Flood Risk Assessment

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Fort Augustus
8 January 2024



Flood Risk Assessment

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Executive summary

Scottish & Southern Energy Networks (SSEN) has commissioned Jacobs to carry out a Flood Risk Assessment (FRA) to support a planning application for the proposed extension for the Fort Augustus substation in The Highlands, Scotland.

Flood risks have been considered from all sources including river, sea, surface water, groundwater, sewers and artificial drainage systems, canals and reservoirs. The assessment has considered the flood risks associated with the Proposed Development and the potential impacts it may have on third parties.

This assessment has concluded that there is a low or very low risk of flooding to or arising from the Proposed Development for all flood sources.

The principal flood sources in the vicinity of the Proposed Development are fluvial and surface water. However, these are managed by an already in-situ flood alleviation scheme and a proposed drainage system designed to a 0.1% AEP standard including allowance for climate change.

The in-situ flood alleviation scheme comprises a number of flow control structures on local watercourses, a flood bund and associated compensatory storage area.

This assessment has demonstrated that despite the loss of compensatory storage area volume due to extension of the substation, sufficient volume will remain to ensure its design standard (0.1% AEP) is not compromised.

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1. Introduction

Jacobs has been commissioned by Scottish & Southern Energy Networks (SSEN) to complete a Flood Risk Assessment (FRA) to support the extension of an existing substation at Fort Augustus.

1.1 Aims and Objectives

The aim of this report is to present the assessment of flood risk to and potentially arising from the Proposed Development and the requirements for managing those risks.

In order to achieve this aim, the following objectives have been met:

- Consulted with local flood Risk Management Authorities (RMAs) for any information they hold in relation to flood risk and the requirements they may have of new development with regards to the management of flood risk to and arising from the Proposed Development;
- Reviewed information available in the public domain from various websites (Scottish Environment Protection Agency (SEPA) Flood Maps, Magic Map, Scotland's Soils, Asset Information and Maintenance Programme);
- Reviewed information available from a previous study[1] completed in support of a prior application for an extension of the substation;
- Undertaken a qualitative assessment of flood risk to and arising from the Proposed Development accounting for all information available; and,
- Where necessary identified measures to mitigate for flood risk to and arising from the Proposed Development including preparation of a drainage impact assessment to comply with local policy/regulatory requirements.

1.2 Synopsis

This FRA is structured as follows:

- Section 2: Site Setting and Proposed Development; describes the setting of the site in relation to local features significant for the assessment of flood risk, it also describes the Proposed Development, identifying significant features pertaining to the management of flood risk;
- Section 3: Planning Policy and Guidance; outlines the policies relevant to the Proposed Development with respect to flood risk;
- Section 4: Assessment of Flood Risk to the Proposed Development; presents information on the flood risk to the Proposed Development considering mitigation measures;
- Section 5: Assessment of Risk arising from the Proposed Development; assesses how flood risk may change in the surrounding area as a result of the Proposed Development;
- Section 6: Additional Mitigation Measures and Residual Risk presents any additional mitigation measures needed and the remaining risks after all inherent risks have been reduced to a practicable level; and
- Section 7: Conclusion and Recommendations summarises the FRA presenting the key information about the Proposed Development for design development.

[1] SLR, November 2017. Fort Augustus Substation, Auchteraw, Proposed Substation Extension: Platforms LT92 and LT94. Appendix FRA-A: Hydrological Modelling Report Flood Risk Assessment. SLR Ref No:405.00660.00047, Version 1; and,

SLR, November 2017. Fort Augustus Substation, Auchteraw, Proposed Substation Extension: Platforms LT92 and LT94. Appendix FRA-B: Hydraulic Modelling Report Flood Risk Assessment. SLR Ref No:405.00660.00047, Version 2

2. Proposed Development and Site Setting

2.1 Proposed Development

The Proposed Development comprises the construction of an extension to the existing Fort Augustus substation platform. The platform extension will be installed to tie into the existing platform, completed at an elevation of approximately 39.8m aOD.

This extension will include construction of transmission towers, a cable corridor, a GIS substation, super grid transformers, backstart reactors, overhead power lines and an access road to the site. (Figure 2 - 1). In addition to power transmission infrastructure the Proposed Development will also include a drainage system designed in accordance with current standards and a foul water treatment system independent of local foul sewer networks.

The main access road to the substation with remain as the existing access connecting to Auchteraw Road, northeast of the substation.

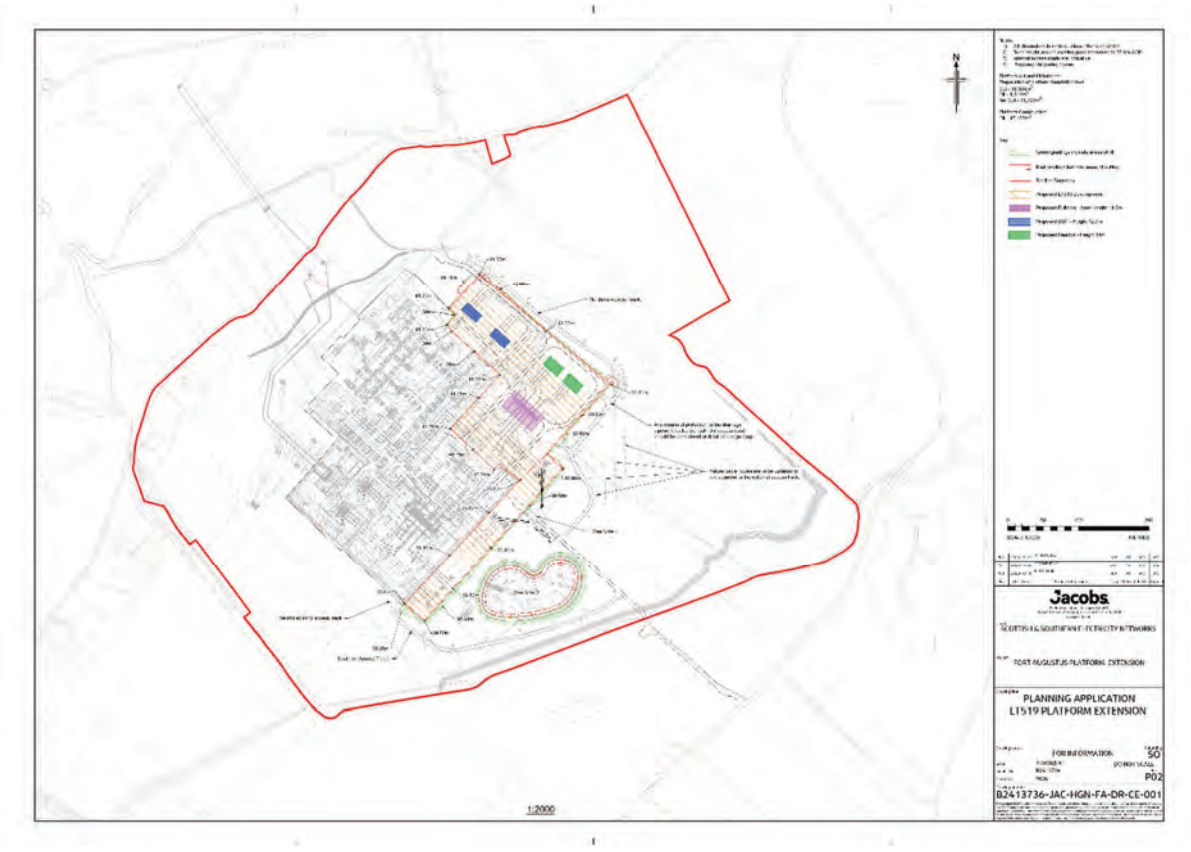


Figure 2 - 1. Proposed Development Layout

2.2 Site Setting

2.2.1 Site Location

Fort Augustus is located at the south-western tip of Loch Ness within the Scottish Highlands. The substation is located approximatley2.4km southwest of Fort Augustus, with a grid reference of NH 35233 08277 (Figure 2 - 2).

