

10 Ground Conditions

10.1 Introduction

- 10.1.1 This chapter of the EIAR identifies and assesses the potential impacts and likely significant effects on underlying ground conditions during construction of the Proposed Development (as described in Chapter 2). This includes consideration of impacts and effects resulting from existing sources of land contamination including those associated with historic mining or quarrying activity. Potential reconductoring of the XL route and operational effects have not been considered within this chapter as no significant ground works are proposed for the reconducting or during operation.
- 10.1.2 This chapter is supported by the following figures:
- Figure 10.1 Superficial Geology
 - Figure 10.2 Bedrock Geology
 - Figure 10.3 Historic Mining Activity
 - Figure 10.4 Designated Sites Relating to Geology
- 10.1.3 This chapter is also supported by the following additional reports which accompany the applications:
- Mining Stability Report Including Past Mining Risk Assessment (JWHROSS) (October 2025)
 - Phase 2 Geo-environmental and Geotechnical Site Investigation – Interpretive Report (RSK GeoSciences) (December 2025)
 - Mine Gas Assessment (JWHROSS) (December 2025)
- 10.1.4 Impacts on geology and ground conditions have the potential to result in effects on surface and ground water. This chapter should be read with reference to Chapter 9 Water Environment which considers the impacts and likely significant effects of the Proposed Development on the water environment including surface and groundwater.

10.2 Legislation, Policy and Guidance

Legislation

- 10.2.1 The following national legislation (and European Directives incorporated into UK law by the European Union (Withdrawal) Act 2018 and the UK withdrawal from the European Union (Continuity) (Scotland) Act 2021) (Ref **10-1**) is relevant to the assessment of ground conditions:
- The Environmental Liability (Scotland) Regulations 2009 (Ref **10-2**),
 - Contaminated Land (Scotland) Regulations 2005 (Ref **10-3**),
 - The Environmental Protection (Duty of Care) (Scotland) Regulations 2014 (Ref **10-4**),
 - The Construction (Design and Management) Regulations 2015 (Ref **10-5**),
 - Nature Conservation (Scotland) Act 2004 (Ref **10-6**),
 - Town and Country Planning (Scotland) Act 1997 (Ref **10-7**)

- Environmental Protection Act 1990 (Ref **10-8**),
- Water Environment and Water Services (Scotland) Act 2003 (Ref **10-9**),
- Environmental Authorisations (Scotland) Amendment Regulations 2025 (Ref **10-10**),
- Water Framework Directive 2000/60/EC (European Community)¹ (“WFD”) (Ref **10-11**),
- Groundwater Directive 2006/118/EC1 (“GWD”) (Ref **10-12**),
- The Climate Change (Scotland) Act 2009 (Ref **10-13**), and
- Environmental Authorisations (Scotland) Regulations 2018(EA(S)R) (Ref **10-14**).

National Policy

National Planning Framework 4 (NPF4)

- 10.2.2 NPF4 (Scottish Government, 2023) (Ref **10-15**) sets out the Scottish Government spatial development principles, regional priorities, national developments and national planning policy, covering six spatial principles which aim to deliver sustainable, liveable and productive places.
- 10.2.3 Policy 5 (Soils) within NPF4 intends to “protect carbon-rich soils, restore peatlands and minimise disturbance to soils from development.” It states that where development on peatland, carbon-rich soils, or priority peatland habitat is proposed, a detailed site specific assessment will be required to identify a number of factors (including peat depth, condition, stability and an assessment of the likely effects of the development on peatland) , which should inform careful project design and ensure, in accordance with relevant guidance and the mitigation hierarchy, that adverse impacts are first avoided, then minimised through best practice. It notes that a peat management plan will be required to demonstrate this approach.
- 10.2.4 Policy 9 (Brownfield, vacant and derelict land and empty buildings) within NPF4 intends to “encourage, promote and facilitate the reuse of brownfield, vacant and derelict land and empty buildings, and to help reduce the need for greenfield development.” It states that “where land is known or suspected to be unstable or contaminated, development proposals will demonstrate that the land is, or can be made, safe and suitable for the proposed new use.”
- 10.2.5 Policy 11 (Energy) within NPF4 states that project design and mitigation should address any effects on hydrology and the water environment (see also Chapter 9: Water Environment).

