Appendix 10.3 Drainage Impact Assessment (DIA)

1. Drainage Impact Assessment (DIA)

1.1. Introduction

1.1.1. Wardell Armstrong LLP (part of SLR) (WA) were commissioned by Boralex Limited to undertake a Drainage Impact Assessment (DIA) in support of a proposed Battery Energy Storage System (BESS) facility and associated infrastructure located in Lochluichart, Garve. This document outlines the drainage strategy for the development and assesses the flood risk to and from the development.

1.1.2. Where appropriate, these assessments have been carried out in accordance with the relevant guidance set out in National Planning Framework 4 (NPF4), Construction Industry Research and Information Association (CIRIA) guidance, Scottish Environmental Protection Agency (SEPA) guidance, Scottish Water (SW) guidance, and The Highland Council (THC) guidance.

1.1.3. The NPF4[1] provides a risk framework as a basis for making planning decisions relating to flooding and surface water drainage and is further discussed in Section 1.3 of this report.

1.1.4. CIRIA guidance[2] provides a basis for the planning, design, construction, and maintenance of Sustainable Drainage System (SuDS) measures for both new and existing developments and has been reviewed to ensure proposals comply with best practice.

1.1.5. SEPA[3] provide advice on the protection of developments against flooding which includes flood maps (see Section 1.3 of this report) and other guidance which has been reviewed to ensure the proposals comply with best practice.

1.1.6. SW[4] provide online GIS mapping, technical standards, and guidance for adoptable drainage schemes , which is also a useful resource for best practice sewerage designs for private developments and has been reviewed to ensure compliance.

[1] National Planning Framework 4 (2023).
[2] CIRIA C753 – The SuDS Manual (2015).
[3] SEPA Flood Risk Standing Advice for Planning Authorities and Developers (2024) / SEPA Flood Risk and Land Use Vulnerability Guidance (2024)
[4] Sewers for Scotland – A technical specification for the design and construction of sewerage infrastructure - Version 4.0 (2018).

1.1.7. THC provides guidance for developers and regulators[5], to ensure drainage and flood prevention measures are appropriate for local development, which has been reviewed to ensure compliance.

1.1.8. The assessment is based on readily available data and our assessment of Site topography, historical drainage patterns, SEPA flood maps and available service records.

1.2. Site Setting

Site Description and Location

1.2.1. Table 1.1 (below) provides a summary of the Site and its characteristics.

Table 1.1 Site Location Summary

Site Location Summary	
Site Address	Lochluichart, Garve
Site Area (ha)	Approx. 19.50 ha
National Grid Reference	234363 E, 863818 N
Existing Land Use	Forestry
Proposed Land Use	Battery Energy Storage System (BESS)
Local Planning Authority	The Highland Council
Sewer Undertaker	Scottish Water
Environment Authority/Agency	SEPA

1.2.2. The Proposed Development Site is located north of the A832 at Lochluichart, approximately 5km northwest of Garve in the Highlands, west of the existing Corriemoillie substation (where the grid connection is proposed).

1.2.3. Access to the Site is from the existing junction onto the A832 which is currently used as access to agricultural sheds, for forestry works and other estate management purposes.

[5] The Highland Council Flood Risk & Drainage Impact (2013)

1.2.4. The public sector LIDAR DRM data for the Site indicates that existing levels typically fall from the north to the south from a high of 190 m AOD to a low of 147 m AOD.

Existing Drainage Regime

1.2.5. Chapter 10 contains a full hydrological / hydrogeological appraisal but in general terms the Site typically drains via overland flow to a number of existing unnamed mapped watercourses.

1.2.6. The nearest of these watercourses lies approximately 50m west of the proposed BESS platform, and the area of development generally drains to this watercourse.

Development Proposals

1.2.7. The proposal is to construct a new platform for the BESS facility and a new access road linking the platform to the existing onsite access road. The new access road will cross the existing unnamed watercourse approximately 50m west of the proposed BESS platform.

1.3. Flood Risk Assessment

Flood Risk Framework

1.3.1. In February 2023, the Scottish Government published the National Planning Framework 4 (NPF4) which sets out national policy on land use planning. Flood risk and water management is covered by Policy 22 of NPF4 and is supported by online planning advice on flood risk[6]. Policy 22 provides a basis for planning decisions relating to flooding and surface water drainage. This is summarised in Table 1.2 below

Table 1.2 Flood Risk Framework

Flood Risk Category (Likelihood)	Annual Probability of Flooding	Planning Response
N/A	Less than 0.1% (1:1000)	No constraints on development (due to flooding).

[6] The Scottish Government's Updated Planning Advice Note on Flooding (2015), Delivering Sustainable Flood Risk Management (2011), and Surface Water Management Planning Guidance (2013).

Low	0.1% (1:1000)	Development proposals will only be supported for: i. Essential infrastructure ii. Water compatible uses iii. Redevelopment of existing Sites for equal or less vulnerable use iv. Redevelopment of existing Sites where the LDP identifies a need to bring these into positive use. Small scale extensions and alterations to existing buildings must not significantly increase flood risk. 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 SuDS. iii. Seek to minimise the extent of impermeable surface. Development proposals will be supported if they can be connected to the public water mains. Development proposals which create, expand, or enhance opportunities for natural flood risk management will be supported.
Medium	0.5% (1:200)	
High	10% (1:10)	

1.3.2. In March 2003, a National Flooding Framework was established under which the (then) Scottish Executive commissioned SEPA to create a flood map. These maps, which have since been updated and extended to include the risk of surface water flooding, give an indication of the areas likely to be affected by flooding and the likelihood of the flooding. Updated and more detailed maps are now available online and have been reviewed in preparing this report.

1.3.3. THC's Highland-Wide Local Development Plan Policy 64 (Flood Risk) also states that development proposals should avoid areas susceptible to flooding and promote sustainable flood management

1.3.4. In 2021, SEPA published the Local Flood Risk Management Plan for the Highland and Argyll Local Plan District which identifies several Potentially Vulnerable Areas (PVAs) that may be susceptible to flooding. The Site is not currently located within any of the PVAs identified and therefore a detailed Flood Risk Assessment is not considered necessary, however commentary on flood risk has been included in this report as part of the overall DIA.

Flood Risk – to the Development

1.3.5. The main potential sources of flooding are from rivers and watercourses (fluvial flooding), surface water and overland flow (pluvial flooding), tidal waters (coastal flooding), high water tables (ground water flooding), sewers and drains, and from other artificial sources such as canals or reservoirs.

1.3.6. The presence of a potential flooding source within the vicinity of the Site does not necessarily translate into a high risk of flooding. Table 1.3 (below) summarises the potential flood sources and the related flood risks posed to the Site.