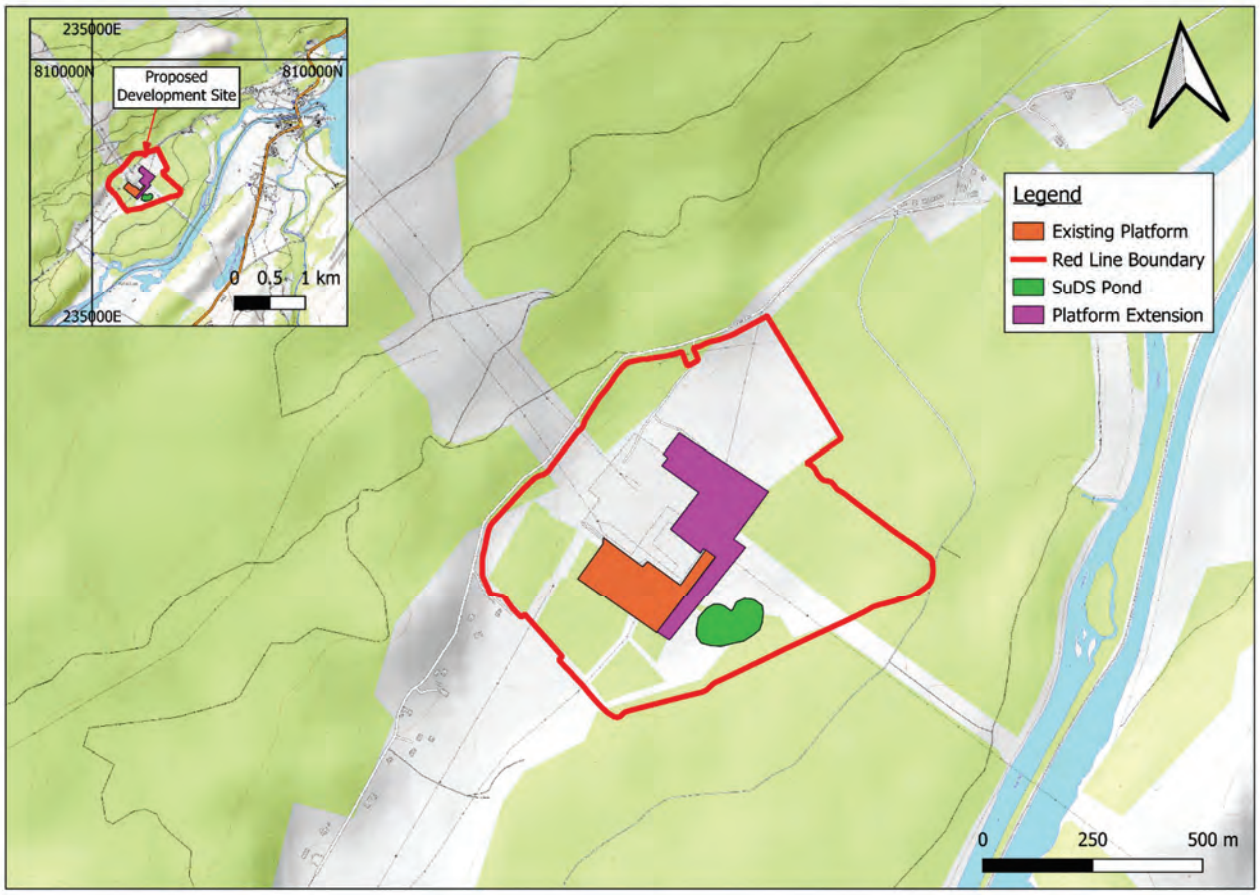


Figure 2 - 2. Site Location map for the Proposed Development.

2.2.2 Land Use

The site of the proposed extension comprises bare fields and grasslands. The immediate surrounding areas are mostly Scots pine or coniferous woodland, managed by Forestry and Land Scotland (FLS). The nearest urban area is Fort Augustus which lies approximately 2.4km northeast of the site (Figure 2 - 3).

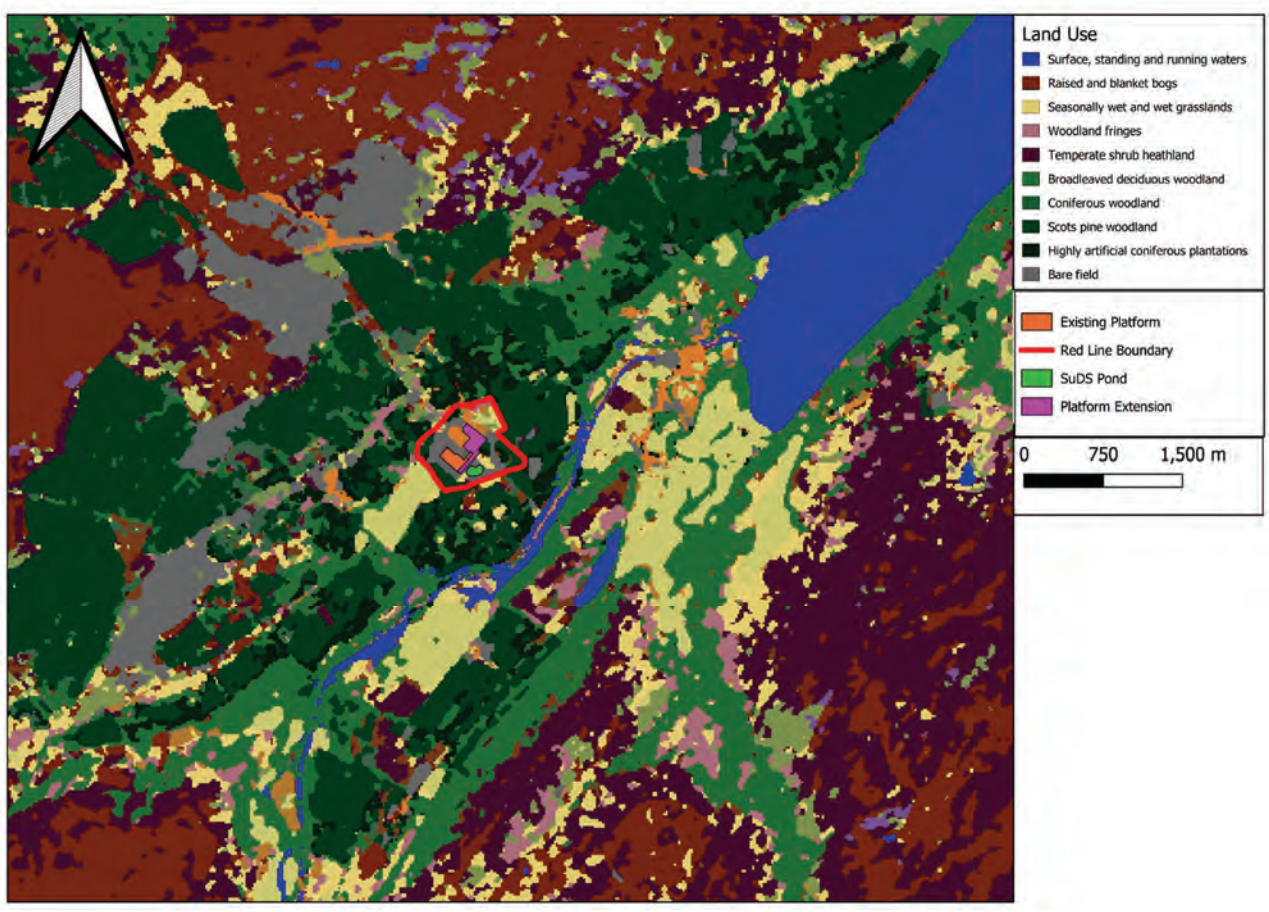


Figure 2 - 3. Land use map of Fort Augustus and the surrounding area, denoting the substation location as site location. Data from the Scotland Habitat and Land Cover Map, 2020.[2]

2.2.3 Topography

The existing substation site comprises a platform at an approximate elevation of ~40m aOD. This lies in an area at the base of a steeper, wooded region to the northwest of the substation. The site of the proposed extension lies at an elevation of approximately ~37m aOD (Figure 2 - 4). Within proximity of the substation ground elevations vary by approximately10m.