Scotland’s Zero Waste Plan

- 10.2.6 Scotland’s Zero Waste Plan (Scottish Government, 2010) (Ref **10-16**) sets the strategic direction for waste policy for Scotland. It aims to maximise the reuse, recycling and recovery of resources and minimise demand on primary resources. Decision-making for all new developments must take account of the waste management hierarchy (prevention, reduction, reuse, recycling and energy recovery over waste disposal).

Scottish Soil Framework

- 10.2.7 The Scottish Soil Framework (Scottish Government, 2009) (Ref **10-17**) aims to raise awareness of the services soils provide to society, the pressures soils face, and to instigate a process by which key stakeholders work together to achieve better soil protection. It promotes the

¹ Post Brexit, the Directive itself no longer applies directly to the UK. However, the domestic legislation that was based on the Directive continues to apply.

sustainable management and protection of soils consistent with the economic social and environmental needs of Scotland. The Framework identifies activities that will contribute to thirteen soils ‘outcomes.’ The activities particularly relevant to geology and soils on the Proposed Development include reducing soil contamination and reducing pressure on soils by using brownfield sites in preference to greenfield land.

Planning Advice Notes (“PANs”) and Specific Advice Sheets

- 10.2.8 PANs (Ref **10-18**) and Specific Advice Sheets set out detailed advice from the Scottish Government in relation to a number of planning issues. PANs and Specific Advice Sheets relevant to the Proposed Development are detailed in Table 10-1.

Table 10-1 Planning Advice Notes and Specific Advice Sheets

Planning Advice Notes and Specific Advice Sheets	Key Requirements relating to Geology, Soils and Mining	The Proposed Development
PAN 33: Development of Contaminated Land (2017)	Provides advice on the following: - the implications of the new contaminated land regime for the planning system - the development of contaminated land - the approach to contaminated land in development plans - the determination of planning applications when the site is or may be contaminated	Mitigation measures are outlined within Section 10.5 of this chapter and will be within the CEMP prepared prior to construction.
Planning and Waste Management Advice (2015)	States that there should be environmental protection considerations to mitigate any potential effects on the water environment.	Mitigation measures are outlined within Section 10.5 of this chapter and will be within the CEMP prepared prior to construction

Local Policy

- 10.2.9 The majority of the elements of the Proposed Development which are considered in this chapter are located entirely within Fife, however, two new towers on the ZCN/ZCS route west of the Canal Burn are located within Clackmannanshire.

10.2.10 The Fife Local Development Plan (LDP) was formally adopted in September 2017 and sets out local planning policy for Fife. The relevant Policies to the Proposed Development are:

- Policy 1 Development Principles; this comprises three parts with Part B setting out criteria against which development proposals will be assessed. With regard to geology this includes safeguarding against the loss of natural resources
- Policy 13 Natural Environment and Access states that development proposals will only be supported where they protect or enhance natural heritage and access assets including sites designated for geological conservation
- Policy 15 Minerals is largely related to development proposals for mineral extraction which is not relevant to the Proposed Development but the policy also provides protection to mineral resources that are, or may be, of economic or conservation value.

10.2.11 The Clackmannanshire LDP was adopted in August 2015. The relevant Policies to the Proposed Development are:

- Policy EP3 Business and Industrial Uses Outwith Existing or Allocated Business Sites: This policy sets out criteria in relation to business and industrial proposals outside of allocated sites identified within the LDP.
- Policy EP9 Protection of Mineral Resources: This policy aims to protect mineral resource with development that would result in the sterilisation of proven mineral resources would not normally be supported.
- Policy EA11 Environmental Quality: This policy seeks to protect the quality of the environment and where development has the potential to affect the development, for example through noise, light, soil, water or air impacts requires all reasonable measures to mitigate such impacts to be taken.
- Policy EA12 Water Environment: This policy aims to protect and enhance the water environment.

River Basin Management Plan for Scotland 2021 - 2027 (“RBMP”)

10.2.12 The RBMP (Scottish Environment Protection Agency (“SEPA”), 2021) (Ref **10-19**) sets out a range of actions to address impacts to the water environment. The RBMP outline actions for public bodies and land managers. The Proposed Development is within the RBMP. In summary, the RBMP provides the following:

- The conditions of the water environment,
- Pressures which could or are impacting the water environment, and
- Actions to address any impacts.