Table 1.3 Sources of Flood Risk

Flood Source	Presence at Site	Potential Risk at Site	Description
Fluvial (River)	N	N/A	SEPA flood maps don't indicate any river flooding on or near the Site.
Pluvial (Surface Water)	Y	High	SEPA flood maps indicate some areas of surface water flooding at the unnamed watercourse 50m west of the BESS platform.
Tidal (Coastal)	N	N/A	The Site is in an inland location.
Groundwater	Y	Low	SEPA flood maps show the Site is outside the areas identified as having a "low likelihood" of groundwater flooding. Hydrology / hydrogeology suggests the potential for some near surface groundwater.
Sewers	N	N/A	The Site is rural greenfield land with no sewerage expected to cross the Site. There are a number of CAR licences within 2km of the Site, but all are downstream of the Site.
Artificial Sources	N	N/A	There are no private water supplies within 250m of the Proposed Development footprint.

Fluvial (River) Flooding

1.3.7. River flooding can occur when the water draining from surrounding land exceeds the capacity of the watercourse during intense rainfall (or snow melt) or due to a reduction in conveyance due to blockage or failure of hydraulic structures. This can lead to overtopping of riverbanks and flood inundation of surrounding land.

1.3.8. The nearest potential source of river flooding is the unnamed mapped watercourse (approximately 50m west of the BESS platform). However, this is classed as a small watercourse and no river flooding is shown on SEPA flood maps.

1.3.9. Therefore, there is no risk of flooding from fluvial sources.

Pluvial (Surface Water) Flooding

1.3.10. Surface water flooding often occurs during intense rainfall when water is unable to soak into the ground or enter drainage systems and runs quickly overland resulting in local flooding.

1.3.11. SEPA flood maps show areas of low, medium, and high likelihood of pluvial (surface water) flooding in and adjacent to the unnamed mapped watercourse (approximately 50m west of the BESS platform). The areas of high likelihood of flooding appear to be restricted to the banks of the watercourse whereas the areas of low and medium likelihood indicate some overland flow to the northwest and southwest of the Site, however these would bypass the Site.

1.3.12. Whilst none of these areas directly impact the development platform, proposals do require the watercourse to be culverted where it's crossed by the new access track. Cognisance of any existing overland flow paths impacted by the new access track and BESS platform will also be required and cut-off drains implemented where necessary.

1.3.13. Therefore, the risk of flooding from pluvial sources is low.

Tidal (Coastal) Flooding

1.3.14. Tidal or coastal flooding can be caused by a combination of high tides, storm surge or high waved conditions (linked to low pressure weather systems).

1.3.15. The local watercourses are non-tidal, and the Site is not located in a coastal zone. The Site is not located in an area identified on SEPA flood maps as being at risk of coastal flooding.

1.3.16. Therefore, there is no risk of flooding from costal sources.

Groundwater Flooding

1.3.17. Groundwater poses a risk of flooding, particularly where the water table is high or prolonged rainfall causes the groundwater table to rise to the point where it affects development of a Site. In Scotland this is most commonly associated with the movement of water through sands and gravels and often connected to the rise and fall of river levels.

1.3.18. SEPA flood maps show the Site is outside the areas identified as having a “low likelihood” of groundwater flooding and the expected presence of clay containing glacial deposits would inhibit vertical movement of groundwater from the bedrock. However, BGS online hydrogeology mapping indicates small amounts of groundwater in bedrock in near surface weathered zone and secondary features.

1.3.19. This may result in some groundwater flow in areas where the Site is in cut below existing ground levels, however, this can be managed by the implementation of cut-off drains where necessary.

1.3.20. Therefore, the risk of flooding from groundwater sources is low.

Flooding From Sewers

1.3.21. Flooding from sewers can occur during extreme rainfall events that exceed the design capacity of the sewer system.

1.3.22. The Site is rural greenfield land with no sewerage expected to cross the Site. There are a number of CAR licences within 2km of the Site, but all are downstream of the Site.

1.3.23. Therefore, there is no expectation of flooding from sewers.

Flooding From Artificial Sources

1.3.24. Flooding from artificial sources where man-made water bodies (canals, reservoirs, water mains etc) suffer a catastrophic failure due to extreme weather events or poor maintenance.

1.3.25. There are no artificial waterbodies on, or crossing, the Site and there are no private water supplies within 250m of the Proposed Development footprint.

1.3.26. Therefore, there is no expectation of flooding from artificial sources.

Flood Risk – from the Development

1.3.27. The proposal is to construct a new BESS platform and a new access road linking the platform to the existing access road. The new access road will cross the existing unnamed watercourse approximately 50m west of the proposed BESS platform.

1.3.28. The new access road will be constructed with free draining gravel material with cut-off drains installed to capture and divert overland flows across the track to ensure no localised flooding occurs.

1.3.29. A suitably sized culvert will be installed where the new access track crosses the existing unnamed watercourse to ensure no localised flooding occurs. See Figure 'Indicative Culvert Detail'.

1.3.30. Run-off from the BESS platform will be captured and discharged to an adjacent attenuation basin prior to discharging at a controlled rate into the nearby watercourse thereby ensuring no increase in flows to the watercourse (or subsequent downstream flooding).

1.3.31. Fire-fighting water stored / used on Site will also be captured by the adjacent attenuation basin ensuring there will be no flooding during a failure of the storage system or during a fire-fighting event.

1.3.32. Full details of the proposed surface water management for the Site are discussed in sections 1.4 and 1.5.

1.3.33. Therefore flood risk from the development is considered to be low. However, the Local Authority should satisfy themselves that the drainage proposals are satisfactory for the development.

Flood Risk – from Climate Change

1.3.34. Flooding is expected to become a greater problem in the future due to an increase in the intensity and frequency of rainfall because of climate change. SEPA flood maps now provide a projection of future river, surface water, and coastal flooding up to the 2080s.

1.3.35. SEPA future flood maps indicate the projected extent of medium likelihood future pluvial (surface) water flooding will roughly correlate with the extent of low likelihood flooding shown on the current maps. This would not impact the current proposals. Anticipated flood risk from all other identified sources remains unchanged.

1.3.36. Therefore the impact of a change in flood risk to the development from climate change is therefore considered to be low.

1.4. Flood Risk Management

Surface Water Management (during construction)

1.4.1. During construction, the off-Site sewers, receiving watercourses and on-Site groundwater will be vulnerable to diffuse pollution until SuDS systems are complete and fully functional, and earthworks operations, stripped ground surfaces and roads and drainage works are similarly completed.

1.4.2. Measures will be required to control run-off from the Site to sewers, watercourses, and groundwater during the construction phase and to treat run-off appropriately to ensure soils are not eroded during earthworks and excess silt is not discharged into the system.

1.4.3. The contractor should provide a temporary drainage SuDS design, such as cut-off drainage and filter trenches, to manage surface water run-off. The earthworks design should also include measures to manage run-off.

1.4.4. The presence of any unrecorded drainage should be reported to the design engineer to allow the design of suitable mitigation (if required).