[2] http://mapapps.bgs.ac.uk/geologyofbritain/home.html

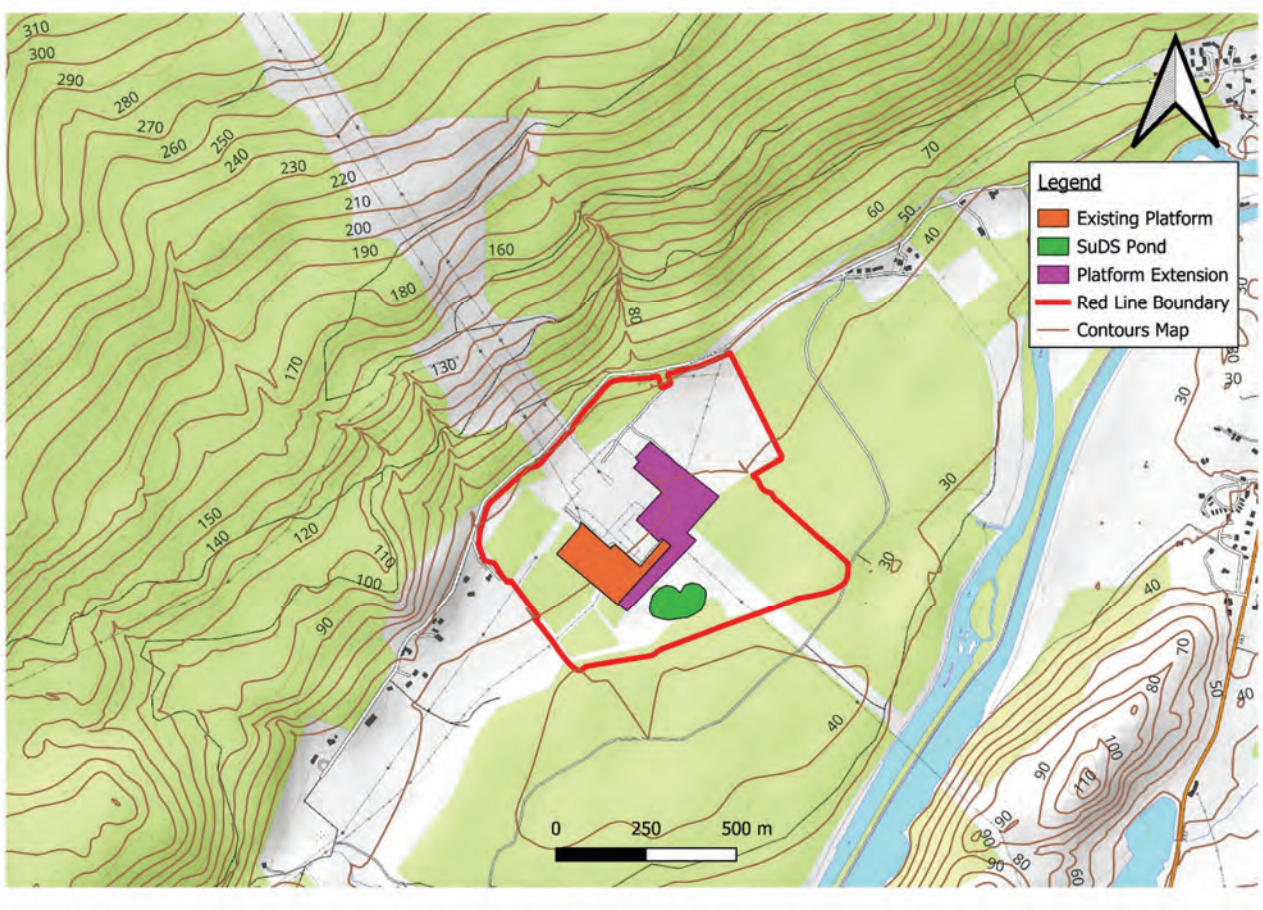


Figure 2 - 4. A topographic map of the Fort Augustus station and its surrounding area.

2.2.4 Hydrology and hydrological / hydraulic features

There are four watercourses in close proximity to the existing substation (Figure 2 - 5), these are:

- the Allt na Fearna flows from the northwest to the southeast approximately approximately165m northeast of the site. This watercourse drains a catchment area of approximately 2.79km² upstream of the site;
- the Auchteraw Burn flows from the west to the east lying approximately 270 to the south and southeast of the site. This watercourse drains a catchment area of approximately 3.31km² upstream of the site;
- a tributary of the Auchteraw Burn flowing from the northwest to the southeast approximately 360m southwest of the site. This watercourse drains a catchment area of approximately 0.54km² upstream of the site; and
- a realigned watercourse flowing from the northwest to the south east approximately 900m east of the site, converging with the Auchteraw Burn.

The River Oich also flows northward approximately1km east of the substation and lies within the River Ness catchment of the Scotland river basin district.

The Caledonian Canal lies approximately 500m southeast of the site adjacent to the River Oich at an elevation of approximately 30m aOD.

Construction drawings dated 2019-2020 for the site show several features constituting a flood alleviation scheme for the existing site and Proposed Development that influence flooding in the vicinity of the site. These comprise:

- A realigned watercourse. This combines flows from several watercourses upstream of the site to enable them to be conveyed past the site without resulting in flooding for events up to and including the 0.1% AEP event;
- A bund installed along the left bank of the Auchteraw Burn. This has a minimum crest level of 38.9m aOD and forms a flood compensation area across land to the south of the existing substation platform
- A control structure within the bund on the line of the realigned watercourse that restricts flow downstream / encourages back-up of flows within the flood compensation area
- A control structure on the Auchteraw Burn; and,
- A control structure on the Allt na Fearna

The locations of these features are illustrated in Figure 2 - 5. The influence of these features on local flood risk is discussed in Section 4.1. Drawings are provided in Error! Reference source not found..

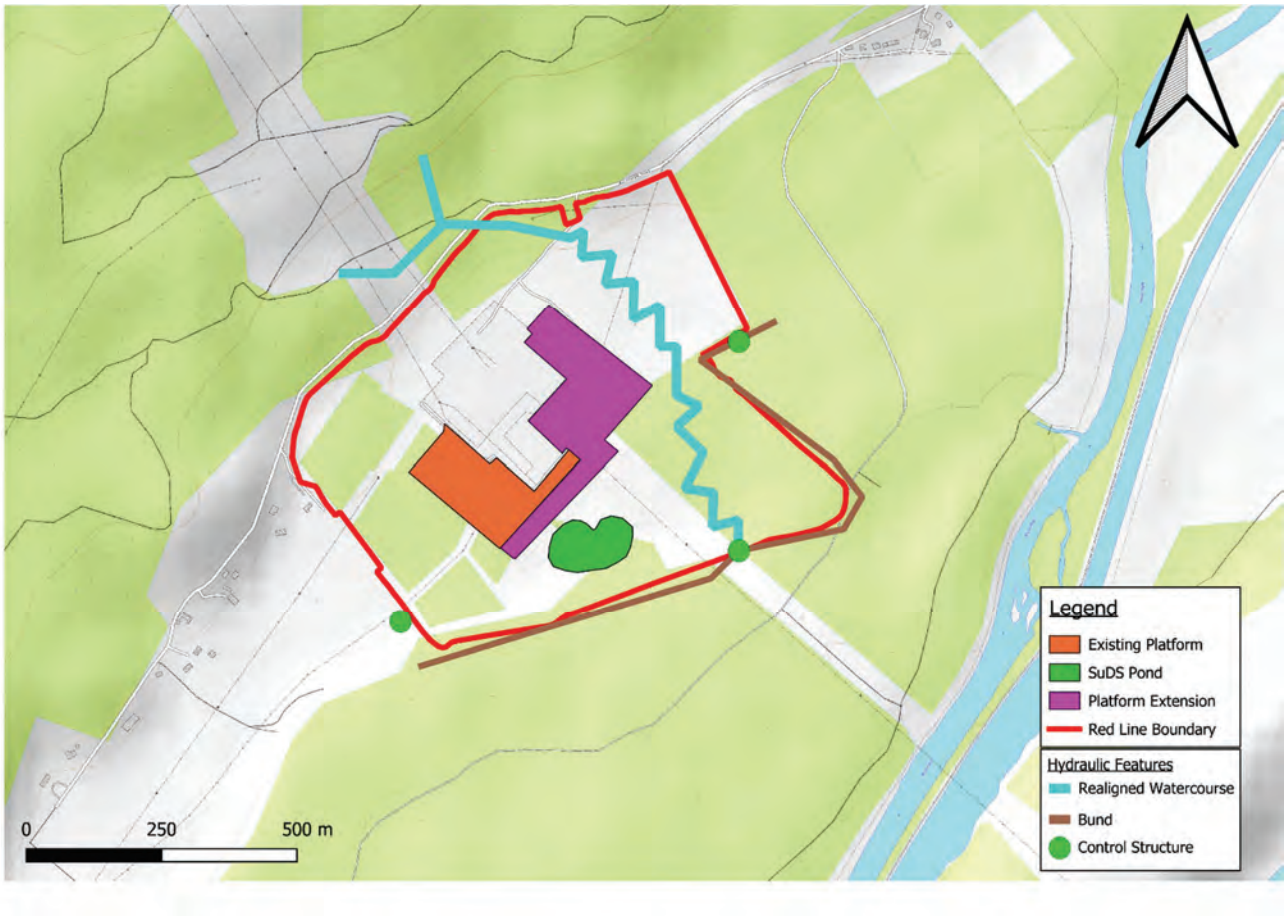


Figure 2 - 5. Watercourses and hydrological / hydraulic features in the vicinity of the site

2.2.5 Geology and Hydrogeology

The British Geological Survey (BGS) Geodex[3] viewer identifies the bedrock geology underlying the site as part of the Tarvie Psammite Formation (sandstone). In close proximity to the site lies the West Highland granite gneiss intrusion into which the River Oich incises. Superficial deposits mainly consist of glaciofluvial sheet deposits at the site with some alluvial fan deposits and alluvium nearer to the River Oich and the smaller nearby tributaries.