Guidance

10.2.13 Relevant guidance documents for geology, soils and mining are:

- Environment Agency’s online guidance for the management of land contamination ‘Land Contamination: Risk Management’ (updated 2025) (“LCRM”), UK Specification for Ground Investigation (Ref **10-20**),
- Eurocode 7 Geotechnical design. Part 2: Ground investigation and testing (British Standard (BS) EN 1997-2:2007) (Ref **10-21**),

- BS 5930:2015+A1:2020, Code of Practice for Ground Investigations (Ref **10-22**),
 - BS EN 1997-1:2004 + A1:2013, Eurocode 7 – Geotechnical Design – General Rules (Ref **10-23**),
 - BS 10175:2026, Investigation of Potentially Contaminated Sites - Code of Practice (Ref **10-24**),
 - Construction Industry Research and Information Association (“CIRIA”) C552, guidance, Contaminated Land Risk Assessment, A Guide to Good Practice (2001) (Ref **10-25**),
 - Construction Industry Research and Information Association (“CIRIA”) C532, Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors (2001) (Ref **10-26**),
 - Construction Industry Research and Information Association (“CIRIA”) C578D, Abandoned Mine Workings Manual (2019) (Ref **10-27**)
 - Construction Industry Research and Information Association (“CIRIA”) C811, Environmental Good Practice on Site Guide (fifth edition) (2023) (Ref **10-27**),
 - Design Manual for Roads and Bridges (“DMRB”), LA109 Geology and Soils (2019) (Ref **10-29**),
 - DMRB, LA 104 Environmental Assessment and Monitoring (2020) (Ref **10-30**),
- DMRB, LA 110 Material Assets and Waste (2019)** (Ref 10-29 Bridges, D. M. (2019) LA109 Geology and Soils
-),
 - DMRB, LA 113 Road Drainage and the Water Environment (2020) (Ref **10-32**),
 - CL:AIRE, Control of Asbestos Regulations 2012: Interpretation for Managing and Working with Asbestos in Soil and Construction & Demolition materials: Industry Guidance (2016) (shortened name CAR-SOILTM) (Ref **10-33**),
 - SEPA, Guidance on the classification and assessment of waste (1st Edition v1.1), Technical Guidance WM3 (2018) (Ref **10-34**),
 - SEPA, Land Remediation and Waste Management Guidelines (Ref **10-35**),
 - Guidance of Pollution Prevention (“GPP”), available on the NetRegs website and Pollution Prevention notes where GPPs are not yet available (these are gradually being withdrawn and replaced by the GPPs),
 - DEFRA’s 2009 ‘Construction Code of Practice for the Sustainable Use of Soils on Construction Sites’ (Ref **10-36**),
 - Scottish Government (2024), CO₂ Mine Gas - Site Investigation and Risk Assessment: Best Practice (Ref **10-37**),
 - SNIFFER, Review of the application of 'Best Practicable Means' within a regulatory framework for the management of radioactive wastes (2005) (Ref **10-38**).
 - CL:AIRE, Good Practice for Risk Assessment for Coal Mine Gas Emissions (2021) (Ref **10-39**)
 - CO₂ Mine Gas – Site Investigation and Risk Assessment: Best Practice (2024) (Ref **10-40**)

10.3 Consultation

10.3.1 Scoping Opinions were requested from Fife and Clackmannanshire Councils and the Scottish Government Energy Consents Unit regarding the proposed approach to and scope of the EIA. Table 10-2 Summary of Scoping Opinion (Geology) below summarises the Scottish Ministers scoping opinion in relation the assessment of ground conditions and how it has been addressed in the EIAR.

Table 10-2 Summary of Scoping Opinion (Geology)

Consultee	Summary of Response	Action Taken
Fife Council	Land and Air Quality Services noting that ground investigations are to be undertaken and requesting that contaminated land risk assessment be provided.	This is included within this chapter and the Coal Mining Risk Assessment and Ground Investigation Reports which accompanies the applications.
Scottish Ministers	Scottish Ministers consider that where there is a demonstrable requirement for peat landslide hazard and risk assessment (PLHRA), the assessment should be undertaken as part of the EIA process to provide Ministers with a clear understanding of whether the risks are acceptable and capable of being controlled by mitigation measures. The Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments (Second Edition), published at http://www.gov.scot/Publications/2017/04/8868, should be followed in the preparation of the EIA report, which should contain such an assessment and details of mitigation measures.	Based on a desktop review of (i) The British Geological Survey Geology Viewer and (ii) the Carbon and Peatland 2016 Map small areas of peat are present in the vicinity of the existing overhead line routes being uprated however there is no peat present where new overhead line infrastructure (i.e. terminal towers) is proposed to connect XL, ZCN and ZCS routes to the proposed Kincardine North Substation. , There is therefore not considered to be a risk of peat landslide due to the avoidance of areas of peat and the limited intrusive nature of the upgrade works: - On ZCN and ZCS routes no physical works will be undertaken to increase the operating voltage and physical works relating to the turn-in towers will not interact with areas of peat. Therefore there will be no impact on underlying ground conditions including peat. - On XL route there is no peat present on the section that may be reductored between XL12 and XL20. Class 1 Peat on the banks of the Black Devon east of Forest Mill. The existing towers are outside of the area of peat (i.e. it is spanned by the existing overhead line) and therefore would not be impacted by the upgrade works nor give rise to risk of peat slide. Potential reductoring works between XL12 and XL20 lie to the south of this area. Class 5 Peat to the east of the A977 and north of the A907. The existing towers are outside of the area of peat (i.e. it is spanned by the existing overhead line) and therefore would not be