1.4.5. These measures will require agreement and permits from SEPA and THC prior to works commencing, and all contractors should be aware of their responsibilities in this regard.

Surface Water Management (during operation)

1.4.6. Once installed, the proposed surface water drainage system will operate as designed, to manage surface water flows appropriately. The drainage system should be regularly inspected and maintained throughout its lifetime to ensure it continues to operate effectively.

Floodplain Storage

1.4.7. The Proposed Development is not located within a floodplain, therefore, there is no impact on floodplain storage and no further mitigation measures are required.

Flood Level and Safe Access / Egress

1.4.8. The new access road will be constructed with free draining gravel material with cut-off drains installed to capture and divert overland flows across the track to ensure no localised flooding occurs.

1.4.9. A suitably sized culvert will be installed where the new access track crosses the existing unnamed watercourse to ensure no localised flooding occurs.

1.4.10. The SEPA requirements for safe access and egress are therefore considered to be met.

Residual Risk

1.4.11. For storm events exceeding the design capacity of the proposed drainage system, Site levels will be designed to ensure that any exceedance flows are directed to appropriate areas on Site.

1.4.12. As such, no further mitigation measures are proposed.

1.5. Surface Water Drainage Outline Strategy

SuDS Treatment Train

1.5.1. The SuDS treatment train is a logical sequence for implementing SuDS, and is based on the following principles:

- Prevention
- Source Control
- Site Control
- Regional Control

1.5.2. A combination of source control and Site control has been selected for the development. The BESS platform will be formed with a free draining material, with run-off captured by perimeter drains before discharging to an adjacent attenuation basin.

SuDS Discharge Hierarchy

1.5.3. The SuDS discharge hierarchy describes the priority for selecting a method of surface water discharge, and is based on the following sequence:

- Priority 1 - Surface water runoff is collected for re-use.
- Priority 2 - Surface water runoff is infiltrated to ground.
- Priority 3 - Surface water runoff is discharged to a surface water body.
- Priority 4 - Surface water runoff is discharged to a surface water sewer, highway drain, or another drainage system.
- Priority 5 - Surface water runoff is discharged to a combined sewer.

1.5.4. Priority 1 – due to the nature of the project, there is likely to be a limited opportunity for the re-use of surface water, however this will be reviewed at detailed design stage.

1.5.5. Priority 2 – Site investigation and infiltration tests for the Site have not yet been undertaken. However, the requirement to protect groundwater from potential contamination from firewater precludes the use of soakaways and the BESS platform and attenuation will require to be lined with an impermeable membrane.

1.5.6. Priority 3 – As described in sections 1.2 & 1.3 of this report, there is an unnamed mapped watercourse approximately 50m west of the proposed BESS platform. As such, this has been identified as the primary point of discharge for the disposal of surface water. Discharge from the Site will be restricted to the calculated greenfield run-off rate.

1.5.7. Priority 4 – There are no surface water sewers identified on or near the Site and the options above take priority for the discharge of surface water from the development.

1.5.8. Priority 5 – There are no combined sewers on or near the Site and the options above take priority for the discharge of surface water from the development.

1.5.9. Therefore, based on Site conditions, Site requirements, and the currently available information, the adopted method of surface water discharge has been selected as high up the SuDS Hierarchy as possible.

SuDS Water Quality Criteria

1.5.10. SuDS guidance requires that a SuDS management train is developed and that treatment is provided to surface water run-off to ensure preventative measures are in place to mitigate any negative impacts to the water quality of the receiving water bodies and/or downstream drainage systems.

1.5.11. In order to determine whether the proposed SuDS features will be sufficient at removing pollutants from surface water runoff, the CIRIA Simple Index Approach has been applied. This approach provides pollution hazard levels and indices to relevant pollutants based upon contributing hardstanding surfaces.

1.5.12. Table 1.4 below provides an extract of the land use types and pollutant indices from the Simple Index approach which are relevant to the development.

Table 1.4 Pollution Hazard Indices

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Other roofs	Low	0.3	0.2	0.05

Low traffic roads and non-residential car parking with infrequent change (i.e., < 300 traffic movements a day)	Low	0.5	0.4	0.4

1.5.13. Based upon the above, the worst-case indices for the development are 0.5 (Total Suspended Solids), 0.4 (Metals), and 0.4 (Hydrocarbons).

1.5.14. Under the Simple Index Approach, in order to suitably mitigate surface water pollutants, the total combined indices for any SuDS components will need to be greater than the worst-case indices above. Where multiple SuDS components are proposed, the primary component is given its full indices, while subsequent component indices are applied with a factor of 50%.

1.5.15. Table 1.5 below indicates the mitigation indices for different types of SuDS components with only those relevant to the development included.

Table 1.5 Indicative SuDS Mitigation Indices for Discharges to Surface Waters

Proposed SuDS Component	Mitigation Indices		
	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Filter Drain	0.4	0.4	0.4
Attenuation Basin	0.5	0.5	0.6

1.5.16. Based on the above, the proposed series of SuDS features will be able to sufficiently mitigate surface water run-off pollution from the Proposed Development.

1.5.17. The SuDS management train will be reviewed during the detailed design stage to ensure the water quality criteria for SuDS are met.

<u>Surface Water Drainage Outline Strategy</u>

1.5.18. Based on the SuDS treatment train and SuDS discharge hierarchy, it is proposed that the BESS platform will be formed with a free draining material (source control) acting as a filter drain, with run-off captured by perimeter drains before discharging to an adjacent attenuation basin (Site control), prior to discharge to the nearby unnamed watercourse at the calculated greenfield run-off rate.

1.5.19. Surface water run-off from topography tending towards the proposed location of the BESS platform shall be redirected by installing cut-off drains at the platform perimeter, thus diverting overland flows around the platform. Additional cut-off drains will be installed at the base of slopes where the platform levels are in cut below existing ground, thus diverting potential groundwater flows around the platform. Cut-off drains will be designed at detailed design stage to mimic existing overland flows.

1.5.20. The new access road will be constructed with free draining gravel material with cut-off drains installed to capture and divert overland flows across the track to ensure no localised flooding occurs.

1.5.21. A suitably sized culvert will be installed where the new access track crosses the existing unnamed watercourse to ensure no localised flooding occurs. The culvert will be designed at detailed design stage to convey a 1:200-year storm event (plus climate change) to satisfy SEPA's requirements.

1.5.22. **Drawings ED14475-1000 and ED14475-1001** showing the indicative BESS platform, access track and attenuation engineering layout, are located in **Appendix A** of this report.

Attenuation Basin Indicative Design

1.5.23. To comply with accepted minimum design requirements, and to cater for a "worst case" scenario, the following design parameters have been adopted:

- Hardstanding areas - The BESS platform is assumed to be 100% hardstanding – worst case design. The designed top area of the attenuation basin is also included in the design.
- Greenfield run-off rate - Restricted to the 1:2-year rainfall event. Both IH124 and FEH methods have been calculated (using the HR Wallingford Online Tool) and the lowest (worst case) rate selected. The preliminary 1:2-year greenfield run-off rate has been calculated as approximately 12 l/s.
- Design storm event – SEPA guidance[7] requires the design to cater for up to the 1:200-year storm event. FEH22 rainfall figures have been used within the design.