[3] http://mapapps.bgs.ac.uk/geologyofbritain/home.html

The National Soil Map of Scotland[4] shows that alluvial soils underlie the site, these soils are developed from river deposits and are typically peaty.

Soakage testing in accordance with the method of BRE365 was completed across the site of the proposed extension in August 2023. This established soakage rates between 2.4x10-5 and 8.8x10-5, with water draining to between 0.66m and 1.84m below ground level. Details of the soakage test results are provided within the Drainage Impact Assessment appended to this report (Error! Reference source not found.).

[4] https://map.environment.gov.scot/Soil_maps/?layer=1

3. Planning Policy Review

3.1 Scottish Planning Policy

The Scottish Planning Policy (SPP)[5] provides a statement on the Scottish Government's policy on nationally important land use planning issues such as flood risk. It outlines a series of considerations for developers including:

- FRAs should regard the flood maps prepared by SEPA and take account of finalised and approved Flood Risk Management Strategies (FRMS) and River Basin Management Plans (RBMP);
- Flood reduction: assessing flood risk, and where appropriate, undertaking flood management measures; and
- Avoidance of increased surface water flooding through requirements for Sustainable Drainage Systems (SuDS) and minimising the area of impermeable surface.

3.1.1 SEPA Technical Flood Risk Guidance for Stakeholders

SEPA's Technical Flood Risk Guidance for Stakeholders[6] states that a precautionary approach should be applied to FRAs and outlines the information required within an FRA should include:

- A site plan showing areas of flooding;
- An assessment of future climate change;
- Details of any structures that may influence local hydraulics, such as culverts;
- The flood extent for appropriate return periods indicated on a site plan; and
- Details of any mitigation measures proposed.

3.1.2 National Planning Framework 4 (NPF4), 2023

Policy 22 of the NPF4[7] gives guidance for reducing the vulnerability of existing and future developments to flooding. NPF4 provides a framework for when development proposals can/ cannot be built in areas of flood risk. Policy 22a states development proposals in flood risk areas will only be supported if they are for:

- Essential infrastructure when cannot be relocated for operational reasons, this applies to our proposed development
- Water compatible uses
- redevelopment of an existing building or site for an equal or less vulnerable use
- redevelopment of previously used sites in built up areas where the local development plan has identified a need to bring these into positive use (devised by local planning authorities)

Existing formal flood protection schemes can be used when determining flood risk for new developments. For new developments, it must be demonstrated that (NPF4, 2023):

- all risks of flooding are understood and addressed;

[5] https://www.gov.scot/publications/scottish-planning-policy/

[6] https://www.sepa.org.uk/media/162602/ss-nfr-p-002-technical-flood-risk-guidance-for-stakeholders.pdf

[7] https://www.gov.scot/publications/national-planning-framework-4/

- 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;
- future adaptations can be made to accommodate the effects of climate change
- safe egress and access can be achieved at the site when flooding occurs
- the first utilised floor/ underside of the development is above the flood risk level with an allowance for freeboard

Small-scale developments and alterations to existing buildings will only be approved if flood risk is not significantly altered (Policy 22b). Surface water risk cannot be increased by new developments and sustainable urban drainage systems (SUDS) should be used to ensure this (Policy 22c).

3.1.3 SEPA Flood Risk and Land Use Vulnerability Guidance, 2018

This SEPA guidance[8] sets out the relative vulnerability of different land uses to flooding, specifying various types of development (e.g. police stations, hospitals, shops) and their relative vulnerabilities. Also, the likelihood of SEPA planning approval being granted based on the type of development and flood risk of the underlying land (no risk, low risk, medium risk, or high risk).

The proposed development is essential infrastructure under SEPA guidance. Table 3-1 below outlines the probable decisions made by SEPA at various levels of flood risk in the planning process.

Table 3-1. A section of the SEPA matrix for flood risk.

	Little or no risk (>0.1% AP)	Low to medium risk (0.1-0.5% AP)	Medium to high risk within undeveloped and sparsely developed areas (>0.5%AP)
Essential Infrastructure	No constraints	Generally suitable for development.	Generally suitable where a flood risk location is required for operational reasons and an alternative lower-risk location, is not available – development should be designed and constructed to be operational during floods (i.e. 0.5% AP), and not impede water flow.

3.1.4 SEPA Flood Risk Standing Advice for Planning Authorities and Developers, 2020

The SEPA Flood Risk Standing Advice[9] gives many regulations for building essential infrastructure in flood risk areas. These are:

- the infrastructure must remain operational during floods and not impede water flow;
- safe and flood-free access and egress should be provided, where possible, for people of all mobilities;
- finished floor levels should be set 600mm above the design flood level to provide an allowance for freeboard;

[8] https://www.sepa.org.uk/media/143416/land-use-vulnerability-guidance.pdf

[9] https://www.sepa.org.uk/media/534740/sepa-flood-risk-standing-advice-for-planning-authorities-and-developers.pdf

- An allowance for climate change should be included within design flood levels calculation, of which SEPA guidance specifies;
- Designs should be flood resistant or resilient depending on the characteristics of the design flood;
- A 6m undeveloped buffer strip is recommended between all development types and watercourses. Note that the 6m buffer is for channels of width <1m and this buffer distance should increase proportionally with channel width.

3.1.5 SEPA Technical Flood Risk Guidance for Stakeholders

SEPA's Technical Flood Risk Guidance for Stakeholders[10] states that a precautionary approach should be applied to FRAs and outlines the information required within an FRA should include:

- A site plan showing areas of flooding;
- An assessment of future climate change;
- Details of any structures that may influence local hydraulics, such as culverts;
- The flood extent for appropriate return periods indicated on a site plan; and
- Details of any mitigation measures proposed.

3.2 Local Planning Policy and Evidence Base Review

3.2.1 Highland-wide Local Development Plan, The Highland Council, 2012

The Highland Council (THC) has supplementary guides to support the delivery of their Local Development Plan[11]. The relevant policies on carrying out FRAs from the Local Development Plan and supplementary guides are outlined below:

- Development proposals should avoid areas susceptible to flooding and promote sustainable flood management;
- Development proposals within medium to high flood risk areas should demonstrate compliance with SPP;
- Where flood management measures are required, natural methods such as restoration of floodplains, wetlands and water bodies should be incorporated, or adequate justification should be provided as to why they are impracticable; and
- All proposed developments must be drained by SuDS designed in accordance with The SuDS Manual.

3.2.2 Highland and Argyll Flood Risk Management Plan

The Highland and Argyll Flood Risk Management Plan (FRMP)[12] sets out the long-term ambition for flood risk management in the district. In this FRMP potentially vulnerable areas (PVAs) are identified, the nearest one to the Proposed Development being Fort Augustus, approximately 7km north of the Proposed Development. Additionally, the FRMP sets out a number of actions in relation to flood planning and flood risk. The Land Use Planning action states that planning policies aim to:

[10] https://www.sepa.org.uk/media/162602/ss-nfr-p-002-technical-flood-risk-guidance-for-stakeholders.pdf

[11] https://www.highland.gov.uk/info/178/development_plans/199/highland-wide_local_development_plan

[12] https://www.highland.gov.uk/info/1226/emergencies/81/flooding/3#:~:text=The%20plan%20explain%20what%20causes,to%20work%20towards%20those%20objectives.

- Restrict development within floodplains;
- Limit exposure of new receptors to flood risk;
- Promote flood reduction via natural and structural flood management measures; and
- Avoid increased surface water flooding through sustainable drainage, minimising impermeable surfaces where possible.

3.2.3 River Basin Management Plan

The River Basin Management Plan (RBMP) for Scotland 2021 – 2027[13] outlines the framework for protecting and improving the benefits provided by the water environment across Scotland. The RBMP outlines how it is proposed rural land is used to provide a contribution to Scotland. This includes using a spatial approach including the use of flood risk data to assess opportunities for development in rural areas.

3.3 Consultations

The following organisations were contacted for any flooding information held for the site:

- SEPA;
- The Highland Council; and
- Scottish Water.

A record of the information requested is included in Error! Reference source not found..

[13] https://www.sepa.org.uk/media/594088/211222-final-rbmp3-scotland.pdf

4. Assessment of Risk to the Proposed Development

4.1 Fluvial Flood Risk

Fluvial flooding is defined as flooding that arises when the water level in a river, lake or stream rises and overflows onto the surrounding banks, shores and neighbouring land. It occurs when excessive rainfall causes a waterbody to exceed its capacity.

