167	8.073
100 year 720 minute summer	26.828	7.190
100 year 720 minute winter	18.030	7.190
100 year 960 minute summer	22.736	5.987
100 year 960 minute winter	15.061	5.987
100 year 1440 minute summer	17.216	4.614
100 year 1440 minute winter	11.571	4.614
100 year 2160 minute summer	12.838	3.548
100 year 2160 minute winter	8.846	3.548
100 year 2880 minute summer	10.977	2.942
100 year 2880 minute winter	7.377	2.942
100 year 4320 minute summer	8.639	2.259
100 year 4320 minute winter	5.689	2.259
100 year 5760 minute summer	7.320	1.874
100 year 5760 minute winter	4.738	1.874
100 year 7200 minute summer	6.364	1.623

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year 7200 minute winter	4.107	1.623
100 year 8640 minute summer	5.667	1.446
100 year 8640 minute winter	3.657	1.446
100 year 10080 minute summer	5.143	1.312
100 year 10080 minute winter	3.319	1.312
200 year 15 minute summer	273.315	77.339
200 year 15 minute winter	191.800	77.339
200 year 30 minute summer	200.647	56.776
200 year 30 minute winter	140.805	56.776
200 year 60 minute summer	146.569	38.734
200 year 60 minute winter	97.377	38.734
200 year 120 minute summer	96.580	25.523
200 year 120 minute winter	64.165	25.523
200 year 180 minute summer	76.970	19.807
200 year 180 minute winter	50.033	19.807
200 year 240 minute summer	62.434	16.499
200 year 240 minute winter	41.480	16.499
200 year 360 minute summer	49.421	12.718
200 year 360 minute winter	32.125	12.718
200 year 480 minute summer	39.953	10.558
200 year 480 minute winter	26.544	10.558
200 year 600 minute summer	33.402	9.136
200 year 600 minute winter	22.822	9.136
200 year 720 minute summer	30.287	8.117
200 year 720 minute winter	20.355	8.117
200 year 960 minute summer	25.568	6.733
200 year 960 minute winter	16.937	6.733
200 year 1440 minute summer	19.246	5.158
200 year 1440 minute winter	12.934	5.158
200 year 2160 minute summer	14.260	3.941
200 year 2160 minute winter	9.825	3.941
200 year 2880 minute summer	12.135	3.252
200 year 2880 minute winter	8.155	3.252
200 year 4320 minute summer	9.486	2.480
200 year 4320 minute winter	6.247	2.480
200 year 5760 minute summer	8.002	2.049
200 year 5760 minute winter	5.180	2.049
200 year 7200 minute summer	6.934	1.769
200 year 7200 minute winter	4.475	1.769
200 year 8640 minute summer	6.160	1.571
200 year 8640 minute winter	3.976	1.571
200 year 10080 minute summer	5.581	1.424
200 year 10080 minute winter	3.602	1.424
200 year +37% CC 15 minute summer	374.442	105.954
200 year +37% CC 15 minute winter	262.766	105.954
200 year +37% CC 30 minute summer	274.886	77.783
200 year +37% CC 30 minute winter	192.903	77.783
200 year +37% CC 60 minute summer	200.800	53.066
200 year +37% CC 60 minute winter	133.407	53.066
200 year +37% CC 120 minute summer	132.314	34.967
200 year +37% CC 120 minute winter	87.907	34.967
200 year +37% CC 180 minute summer	105.449	27.136

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
200 year +37% CC 180 minute winter	68.545	27.136
200 year +37% CC 240 minute summer	85.535	22.604
200 year +37% CC 240 minute winter	56.827	22.604
200 year +37% CC 360 minute summer	67.707	17.423
200 year +37% CC 360 minute winter	44.011	17.423
200 year +37% CC 480 minute summer	54.736	14.465
200 year +37% CC 480 minute winter	36.365	14.465
200 year +37% CC 600 minute summer	45.761	12.517
200 year +37% CC 600 minute winter	31.267	12.517
200 year +37% CC 720 minute summer	41.493	11.121
200 year +37% CC 720 minute winter	27.886	11.121
200 year +37% CC 960 minute summer	35.028	9.224
200 year +37% CC 960 minute winter	23.203	9.224
200 year +37% CC 1440 minute summer	26.367	7.067
200 year +37% CC 1440 minute winter	17.720	7.067
200 year +37% CC 2160 minute summer	19.536	5.399
200 year +37% CC 2160 minute winter	13.461	5.399
200 year +37% CC 2880 minute summer	16.624	4.456
200 year +37% CC 2880 minute winter	11.173	4.456
200 year +37% CC 4320 minute summer	12.996	3.398
200 year +37% CC 4320 minute winter	8.559	3.398
200 year +37% CC 5760 minute summer	10.963	2.806
200 year +37% CC 5760 minute winter	7.096	2.806
200 year +37% CC 7200 minute summer	9.500	2.423
200 year +37% CC 7200 minute winter	6.131	2.423
200 year +37% CC 8640 minute summer	8.439	2.153
200 year +37% CC 8640 minute winter	5.447	2.153
200 year +37% CC 10080 minute summer	7.646	1.951
200 year +37% CC 10080 minute winter	4.935	1.951

Results for 1 year Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
4320 minute winter	Basin	3180	48.865	0.265	2.7	142.5829	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
4320 minute winter	Basin	Hydro-Brake®	0.8	168.9

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
7200 minute winter	Basin	5460	49.126	0.526	3.2	306.6829	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
7200 minute winter	Basin	Hydro-Brake®	0.8	280.8

Results for 30 year +37% CC Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
10080 minute winter	Basin	7620	49.362	0.762	3.6	473.8742	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
10080 minute winter	Basin	Hydro-Brake®	0.9	439.7

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
8640 minute winter	Basin	6540	49.223	0.623	3.3	373.2554	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
8640 minute winter	Basin	Hydro-Brake®	0.8	353.7

Results for 200 year Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
10080 minute winter	Basin	7560	49.287	0.687	3.3	418.5696	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
10080 minute winter	Basin	Hydro-Brake®	0.8	424.0

Results for 200 year +37% CC Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
10080 minute winter	Basin	7800	49.574	0.974	4.5	640.5258	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
10080 minute winter	Basin	Hydro-Brake®	1.0	486.5

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