[7] SEPA Technical Flood Risk Guidance for Stakeholders (Version 13)

- Climate change allowance - SEPA guidance[8] requires a minimum 42% increase in peak rainfall in hydraulic calculations for climate change.
- Design depth - A maximum design depth of 1.2m has been adopted up to the design storm event as a worst case scenario for estimating the attenuation basin footprint. An overall construction depth of 1.7m has been adopted for the attenuation basin to allow 0.4m freeboard and an access track within the design.
- Sensitivity checks: Additional sensitivity checks have been undertaken to assess the impact of the 1:1000-year storm event (+42% climate change) and the impact of a 1:10 year storm event (+42% climate change) occurring within 24 hours of the design storm event (1:200-year storm event +42% CC).

1.5.24. Preliminary Causeway Flow calculations, using the above parameters, have confirmed the total storage required for the 1:200-year design event (+42% climate change) – with a design depth of 1.2m – is approximately 753 m^3.

1.5.25. Sensitivity checks confirm there is also sufficient freeboard within the overall 1.7m construction depth of the attenuation basin to cater for the 1:1000 year (+42% climate change).

1.5.26. Furthermore, the sensitivity checks also confirm there is sufficient freeboard within the overall 1.7m construction depth of the attenuation basin to cater for a 1:10-year (+42% climate change) event within 24 hours of the design event (1:200-year +42% CC).

1.5.27. Based on the above, an attenuation basin with an overall construction depth of 1.7m and a plan area of approximately 1707 m^2 is sufficient for the design.

1.5.28. Preliminary drainage calculations (including greenfield run-off estimates, Causeway Flow calculations and an Attenuation Design Summary and Assumptions spreadsheet) have been provided in **Appendix B** of this report

1.5.29. **Drawings ED14475-1000 and ED14475-1001** showing the indicative BESS platform, access track and attenuation engineering layout, are located in **Appendix A** of this report.

[8] SEPA Climate change allowances for flood risk assessment in land use planning (Version 5)

1.6. Foul Water Drainage Outline Strategy

1.6.1. The exact details of any welfare facilities are still to be determined, however, given the nature of the development (occasionally occupied only for operations and maintenance), foul flows are likely to be minimal. It is anticipated that any foul water flows from the Site will drain to a septic tank or package treatment plant prior to discharge to a nearby watercourse. Design sizing and requirements will be determined at the detailed design stage.

1.7. Fire Water Management Outline Strategy

1.7.1. Provision for fire water containment is required on BESS Sites to store and contain potentially contaminated water during a firefighting event. It is proposed to contain firewater within the attenuation basin on Site, which will be lined to prevent water ingress into the water environment and will have an automatic shut-off facility to prevent discharge into the watercourse.

1.7.2. The National Fire Chiefs Council (NFCC) provides guidance[9] on the provision of fire water on BESS Sites and states a minimum of 1,900 litres per minute for at least 2 hours which equates to 228 m^3 of fire water to be available on Site. This volume of water must also be prevented from entering the water environment during a firefighting event.

1.7.3. SEPA provides pollution prevention guidelines[10] for the management of fire water on Sites for the protection of the environment. With reference to PPG18, it is understood that the capacity of the attenuation basin must be sufficient to store the following:

- 10-year return period, 8 days rainfall prior to the incident
- 10-year return period, 24 hour rainfall immediately after the incident
- Fire-fighting and cooling water

1.7.4. An outline estimation of the required volume of each of these components and the total volume of the proposed attenuation basin are shown in Table 1.6. Full details will be provided during the detailed design stage of the Proposed Development.

[9] NFCC Grid Scale Energy Storage System Planning – Guidance for Fire and Rescue Services (November 2022)
[10] SEPA Managing Fire Water and Major Spillages: PPG18

Table 1.6 Indicative Fire Water Management Volumes

Event	Volume (m3)
10% AEP, 8 days rainfall – controlled discharge	273
10% AEP, 24-hour rainfall – no discharge	855
Fire-fighting and cooling water	228
Total	1,356
Total Attenuation Basin Capacity	1,519

1.7.5. An additional check was carried out on the 1:200-year design event (+42% climate change) followed by a firefighting incident. The resulting volume required is shown in Table 1.7.

Table 1.6 Indicative Fire Water Management Volumes

Event	Volume (m3)
0.5% AEP + 42% CC	753
Fire-fighting and cooling water	228
Total	981
Total Attenuation Basin Capacity	1,519

1.7.6. Preliminary calculations and a Fire Water Storage Requirements Estimation summary have been provided in **Appendix C** of this report.

1.8. Future Maintenance

1.8.1. Any proposed surface water / foul water drainage systems within the curtilage of the development Site will remain the responsibility of the respective asset owner / operator or a factor on their behalf.

1.8.2. Regular inspections and maintenance should be carried out following periods of inclement weather and at regular intervals appropriate to each drainage element.

1.8.3. All future maintenance responsibilities will be reviewed and agreed at detailed design stage.

1.9. Conclusion

1.9.1. This report gives details of the Drainage Impact Assessment (DIA) as prepared in accordance with NPF4, CIRIA guidance, SEPA guidance, Scottish Water guidance, and THC's own guidance.

1.9.2. SEPA flood maps don't show any areas of fluvial (river) flooding on or near the Site. Therefore there is no risk of flooding from fluvial (river) sources.

1.9.3. SEPA flood maps show some areas of pluvial (surface water) flooding related to the nearby unnamed mapped watercourse on Site. However, these do not typically impact the Site, and appropriate measures will be implemented to intercept and divert overland flows tending towards the new access track and BESS platform as necessary. Therefore, the risk of flooding from pluvial (surface water) sources is low.

1.9.4. Groundwater flooding is not anticipated to impact the Site; however, appropriate measures will be implemented to intercept and divert groundwater flows as necessary. Therefore the risk of flooding from groundwater sources is low.

1.9.5. No tidal flooding, flooding from public sewers, or flooding from artificial sources is expected given the Site's location.

1.9.6. The BESS platform will be formed with a free draining material, with run-off captured by perimeter drains before discharging to an adjacent attenuation basin, prior to discharge to the nearby unnamed watercourse at the calculated 1:2-year greenfield run-off rate – thus providing adequate treatment and attenuation. The attenuation basin is sized to cater for the 1:200-year design storm (+40% climate change).

1.9.7. The new access road will be constructed with free draining gravel material and a suitably sized culvert will be installed where the new access track crosses the existing watercourse. The culvert will be designed to convey a 1:200-year storm event (plus climate change).