SEPA flood maps define three areas at risk of flooding:

- The area at risk from a 10% AEP (annual exceedance event) flood;
- The area at risk from a 0.5% AEP flood, defined as the functional floodplain; and,
- The area at risk from a 0.1% AEP flood.

Figure 4 - 1 presents the SEPA flood map for the site. The mapping shows the existing substation and much of the land to its southeast to be at risk during the 10% AEP event.

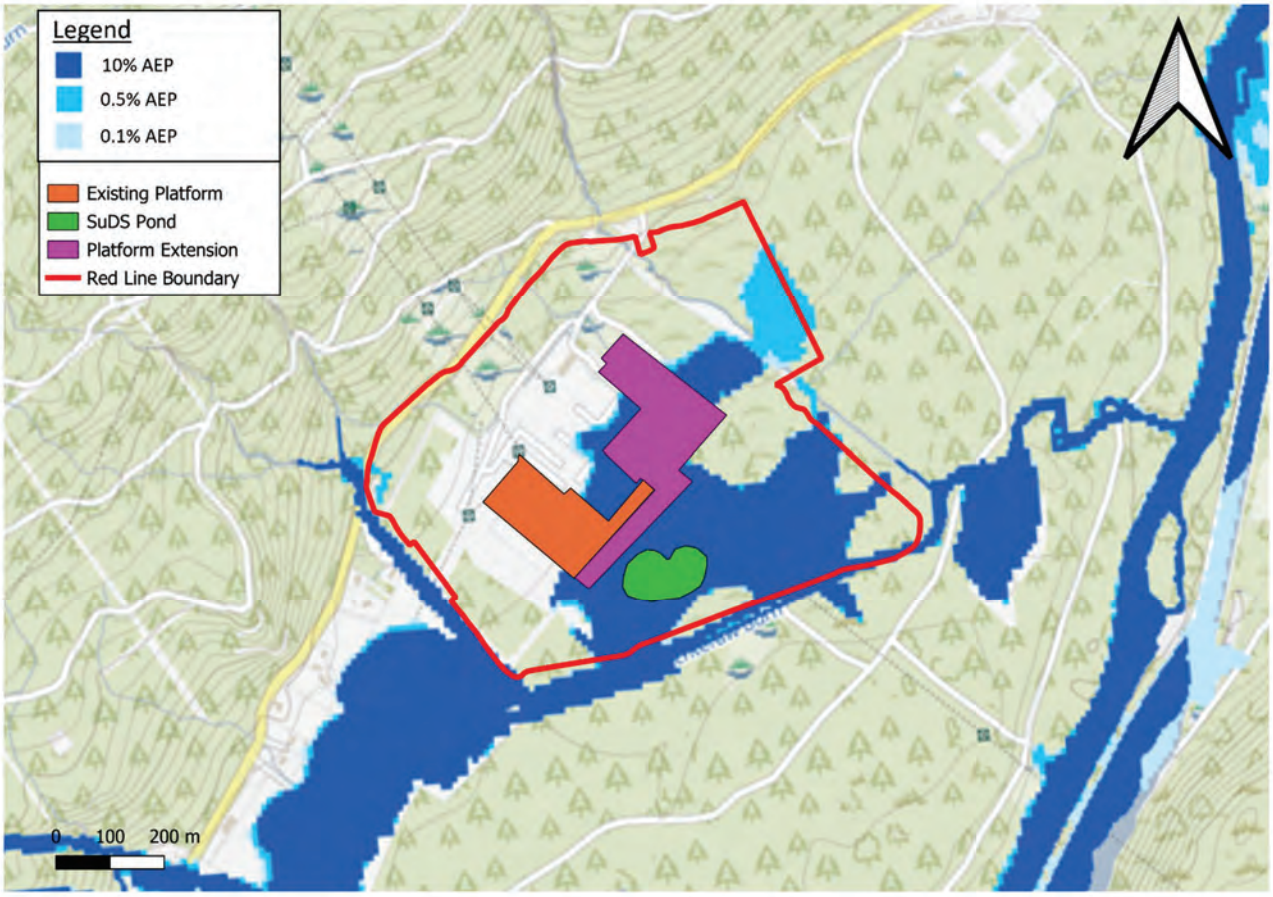


Figure 4 - 1. SEPA Flood map for the site

In support of a previous planning application for extension of the substation an assessment was completed by SLR[1] to define flood risk to the existing substation and site of the proposed extension. An extract of the FRA in support of this application is provided in Error! Reference source not found. .

The SLR report summarises hydraulic modelling hydrological estimation carried out to define flood risks to the existing substation site and the nature of measures necessary to manage flood risk to the existing and proposed extension of the substation, whilst preventing increases in flood risk elsewhere.

The mitigation proposed by SLR comprise (Figure 4 - 2):

- Three flood control structures at points A, B and C which regulate the passing of water downstream, encouraging flows in excess of the pass forward flow into a compensatory storage area;
- A flood storage bund of maximum height 39.2m aOD providing 500mm freeboard on the 0.1% AEP flood level of 38.3m aOD along the southern and eastern boundary;
- The flood storage bund then defines the extent of a compensatory flood storage area. The SLR assessment concludes that a compensatory storage area providing 45,000m³ would be required to mitigate for the throttled pass forward flows arising from control structures. The assessment further demonstrates that with a bund completed to a level of 39.2m aOD the compensatory storage area would provide 110,000m³ of storage.

Construction drawings of these measures are provided in Error! Reference source not found..

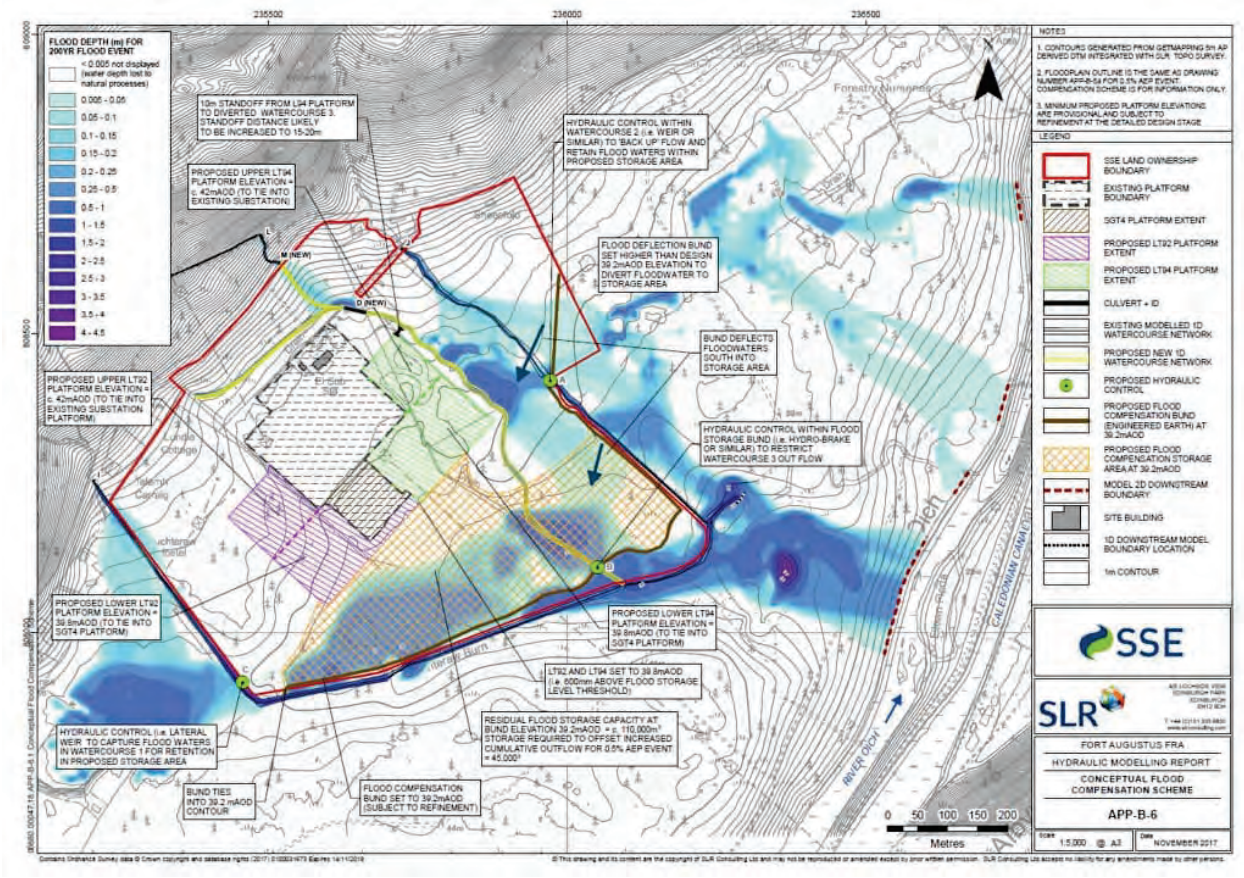


Figure 4 - 2. SLR defined flood mitigation measures

As part of this FRA checks have been undertaken on the dimensions of the flood storage bund and compensatory storage area. This has used LiDAR data provided by SSEN (collected in 2019 - 2020). Interrogation of this data has identified that the flood storage bund has been constructed with a minimum crest level of 38.9m aOD. Using this as the maximum level to which the compensatory storage area would impound flood water, the compensatory storage area can contain up to 164,543m³. This assessment determines that despite the lower crest level of the flood storage bund the compensatory storage area provides a significantly greater volume than assessed as necessary by SLR.