Consultee	Summary of Response	Action Taken
		impacted by the upgrade works nor give rise to increased risk of peat slide. Potential reconductoring works between XL12 and XL20 lie to the west of this area.
Kincardine Community Council	Hawkhill Colliery was the largest historic colliery around Kincardine, there are numerous smaller coal mines in the area. The EIA needs to very careful and scrutinise all available documents concerning mining activity locally. This is a speciality of the local heritage group and they would be the obvious group to assist with this, they have maps available that show the pylon and substation site is completely undermined by substantial mine workings	Ground investigations have been undertaken to inform the design of the Proposed Development as well as the proposed Kincardine North Substation.

10.4 Methods

Study Area

- 10.4.1 This section sets out the study areas adopted for the ground conditions topic, these are considered to be appropriate for the assessment of ground conditions in accordance with methodology as set out in the DMRB LA109 (2019), LA104 (2020), LA110 (2019) and LA113 (2020).
- 10.4.2 The study areas are presented on Figures 10.1 -10-4. For ease of reporting, the features of interest are referenced to the proposed tower/substation locations. As such, the distances discussed may be greater than 250m from the tower/substation.

Geology, Soils and Mining

- 10.4.3 Impacts from the Proposed Development on geology, soils, geological sites and mining will typically occur directly within the vicinity of the Proposed Development where construction activities would take place or interface directly with these receptors. For the purposes of determining the wider geological context, geodiversity and to support the conceptual understanding of the ground model, the geology baseline will consider an extended 250m study area from the Proposed Development.

Land Contamination

- 10.4.4 For the purposes of determining the local baseline conditions with respect to land contamination, potential sources of contamination have been identified within 250m of the Proposed Development.
- 10.4.5 Potential human health, surface water and ecological receptors have been identified up to 250m from the Proposed Development. This is appropriate to assess any impact that potential land contamination might have on these receptors.

- 10.4.6 For hydrogeological receptors, the study area will be extended to 1km from the Proposed Development. This is appropriate to assess the hydrogeological setting, and any impact that potential land contamination might have on the Proposed Development or local receptors (taking into consideration the pathways for contaminant migration). Refer to Chapter 9 Water Environment for impacts on the water environment.

Assessment Scope

- 10.4.7 The assessment of potential effects on geology and ground conditions includes consideration of impacts on the underlying superficial and bedrock geology, impacts on the environment and human health as result of contamination or the disturbance of existing contaminated soils (if present), impacts resulting from interactions with historic mining and quarrying activity as well as impacts on sites designated for geological conservation purposes.
- 10.4.8 The potential impacts from the Proposed Development on Ground Conditions have been assessed by completing an initial desk study, followed by an impact assessment. Table 10-3 summarises the scope of the assessment. Refer to Chapter 9 Water Environment for impacts on the surface and groundwater environment.