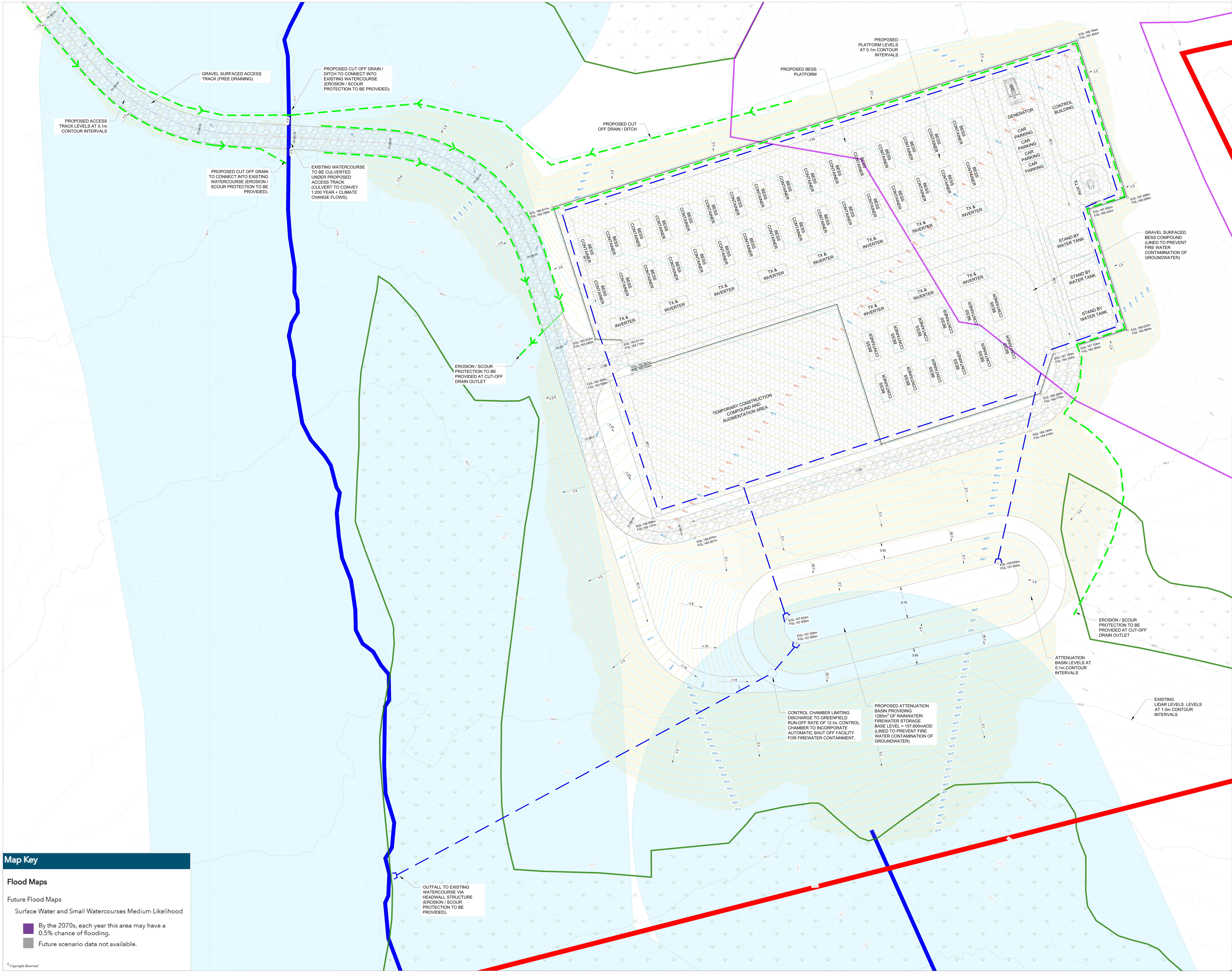
1.9.8. The exact details of any foul water drainage are still to be determined; however, foul flows are expected to be minimal. It is anticipated that any foul water flows from the Site will drain to a septic tank or package treatment plant prior to discharge to a nearby watercourse.

1.9.9. The Proposed Development allows for the storage and containment of firewater which will prevent contaminated water from entering the water environment during a firefighting event.

1.9.10. The Proposed Development is not predicted to increase flows or flooding off-Site and is therefore deemed to be compatible with current guidance and legislation.

Appendix A: Indicative Engineering Layout Drawings

DO NOT SCALE FROM THIS DRAWING



KEY

- SITE BOUNDARY
- EXISTING WATERCOURSES
- WATERCOURSE 50m BUFFER ZONE
- AREA OF EXISTING NATIVE WOODLAND
- EXISTING BLANKET SPHAGNUM BOG
- PROPOSED MINOR CONTOURS (0.1m INTERVALS)
- PROPOSED MAJOR CONTOURS (0.5m INTERVALS)
- EXISTING MINOR CONTOURS (1.0m INTERVALS)
- EXISTING MAJOR CONTOURS (5.0m INTERVALS)
- INDICATIVE PROPOSED PERIMETER DRAINAGE TO PLATFORM
- PROPOSED CUT OFF DRAIN / DITCH
- PROPOSED ROAD ALIGNMENT

NOTES

1. DO NOT SCALE FROM THIS DRAWING.
2. DRAWING IS NOT FOR CONSTRUCTION.
3. DRAWING IS INDICATIVE ONLY AND FEATURES SHOWN MAY VARY FROM FINAL DESIGN. ACTUAL DESIGN TO BE CONFIRMED AT DETAILED DESIGN STAGE. CONSTRUCTION TO BE COMPLETED IN ACCORDANCE WITH RELEVANT STANDARDS DEFINED IN DETAILED DESIGN.
4. KEY OF ABBREVIATIONS
   EGL - EXISTING GROUND LEVEL
   FGL - FINAL GROUND LEVEL
5. EXISTING GROUND LEVELS BASED ON SCOTLAND PUBLIC SECTOR LIDAR DTM (PHASE 1 SURVEY) NH35. EXISTING LEVELS TO BE CONFIRMED BY DETAILED TOPO SURVEY PRIOR TO CONSTRUCTION.
6. EXISTING GROUND CONDITIONS AND SUITABILITY OF CUT MATERIAL FOR REUSE AS FILL TO BE CONFIRMED.
7. FILL ASSOCIATED WITH LANDSCAPING IS TO BE CONFIRMED AND HAS BEEN OMITTED FROM THIS DRAWING.