A flood map demonstrating the extent of the 0.1% AEP accounting for the effect of the SLR defined flood mitigation measures is provided as Figure 4 - 3.

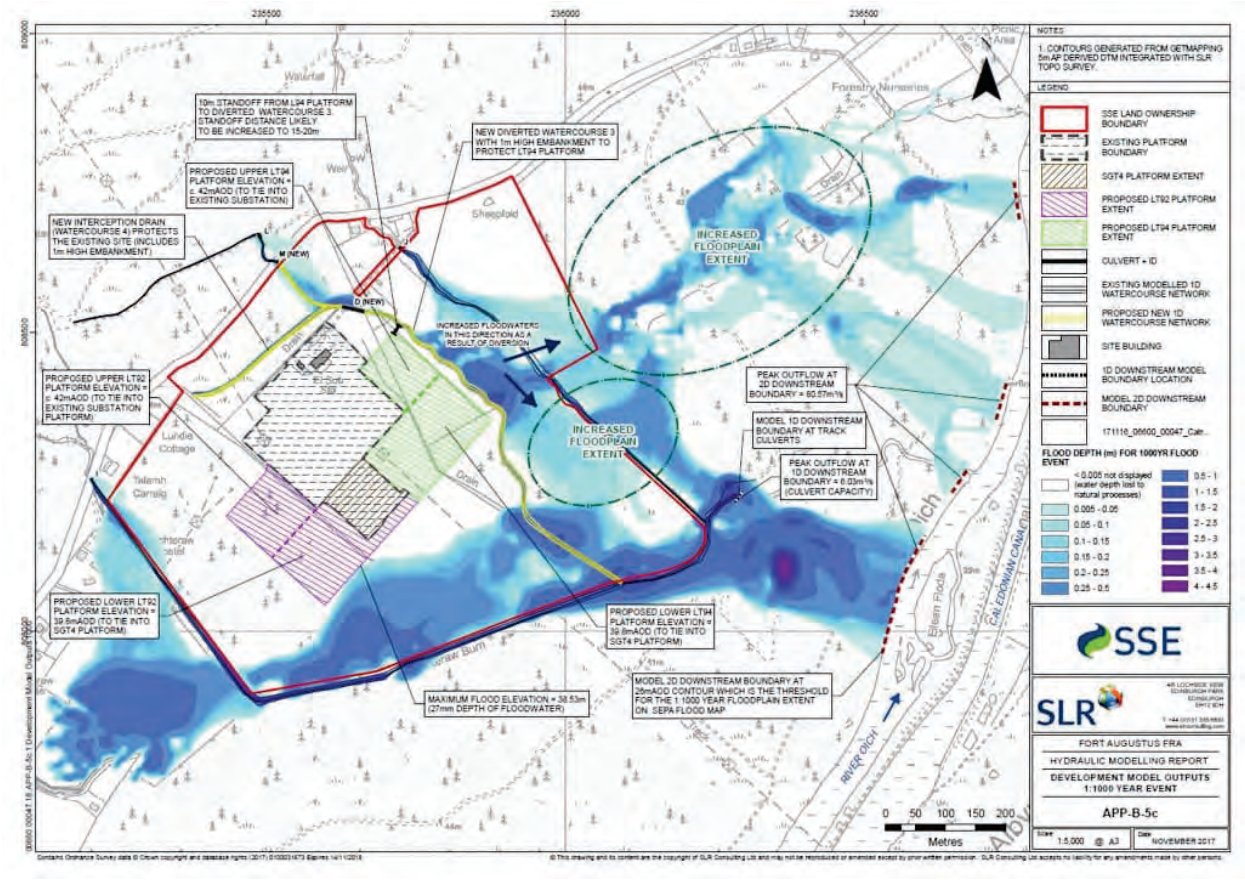


Figure 4 - 3. SLR 0.1% AEP flood extent

Whilst this illustrates the Proposed Development extending into the flood compensation area and extent of the 0.1% AEP flood, the proposed elevation of the platform of 39.8m aOD places it 900mm above the maximum water associated with the compensatory storage area and would therefore not be at risk of flooding.

The risk to the Proposed Development from fluvial sources is therefore assessed to be low for which additional mitigation measures are not considered necessary.

4.2 Surface Water Flood Risk

Surface water flooding typically occurs during or following periods of intense rainfall where the ground's ability to absorb rainfall is overwhelmed. As more runoff is expected from developed (impermeable) areas, urban areas tend to be more susceptible to flooding from surface water.

SEPA flood maps define three areas at risk of flooding:

- The area at risk from a 10% AEP (annual exceedance event) flood;
- The area at risk from a 0.5% AEP flood; and,
- The area at risk from a 0.1% AEP flood.

Figure 4 - 4 presents the SEPA flood map for the site. The mapping shows the existing substation to be at risk during the 0.5% AEP event.

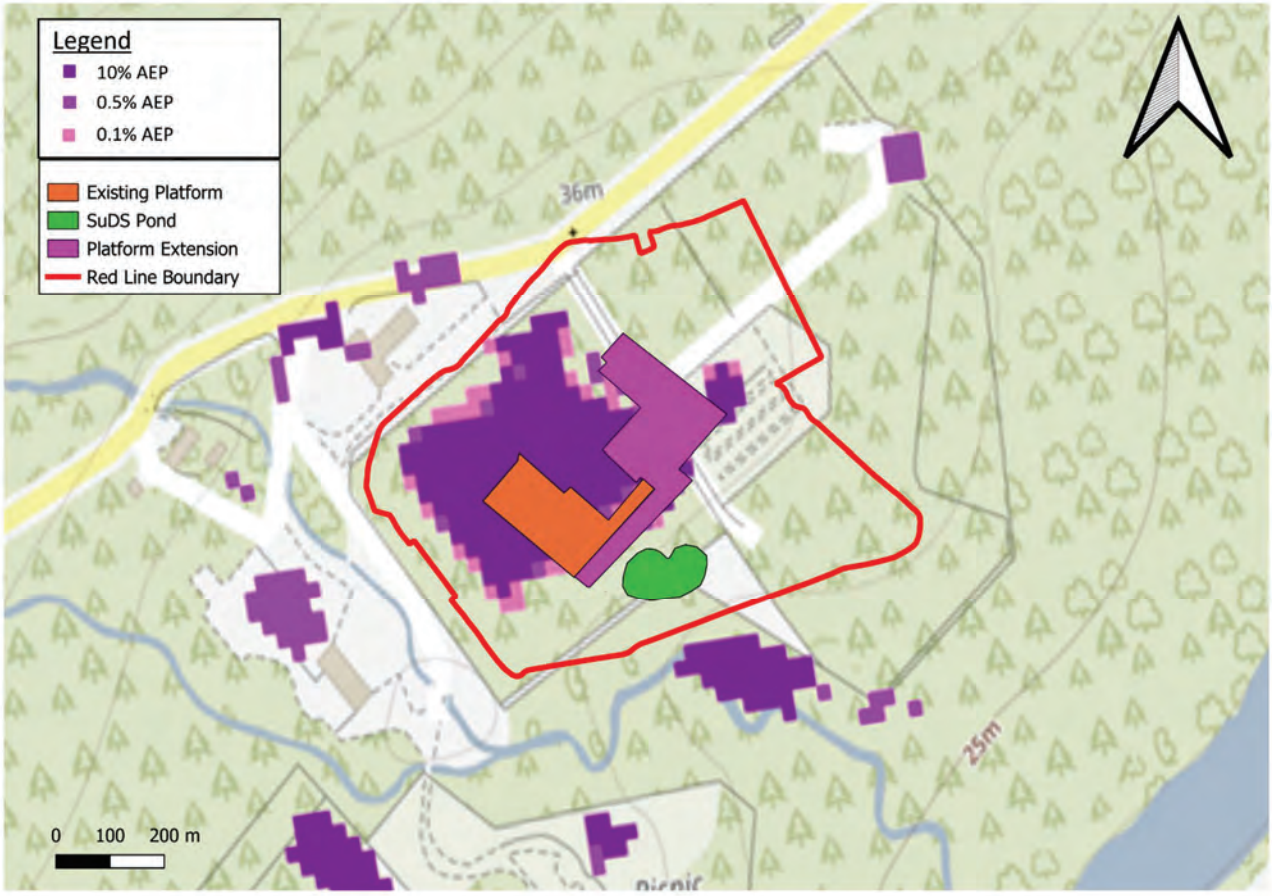


Figure 4 - 4. SEPA Surface Water flood extent map

The existing site is served by a surface water drainage system. This drainage system is designed to a minimum 0.1% AEP standard. Therefore, SEPA flood maps are not considered to be reliable for defining flood risk to the existing site.