Table 10-3 Scope of Assessment

Impact	Receptors	Development Phase
During construction: Potential adverse impact and / or damage to sensitive receptors (i.e. bedrock geology)	Bedrock Geology	Construction
Release of substances to the ground causing pollution	- Underlying soils and geology - Human health (construction workers)	Construction
Reduction of soil quality during handling and storage	Underlying soils	Construction
Reduction of soil quality due to heavy trafficking	Underlying soils	
Disturbance of potentially contaminated soils or ground water	- Underlying soils and geology - Human health (construction workers)	Construction
Import of potentially contaminated materials	- Underlying soils and geology - Human health (construction workers)	Construction
Export of potentially contaminated materials	Human health	Construction
Creation of new pathways for contamination to migrate	- Underlying soils and geology - Human health (construction workers)	Construction
Release of ground gas associated with made ground and historic mine workings	Human health (construction workers)	Construction
Ground stability/subsidence as a result of ground conditions	- Human health (construction workers) - The treatment of existing mine workings by infill grouting can have an effect on a number of other receptors (such as superficial deposits, hydrology,	Construction

	hydrogeology, and agricultural soils)	
Loss of coal and other mineral resources.	• Mineral resources	Construction

Assessment Methodology

Overview

- 10.4.9 The assessment of likely significant effects on geology and ground conditions has been carried out in general accordance with the most recent edition of the Highways England (National Highways) guidance document Design Manual for Roads and Bridges (DMRB) (Ref **10-29**). The potential impacts have been assessed based on guidance in the (DMRB) LA109, Geology and Soils. As there is no specific guidance in relation to electricity transmission infrastructure, DMRB is considered to be the most appropriate methodology for the Proposed Development because it is designed for assessing effects of linear schemes (albeit road schemes).

Sensitivity

- 10.4.10 The sensitivity of the receptor reflects the quality of the receptor and its ability to absorb an effect without perceptible change. Descriptions and examples of sensitivity relevant to geology and ground conditions are presented in Table 10-4.

Table 10-4 Criteria to determine the sensitivity of receptors

Sensitivity	Description	Example(s)
High	Very rare and of international importance with no potential for replacement	Geology • UNESCO World Heritage Sites; • Sites of Special Scientific Interest (SSSIs) of international importance; or • Global Geoparks. Contamination • Very high sensitivity land use (e.g. residential).
Medium	Rare and of national importance with little potential for replacement.	Geology • SSSIs; or • National Nature Reserves. Contamination • High sensitivity land use (e.g. public open space).
Low	Of regional importance with limited potential for replacement	Geology • Regionally Important Geological Sites (RIGS) Contamination • Medium sensitivity land use (e.g. commercial).
Negligible	Of local importance / interest with potential for replacement or little/ no local interest.	Geology • Non-designated geological exposures; • No geological exposures; or

Sensitivity	Description	Example(s)
		Former quarries / mining sites.
		Contamination
		- Low sensitivity land use (e.g. highways and rail); or - No sensitive land use existing or proposed.

Magnitude

- 10.4.11 The magnitude of a potential effect considers the scale of the predicted change to the baseline condition taking into account its duration (i.e. the magnitude may be moderated by the effect being temporary, rather than permanent, short term rather than long term). Descriptions and examples of magnitude relevant to geology are presented in Table 10-5. It is unlikely that any effects on geology and ground conditions would be beneficial, so the examples of magnitude all relate to adverse effects.

Table 10-5 Criteria to determine the magnitude of impacts

Magnitude	Description	Example(s)
High	Loss of feature/ designation and/ or quality and integrity, severe damage to key characteristics.	Geology - Destruction of features at a protected site; i.e. Sites of Special Scientific Interest (SSSI) of international importance; or Global Geoparks. Contamination - Significant contamination identified; - Contaminant concentrations significantly exceed background levels and relevant screening criteria; - Potential for significant harm to human health; or - Contamination heavily restricts future use of land.
Medium	Partial loss of feature / designation, potentially adversely affecting integrity; partial loss of/damage to key characteristics, features or elements.	Geology - Partial loss of features at a protected site; i.e. SSSIs,, Mineral Safeguarding areas. Contamination - Contaminant concentrations exceed background levels and are in line with limits of relevant screening criteria; - Significant contamination can be present; or - Control/remediation measures are required to reduce risks to human health / make land suitable for intended use.
Low	Minor measurable change in geological feature / designation attributes, quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements.	Geology - Minor change of features at Geological sites; i.e. Regionally Important Geological Sites or Contamination - Contaminant concentrations are below relevant screening criteria; - Significant contamination is unlikely with a low risk to human health; or - Control measures can be required to minimise risks to human health.

Magnitude	Description	Example(s)
Negligible	Very minor loss or detrimental alteration to one or more characteristics, features or elements of geological feature / designation. Overall integrity of resource not affected.	Geology - Very minor change of features at sites of local importance, i.e. former mining sites or non-designated geological sites. Contamination - Contaminant concentrations substantially below relevant screening criteria; or - No requirements for control measures to reduce risks to human health/make land suitable for intended use.