REVISION	DETAILS	DATE	DRAWN	CHK'D	APP'D
A	PLANNING ISSUE	22/07/25	ED	CS	AH
P05	UPDATED SITE LAYOUT	05/06/25	ED	CS	AH
P04	AMENDMENTS TO SUIT HYDROLOGY COMMENTS	04/06/25	ED	CS	AH
P03	DESIGN AMENDED AS PER REVISED SITE LAYOUT	27-05-25	PAG	CS	AH
P02	DESIGN AMENDED AS PER REVISED SITE LAYOUT	23-04-25	PAG	CS	AH
P01	DRAFT FOR COMMENT	28-03-25	PAG	CS	AH

CLIENT

BORALEX LTD

PROJECT

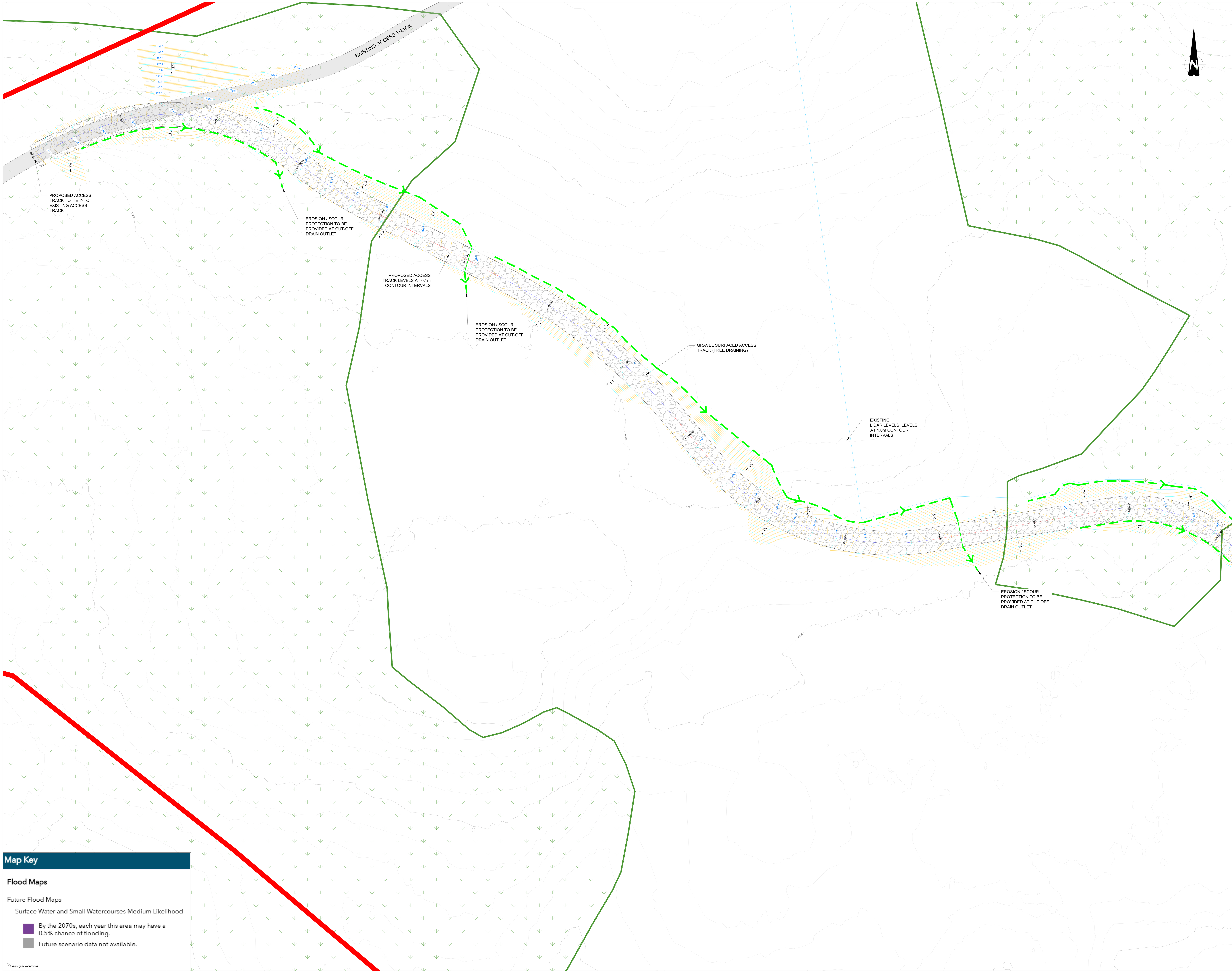
LOCHLUICHART BESS

DRAWING TITLE

LOCHLUICHART BESS PLATFORM INDICATIVE ENGINEERING LAYOUT SHEET 1

DRG No. ED14475-1000	REV A	SUIT. CODE -
DRG SIZE A0	SCALE 1:250	DATE 28-03-2025
DRAWN BY PAG	CHECKED BY CS	APPROVED BY AH

wardell armstrong PART OF SLR



DO NOT SCALE FROM THIS DRAWING

KEY

- SITE BOUNDARY
- EXISTING WATERCOURSES
- WATERCOURSE 50m BUFFER ZONE
- AREA OF EXISTING NATIVE WOODLAND
- PROPOSED MINOR CONTOURS (0.1m INTERVALS)
- PROPOSED MAJOR CONTOURS (0.5m INTERVALS)
- EXISTING MINOR CONTOURS (1.0m INTERVALS)
- EXISTING MAJOR CONTOURS (5.0m INTERVALS)
- PROPOSED CUT OFF DRAIN / DITCH
- PROPOSED ROAD ALIGNMENT

NOTES

1. DO NOT SCALE FROM THIS DRAWING.
2. DRAWING IS NOT FOR CONSTRUCTION.
3. DRAWING IS INDICATIVE ONLY AND FEATURES SHOWN MAY VARY FROM FINAL DESIGN. ACTUAL DESIGN TO BE CONFIRMED AT DETAILED DESIGN STAGE. CONSTRUCTION TO BE COMPLETED IN ACCORDANCE WITH RELEVANT STANDARDS DEFINED IN DETAILED DESIGN.
5. EXISTING GROUND LEVELS BASED ON SCOTLAND PUBLIC SECTOR LIDAR DTM (PHASE 1 SURVEY) NH35. EXISTING LEVELS TO BE CONFIRMED BY DETAILED TOPO SURVEY PRIOR TO CONSTRUCTION.
6. EXISTING GROUND CONDITIONS AND SUITABILITY OF CUT MATERIAL FOR REUSE AS FILL TO BE CONFIRMED.
7. FILL ASSOCIATED WITH LANDSCAPING IS TO BE CONFIRMED AND HAS BEEN OMITTED FROM THIS DRAWING.