A Drainage Impact Assessment prepared for the Proposed Development (Error! Reference source not found.) demonstrates that the drainage proposed for the extension will be effective at mitigating the surface water flood risk at the site for all events up to the 0.1% AEP event plus a 42% increase in rainfall intensity to account for the effects of climate change over the facilities design life.

The risk to the Proposed Development from surface water flood sources is therefore assessed to be low for which additional mitigation measures are not considered necessary.

4.3 Groundwater Flood Risk

Groundwater flooding is caused by the emergence of water from beneath the ground at either point or diffuse locations when the natural level of the water table rises above ground level. This can result in deep and long-lasting flooding of low-lying land and/or below ground infrastructure such as underpasses and basements.

The Highland and Argyll Flood Risk Management Plan (FRMP)[14] states that groundwater is usually a contributing factor to flooding rather than the primary source.

SEPA flood maps show the site is within a 'Potentially Vulnerable Area' as designated in 2018[15]. Potentially vulnerable areas are designated by the SEPA national flood risk assessment and are reviewed every six years. The risks within the Potentially Vulnerable Area are currently managed by the Fort Augustus Flood Protection Scheme.

The Proposed Development comprises the extension of the existing platform at a minimum level of 39.8m aOD. The perimeter of the extended platform will therefore be completed a minimum of 37mm above surrounding ground levels. Therefore, were groundwater to emerge at the surface it would accumulate in the flood compensation area achieving a maximum level of 38.9m aOD, 900mm lower than the minimum level of the extended substation platform.

The Proposed Development does not involve any basement structures or linear piling that could impact local groundwater flow. Therefore, flood risk to the Proposed Development from groundwater is assessed as low for which additional mitigation measures are not considered necessary.

4.4 Flood Risk from Sewers and Artificial Drainage Systems

Flooding from sewers primarily occurs when flow entering a sewer system exceeds the available capacity or if the network capacity has been reduced through blockage or collapse. In the case of surface water sewers that discharge to watercourses, the same effect can be caused as a result of high-water levels in the receiving watercourse. As a result, water can begin to surcharge the sewer network, emerging at ground level through gullies and manholes and potentially causing flooding to highways and properties. If this occurs flooding can represent a significant hazard to human health due to the potential for contaminants in flood water.

Site drainage systems are owned and maintained by SSEN. The surface water drainage systems across the site are designed to a minimum 0.1% AEP standard, discharging to the realigned watercourse.

Information on the wider local sewer network has been requested from Scottish Water, however, at the time of writing no response has been received therefore there is limited information available on drainage systems in the area. However due to the remote nature of the site it is assumed there will be limited sewers and artificial drainage systems in the area.

Flood risk to the Proposed Development from sewers is considered to be low for which additional mitigation measures are not considered necessary.

4.5 Flood Risk from Reservoirs

Reservoir failure can be a particularly dangerous form of flooding as it results in the sudden release of large volumes of water that can travel at high velocity. Reservoir flooding can result in deep and widespread flooding, potentially resulting in significant damage. However, the likelihood of a large, raised reservoir (>25,000m³) flood occurring is very low due to the requirements for regular inspections and maintenance as set out in the Reservoirs Act (Scotland) 2011[16].

SEPAs Reservoir Inundation Map shows an indicative area that may flood from an uncontrolled release of water from all possible dam failure scenarios13. If Loch Ness breached to the northeast of the Proposed Development, the resulting discharge southwest will miss the Proposed Development (Figure 4 - 5). The southern Tip of Loch Ness lies between 20-30m aOD compared to the 37-40m aOD of the site.

[14] https://www2.sepa.org.uk/frmplans/documents/lpd1-highland-and-argyll-frmp-2021.pdf

[15] https://map.sepa.org.uk/floodmap/map.htm

[16] https://www.gov.scot/publications/reservoirs-legislation/



Figure 4 - 5. SEPA reservoirs inundation map where the blue area represents areas flooded by the breach of Loch Ness.

None of the Proposed Development area interfaces with areas at risk from a reservoir failure. Therefore, the risk is considered to be very low for which additional mitigation measures are not necessary.

4.6 Flood Risk from Canals

Canals and artificial waterways rarely flood as the water levels are generally managed all year round. However, large rainfall events, a lack of maintenance or overtopping from nearby rivers can cause flooding of canals and artificial waterways.

The Caledonian Canal is approximately 500m southeast of the Proposed Development, and at a lower elevation. Any flooding associated with the Canal will flowing local topography away from the site. The main risk here is fluvial flooding from the River Oich and the Caledonian Canal would act as a spill for this river.

Therefore, the risk of canal flooding is very low for which additional mitigation measures are not considered necessary.

4.7 Tidal Flood Risk

Tidal flooding can arise during normal or extreme tidal conditions. Such flooding is normally confined to coastal and estuarine areas but can, during extreme events, move further inland resulting in widespread lowland flooding. Extreme tidal flood events are normally associated with high tides which coincide with significant atmospheric depressions so their occurrence can be forecasted several days in advance. However, the magnitude of an event can be more difficult to forecast and is dependent on how storm systems travel and develop.

The Proposed Development is in the Scottish Highlands at an elevation of approximately30-40 m aOD and approximately 50km away from the nearest coastline. The risk from tidal flooding to the Proposed Development is very low for which additional mitigation measures are not considered necessary.

5. Assessment of risk arising from the Proposed Development

5.1 Fluvial Flood Risk

Whilst the Proposed Development will not be subjected to fluvial flooding due to its elevation the platform will extend into the flood compensation area, removing flood storage.

Measurement of the volume of storage available within compensatory storage area up to the minimum level of the flood compensation bund (38.9m aOD) determines there is a volume of 164,543m³. The proposed extension will remove approximately 5,543m³, leaving 159,000m³. The SLR assessment[1] concluded that the extension would require 45,000m³ of storage to limit downstream effects.

This assessment demonstrates that despite the reduction in flood compensation area volume, sufficient remains to ensure compliance with the SLR assessment.

Consequently, it is determined that the substation platform extension will not reduce the 0.1% AEP design standard of the compensatory storage area. The risk of the Proposed Development exacerbating flooding to nearby receptors is therefore considered to be low for which additional mitigation measures are not considered necessary.

5.2 Surface Water Flood Risk

Surface water generated by the existing substation is managed by drainage systems for all events up to and including a minimum of the 0.1% AEP event.

The Proposed Development will include a drainage system to manage surface water flood risk for all events up to and including the 0.1% AEP event including a 42% increase in rainfall intensity to allow for the effects of climate change over the developments lifetime. Discharges from this system will drain to ground via a SuDS pond.

However, on review of the volume of storage available within the compensatory storage area it was established that the crest level of the SuDS pond previously installed as part of the proposed drainage system is lower than the crest level of the flood storage bund. Therefore, the SuDS pond would be at risk of flooding from fluvial events with the volume of it not being available to attenuate site discharges.

To mitigate for this an assessment has been undertaken to determine the volume of storage lost from the compensatory storage area if the crest level of the SuDS pond were to be raised to 38.9m aOD (lowest level of the flood storage bund). This assessment has concluded that a further 13,175m³ of storage would be lost from the compensatory storage area.

Of the 159,000m³ of storage remaining after extension of the substation platform, the loss of a further 13,175m³, to isolate the SuDS pond from fluvial flood events, would reduce the compensatory storage area volume to 148,825m³, remaining significantly in excess of the 45,000m³ of storage assessed as necessary by SLR (November, 2017).

Isolating the SuDS pond will ensure its effective operation during fluvial flood events. Therefore, the risk of the Proposed Development exacerbating surface water flood risk to third parties is considered to be very low, for which additional mitigation measures are not considered necessary.

5.3 Groundwater Flood Risk

The Proposed Development does not involve any earthworks below ground level. There are no basement structures or linear features that could interfere with or modify local groundwater.

The risk of the Proposed Development exacerbating flood risk to nearby receptors is therefore considered to be very low for which additional mitigation measures are not considered necessary.