REVISION	DETAILS	DATE	DRAWN	CHK'D	APP'D
A	PLANNING ISSUE	22/07/25	ED	CS	AH
P05	UPDATED SITE LAYOUT	05/06/25	ED	CS	AH
P04	AMENDMENTS TO SUIT HYDROLOGY COMMENTS	04/06/25	ED	CS	AH
P03	DESIGN AMENDED AS PER REVISED SITE LAYOUT	27-05-25	PAG	CS	AH
P02	DESIGN AMENDED AS PER REVISED SITE LAYOUT	23-04-25	PAG	CS	AH
P01	DRAFT FOR COMMENT	28-03-25	PAG	CS	AH

CLIENT
BORALEX LTD

PROJECT
LOCHLUICHART BESS

DRAWING TITLE
LOCHLUICHART BESS PLATFORM
INDICATIVE ENGINEERING LAYOUT
SHEET 2

DRG No.	REV	SUIT. CODE
ED14475-1001	A	-

DRG SIZE	SCALE	DATE
A0	1:250	28-03-2025

DRAWN BY	CHECKED BY	APPROVED BY
PAG	CS	AH

wardell armstrong PART OF SLR

Appendix B: Preliminary Drainage Calculations

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Peter Gill
Site name:	Lochluichart BESS
Site location:	lochluichart

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

Site Details

Latitude:	57.63363° N
Longitude:	4.77684° W
Reference:	279164729
Date:	Mar 05 2025 07:26

Runoff estimation approach

FEH Statistical

Site characteristics

Total site area (ha):	0.937

Methodology

Q_{MED} estimation method:	Calculate from BFI and SAAR
BFI and SPR method:	Specify BFI manually
HOST class:	N/A
BFI / BFIHOST:	0.322
Q_{MED} (l/s):	
Q_{BAR} / Q_{MED} factor:	1.11

Hydrological characteristics

	Default	Edited
SAAR (mm):	1287	1287
Hydrological region:	1	1
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	1.95	1.95
Growth curve factor 100 years:	2.48	2.48
Growth curve factor 200 years:	2.84	2.84

Notes

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

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

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

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

(3) Is SPR/SPRHOST ≤ 0.3?

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

Greenfield runoff rates

	Default	Edited

Q_{BAR} (l/s):		16.25
1 in 1 year (l/s):		13.81
1 in 30 years (l/s):		31.69
1 in 100 year (l/s):		40.3
1 in 200 years (l/s):		46.15

hr wallingford

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Peter Gill
Site name:	Lochluichart BESS
Site location:	lochluichart

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

Site Details

Latitude:	57.63369° N
Longitude:	4.78121° W
Reference:	3031010528
Date:	Mar 04 2025 10:40

Runoff estimation approach: IH124

Site characteristics

Total site area (ha): 0.937

Methodology

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

Soil characteristics

	Default	Edited
SOIL type:	5	5
HOST class:	N/A	N/A
SPR/SPRHOST:	0.53	0.53

Hydrological characteristics

	Default	Edited
SAAR (mm):	1287	1287
Hydrological region:	1	1
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	1.95	1.95
Growth curve factor 100 years:	2.48	2.48
Growth curve factor 200 years:	2.84	2.84

Notes

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

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

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

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

(3) Is SPR/SPRHOST ≤ 0.3?

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

Greenfield runoff rates

	Default	Edited

Q_{BAR} (l/s):	11.97	11.97
1 in 1 year (l/s):	10.18	10.18
1 in 30 years (l/s):	23.35	23.35
1 in 100 year (l/s):	29.69	29.69
1 in 200 years (l/s):	34	34

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Starting Level (m)	
Rainfall Events	Singular	Skip Steady State	x	Check Discharge Rate(s)	x
Summer CV	0.750	Drain Down Time (mins)	240	Check Discharge Volume	x
Winter CV	0.840	Additional Storage (m^3/ha)	20.0		

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
10	42	0	0
200	42	0	0
1000	42	0	0

Node Depth/Area 1 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	82.300	Product Number	CTL-SHE-0155-1200-1200-1200
Design Depth (m)	1.200	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	12.0	Min Node Diameter (mm)	1500

Node Depth/Area 1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	1.0	Invert Level (m)	82.300
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m^2)	Inf Area (m^2)	Depth (m)	Area (m^2)	Inf Area (m^2)	Depth (m)	Area (m^2)	Inf Area (m^2)	Depth (m)	Area (m^2)	Inf Area (m^2)
0.000	329.0	329.0	1.000	812.0	819.0	1.600	1150.0	1163.5	1.700	1707.0	1720.6

Results for 10 year +42% 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
480 minute winter	Depth/Area 1	368	82.938	0.638	47.9	317.5037	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
480 minute winter	Depth/Area 1	Hydro-Brake®	12.0	424.0

Results for 200 year +42% 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
960 minute winter	Depth/Area 1	750	83.490	1.190	56.0	752.5713	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
960 minute winter	Depth/Area 1	Hydro-Brake®	12.0	727.6

Results for 1000 year +42% 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
960 minute winter	Depth/Area 1	780	83.743	1.443	69.7	1007.3380	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
960 minute winter	Depth/Area 1	Hydro-Brake®	13.1	795.3

SUDS Design Summary - Lochluichart BESS - Compound - Rev B

Notes:

1. Attenuation design proposal to attenuate surface water flows from all site hardstanding areas. Permeable areas to be free draining.

2. Drainage from hardstanding areas to discharge to Attenuation Basin to an existing watercourse at the pre-development run-off rate. To mimic existing drainage regime and achieve no net increase in flows to receiving watercourse. Free draining permeable areas will mimic existing drainage regime.

3. Attenuation design undertaken in line with national and local guidance and as set out in The SUDS Manual (C753).

4. Pre Development discharge rates estimated using lesser of IH124 / FEH method (via HR Wallingford UK SUDS Greenfield Runoff Rate Estimation Online Tool).

5. Attenuation sizing estimated using FEH22 Rainfall and Causeway Flow design software.

6. Additional SUDS may need to be provided as source control / treatment during detailed design.

Design Parameters / Assumptions	Lochluichart BESS	Notes
Site Area		
Platform Area (m2)	9,367	Platform area used for pre-development run-off estimation.
Pre-Development Run-Off Rates (calculated from HR Wallingford Greenfield Runoff Rate Estimation Online Tool) (l/s)		Calculated from platform area using HR Wallingford UK SUDS Greenfield Runoff Rate Estimation Online Tool.
	IH124 Method	
1 Year Return (l/s)	10.18	
2 Year Return (Q_{BAR}) (l/s)	**11.97**	
30 Year Return (l/s)	23.35	
100 Year Return (l/s)	29.69	
200 Year Return (l/s)	34	
	FEH Method	
1 Year Return (l/s)	13.81	
2 Year Return (Q_{BAR}) (l/s)	16.25	
30 Year Return (l/s)	31.69	
100 Year Return (l/s)	40.3	
200 Year Return (l/s)	46.15	
Attenuated Post Development Run-Off Rates	**Limited to 2 Year Return (Q_{BAR}) using IH124 Method as worst case (lowest) pre-development run-off rate - as highlighted above.**	
Hardstanding Areas		Platform Area asssumed to be 100% impermeable as worst case scenario.
Platform Area (m2)	9,367	
Attenuation Basin Footprint (including perimeter access track) (m2)	1,707	
Compound Total (m2)	**11,074**	
Design Storm Event	**1 in 200 year + 42% climate change**	Design storm event as per SEPA "Technical Flood Risk Guidance for Stakeholders (Version 13)". Climate change allowance as per SEPA "Climate Change Allowances for Flood Risk Assessment in Land Use Planning (Version 5)" - North Highland River Basin Region.
Attenuation Storage Required (m3)		Calculated from FEH22 Rainfall Data using Causeway Flow design software.
All Hardstanding Areas (m3)	752.57	
Total storage required (m3)	**753**	
Design Check - Attenuation Dimensions (m)		
Design Top Area (Perimeter Access Track Top Area (m2)	1,707	
Freeboard Top Area (m2)	1,150	
Design Top Area (m2)	926	
Base Area (m2)	329	
Design storage depth (m)	1.2	
Design freeboard (design depth + 0.4m) (m)	1.6	
Overall depth (design depth + 0.4 freeboard + 0.1 access track) (m)	1.7	
Side slopes (m)	1 in 4	
Design Check - Attenuation Storage Provided (m3)		
Detention Basins		
Basin Design	753	
Freeboard	415	
Perimeter access track	143	