5.4 Sewers and Artificial Drainage Systems

The Proposed Development will not be connecting to any existing local sewer or artificial drainage systems. Surface water generated by the Proposed Development will drain to ground via a system designed to a 0.1% AEP standard (including allowance for climate change).

Foul water generated by the Proposed Development will similarly be managed on site discharging to ground after treatment.

The risk of the Proposed Development exacerbating flood risk from sewers and artificial drainage systems to third parties is very low for which additional mitigation measures are not considered necessary.

5.5 Reservoir Flood Risk

The Proposed Development is not within an area at risk of reservoir flooding and will therefore not displace reservoir flood waters (Figure 4 - 5). The Proposed Development does not involve any works which could compromise the structural integrity of local impounding structures.

The risk of the Proposed Development exacerbating flood risk from reservoirs to third parties during is very low for which additional mitigation measures are not considered necessary.

5.6 Canal Flood Risk

The Proposed Development does not involve any works which could compromise the structural integrity of the Caledonian Canal. In addition, the site is not in an area at risk in the event of a failure of the Caledonian Canal, due to its elevated position relative to the canal.

Therefore, the risk of the Proposed Development exacerbating flood risk from canals to third parties during construction and operation is very low for which additional mitigation measures are not considered necessary.

5.7 Tidal Flood Risk

The Proposed Development is in the Scottish Highlands, more than 50km away from the nearest coastline at an elevation of 30-40mAOD. The risk of the Proposed Development exacerbating flood risk from tidal sources to third parties is very low for which additional mitigation measures are not necessary.

6. Additional Mitigation & Residual Risk

Table 0-1 presents a summary of the flood risk to and arising from the Proposed Development as detailed in Section 4 and 5 respectively.

The summary highlights the low to very low risk to and arising from the Proposed Development.

Table 6 - 1. Summary of Flood Risk

Flood source	Risk to the Proposed Development	Risk arising from the Proposed Development	Additional mitigation measures required?
Fluvial	Low	Low	No
Surface water	Low	Low	No
Groundwater	Low	Low	No
Sewers and Artificial sources	Low	Very Low	No
Reservoirs	Very Low	Very Low	No
Canals	Very Low	Very Low	No
Tidal	Very Low	Very Low	No

The assessment has concluded that considering the constituent parts of the Proposed Development (Section 2.1) there are no further mitigation measures required to ensure the Proposed Development is not at unacceptable risk from flood sources or will exacerbate flooding to third parties.

6.1 Residual Risks

Notwithstanding the conclusion that further mitigation measures are not required for the Proposed Development, much of this assessment has drawn upon the conclusions of an SLR[1] assessment, underpinning the now in-situ flood mitigation measures around the existing and proposed substation.

At the time of the SLR assessment the guidance was to apply a 20% increase in peak river flows to account for the effects of climate change. Current guidance is to apply a 42% increase.

Reflecting on the effects of a 42% increase on fluvial flows it is considered that the risks to and arising from the Proposed Development will remain low. Control structures on the watercourses draining around the site will continue to limit downstream flows. Flood water throttled by these structures will back-up and accumulate within the compensatory storage area. Given the lowest level of the flood storage bund (38.9m aOD), the proposed development will always be afforded a freeboard above the maximum flood level of the compensatory storage area.

The assessment has also demonstrated that whilst the Proposed Development will remove volume from the compensatory storage area as will the SuDS pond, 148,825m³ of flood storage will remain to accommodate the 45,000m³ of storage assessed as necessary to compensate for the extension. It is therefore considered that despite a 42% increase in river flows the compensatory storage area will remain sufficient to attenuate the 0.1% AEP event.

Despite confidence that the compensatory storage area would continue to provide a 0.1% AEP standard of protection when accounting for current climate change allowances an exercise has been completed to investigate if volume lost due to the Proposed Development could be replaced through ground reprofiling.

This assessment has concluded that with a reduction in ground level to 36.6m aOD in areas of the compensatory storage area that are not subject to flooding during the 0.1% AEP event a volume of 14,547m³ could be created. Figure 6 - 1 identifies the locations for potential ground re-profiling.

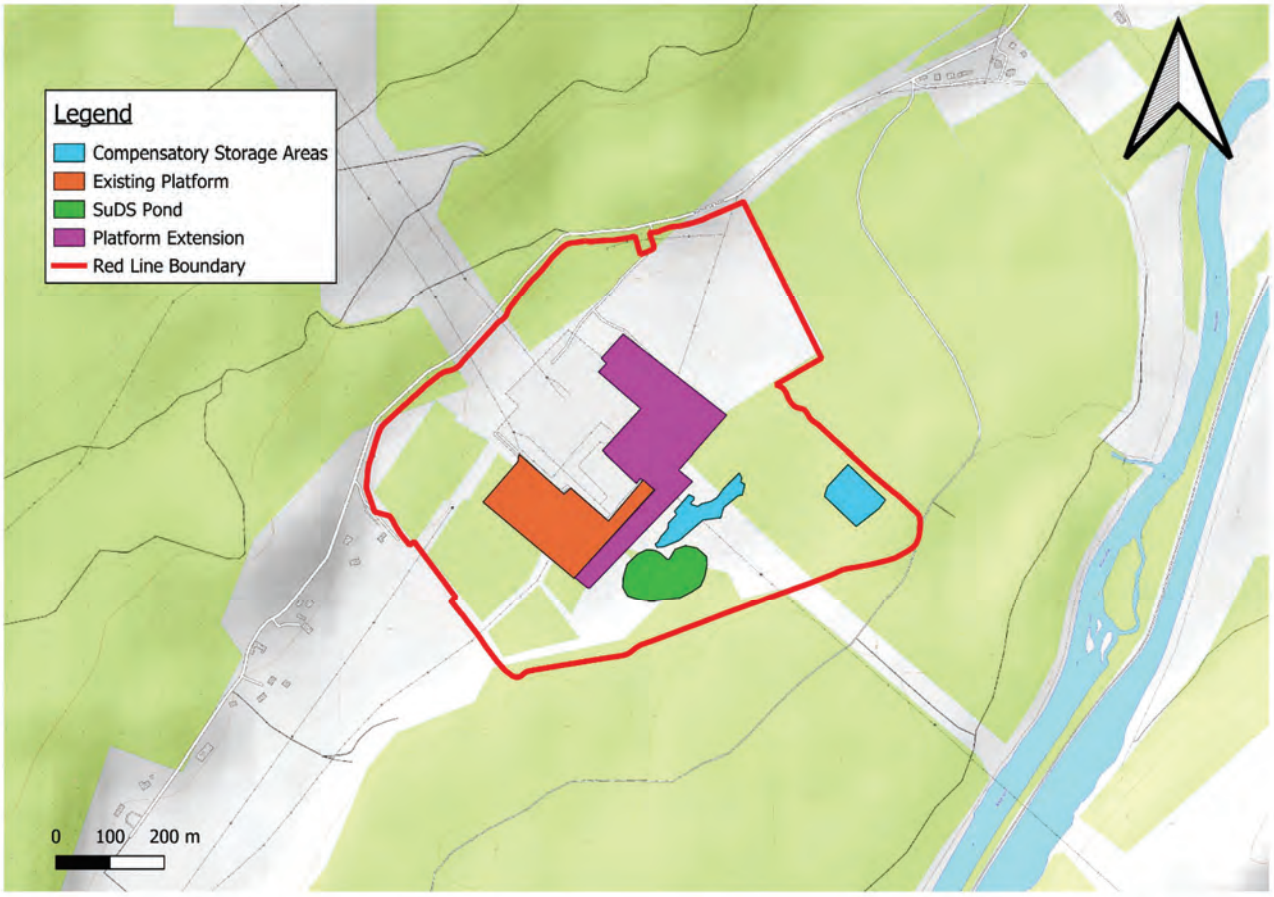


Figure 6 - 1. Possible areas for relocation of lost flood compensation area due to the Proposed Development.

7. Conclusions

This FRA has been prepared by Jacobs in support of a Proposed Development for extending an existing substation at Fort Augustus in the Scottish Highlands.

An assessment of all flood sources has concluded that there is a low or very low risk to and arising from the Proposed Development.

Fluvial and surface water are the principal flood sources presenting a risk to the Proposed Development, however these are mitigated by virtue of a flood alleviation scheme already in-situ, a 900mm freeboard from the maximum flood water level to the proposed platform level and the design of a surface water drainage system designed to a 0.1% AEP standard including allowance for climate change.

Since the flood alleviation scheme was designed by SLR in November 2017, climate change allowances have changed. Considering the effects of climate change and the scale of the flood alleviation measures it is considered that new climate change allowances are unlikely to erode the design standard of the measures meaning the Proposed Development will remain safe from the effects of flooding without impacting flood risk elsewhere.