Total (design)	**753**	
Total (inc. freeboard, access track etc)	1,311	
Design storage required < attenuation storage provided?	**YES = OK**	
Discharge Location	**Existing watercourse (TBC).**	Surface water flows up to the design storm event are attenuated within the basin design depth. An additional 400mm freeboard provided provided over and above design capacity and an additional 100mm to the top of the basin / outside edge of the access track (total 1.7m depth) is available to cater for subsequent events - see sensitivity check below.
Sensitivity Check - Attenuation Storage Provided		
Storage Requirements		
1 in 1000 year + 42% climate change	**1,007**	
Storage Available		
Total (inc. freeboard, access track etc)	**1,311**	
Sensitivity check storage required < attenuation storage provided?	**YES = OK**	
Sensitivity Check - Half Drain Down Time		
Half Drain Down Time = < 24 hours?	**YES**	
Surplus Storage Available (Over and Above Design Storm)		
Total storage required (m3) - 1 in 200 year + 42% climate change	753	
Total storage available (inc. freeboard, access track etc)	1,311	
Surplus (freeboard minus design)	**558**	
1 in 10 year + 42% climate change	**318**	
Subsequent storm surplus storage can cater for	**Up to 1 in 10 year**	
Sensitivity check storage required < attenuation storage provided?	**YES = OK**	

Appendix C: Fire Water Storage Requirements Estimation Summary

Simulation Settings

Rainfall Methodology	FEH-22	Skip Steady State	x
Rainfall Events	Consecutive	Drain Down Time (mins)	240
Winter CV	0.840	Additional Storage (m³/ha)	20.0
Additional Area (A %)	0	Starting Level (m)	
Additional Flow (Q %)	0	Check Discharge Rate(s)	x
Analysis Speed	Normal	Check Discharge Volume	x

Time Offset (mins)	Duration (mins)	Return Period (years)	Climate Change (CC %)	Time Offset (mins)	Duration (mins)	Return Period (years)	Climate Change (CC %)
0	10080	10	42	0	1440	10	42

Node Depth/Area 1 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	82.300	Product Number	CTL-SHE-0155-1200-1200-1200
Design Depth (m)	1.200	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	12.0	Min Node Diameter (mm)	1500

Node Depth/Area 1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	1.0	Invert Level (m)	82.300
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	329.0	329.0	1.000	812.0	819.0	1.600	1150.0	1163.5	1.700	1707.0	1720.6

Results for Consecutive Rainfall 10080-1440. 11760 minute analysis at 60 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
10080-1440	Depth/Area 1	11100	82.867	0.567	24.4	272.8286	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
10080-1440	Depth/Area 1	Hydro-Brake®	12.0	2866.8

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Starting Level (m)	
Rainfall Events	Singular	Skip Steady State	x	Check Discharge Rate(s)	x
Summer CV	0.750	Drain Down Time (mins)	240	Check Discharge Volume	x
Winter CV	0.840	Additional Storage (m³/ha)	20.0		

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
10	42	0	0

Node Depth/Area 1 Online Head/Flow Control

Flap Valve	x	Invert Level (m)	82.300	Design Flow (l/s)	12.0
Replaces Downstream Link	x	Design Depth (m)	1.200		

Head (m)	Flow (l/s)
1.700	0.000

Node Depth/Area 1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	1.0	Invert Level (m)	82.300
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)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	329.0	329.0	1.000	812.0	819.0	1.600	1150.0	1163.5	1.700	1707.0	1720.6

Results for 10 year +42% 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
1440 minute winter	Depth/Area 1	1470	83.596	1.296	24.8	854.9969	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
1440 minute winter	Depth/Area 1	Head/Flow	0.0	0.0

Fire Water Storage Requirements Estimation - Rev B

Storage requirements based on National Fire Chiefs Council (NFCC) "Grid Scale Battery Energy Storage System planning - Guidance for FRS" (2023)

"As a minimum, it is recommended that hydrant supplies for boundary cooling purposes should be located close to BESS containers (but considering safe access in the event of a fire) and should be capable of develivering no less than 1,900 litres per minute for at least 2 hours."

Minimum Fire Water Storage Requirements (Supply)

Flow Rate (litres/min)	Duration (Min)	Min Storage Volume (litres)	Min Storage Volume (m3)
1900	120	228000	228

Additional requirements based on SEPA Guidance "Managing Fire Water and Major Spillages: PPG18"

"Allow for a 10 year return, 8 days rainfall prior to the incident, and a 10 year return, 24 hour rainfall, plus an allowance for rain falling directly on to remote containment and areas of the site draining into it, immediately after the incident."

Minimum Fire Water Storage Requirements (Rainfall)	Min Storage Volume (m3)	Total Hardstanding Area (m2)
10 Year Return, 8 Days Rainfall Immediately Prior (Outflow Controlled)	273	11074
10 Year Return, 24 Hour Rainfall Immediately After Incident (Outflow Closed)	855	11074

Total Storage Required	1356
Total Storage Available in Attenuation Basin	1519

Design Check - Attenuation Dimensions (m)	
Design Top Area (Perimeter Access Track Top Area (m2)	1,707
Freeboard Top Area (m2)	1,150
Design Top Area (m2)	926
Base Area (m2)	329
Design storage depth (m)	1.2
Design freeboard (design depth + 0.4m) (m)	1.6
Overall depth (design depth + 0.4 freeboard + 0.1 access track) (m)	1.7
Side slopes (m)	1 in 4
Design Check - Attenuation Storage Provided (m3)	
Detention Basins	
Basin Design	753
Freeboard	623
Perimeter access track	143
Total (design)	753
Total (inc. freeboard, access track etc)	**1,519**
Design storage required < attenuation storage provided?	**YES = OK**