Significance of Effect

- 10.4.12 The significance of a specific potential effect is derived from both the sensitivity of the feature and the magnitude of the impact and can be determined using the matrix presented in Table 10-6. Effects can be beneficial, adverse or negligible and their significance Major, Moderate, Minor or Negligible.

Table 10-6 Approach to Assessment of Significance

		Magnitude			
		High	Medium	Low	Negligible
Sensitivity	High	Major	Major	Moderate	Negligible / Minor
	Medium	Major	Moderate	Minor	Negligible
	Low	Moderate	Minor	Negligible	Negligible
	Negligible	Negligible / Minor	Negligible	Negligible	Negligible

- 10.4.13 Any effect predicted to be Negligible or Minor is considered to be 'Not Significant'. Effects assessed as Moderate or Major are considered to be 'Significant'.

Limitations and Assumption

- 10.4.14 This chapter should be read in conjunction with the Ecology and Water Environment (Chapters 6 and 9 respectively).
- 10.4.15 This chapter should be read in light of the legislation, statutory requirements and / or industry good practice applicable at the time of the assessment being undertaken. Any subsequent changes in this legislation, guidance or design may necessitate the findings to be reassessed in consideration of these circumstances.
- 10.4.16 It is assumed that the design, construction, and completed stages of the Proposed Development will satisfy minimum environmental standards, consistent with the contemporary legislation, practice, and knowledge applicable at the time of the assessment. Any subsequent changes in this legislation, guidance or design may necessitate the findings to be reassessed in the light of these circumstances.
- 10.4.17 The assessment assumes that during the construction phases, excavation / earthworks / cutting may be required anywhere within the Proposed Development boundary (worst-case situation).

- 10.4.18 The assessment is based on the evaluation of readily available documentation from the standalone reports submitted with the Applications (see Section 10.1), SEPA, the BGS, and other data sources made available.
- 10.4.19 The identified potential contamination sources depend on the accuracy of available historical mapping. The assessment of past quarrying activities is based on information from OS maps. It is possible that quarrying could have occurred, and the voids backfilled between the recorded years of available mapping.
- 10.4.20 Unforeseen and unforeseeable ground conditions and potentially contaminated materials or groundwater may be encountered within localised areas across the Proposed Development.

10.5 Baseline

- 10.5.1 The following sections describe the baseline conditions in relation to geology in the vicinity of the proposed locations for the new substation, terminal towers along the XL, ZCN and ZCS routes and low voltage underground cables for the Scottish Power Distribution Works.

Superficial Geology

- 10.5.2 The British Geological Survey (BGS) Onshore GeoIndex mapping (Ref **10-41**) indicates that the superficial deposits underlying the Proposed Development (see Figure 10.1 Superficial Geology) are dominated by raised tidal flat deposits of Holocene age-silt and clay. This lithology typically comprises silt, clay and fine-grained sand with lenses of gravel.

Made Ground

- 10.5.3 No areas of made ground are present within the area of the Proposed Development, however, made ground is present in the wider area.

Faults

- 10.5.4 The BGS viewer (Ref **10-41**) and Mining Stability Report (Ref **10-42**) indicates a fault at rockhead dissects the site from west to east known as the Craigton Fault, with a second known as the Hawkhill Pit Fault to the south (see Figure 10.2 Bedrock Geology). Geological faults occur where a body of bedrock has been fractured and displaced by large scale processes affecting the Earth's crust (tectonic forces). Faults at rockhead are characterised by their location at the surface of bedrock, where the rock is fractured and displaced. A fault at rockhead represents the normal dip-slip and strike-slip faults. No historical earthquakes are recorded in the area. Further information on the faults can be found within the Mining Stability Report submitted with the Application.

Bedrock Geology

- 10.5.5 The BGS Onshore GeoIndex mapping indicates that the bedrock geology within the area of the proposed terminal towers is dominated by Sedimentary rock formations which belong to the Coal Measure type. The strata is predominantly sandstone, siltstone and mudstone. Coal seams are common and many exceed 0.3m in thickness. Please refer to Figure 10.2 Bedrock Geology.

Soils

- 10.5.6 The National Soil Map of Scotland on the Scotland's Soils map viewer (Ref **10-43**) was used to determine the soils present underlying and within the vicinity of the Proposed Development.

The underlying soils comprise mineral gleys. Gleys are soils that are periodically or permanently waterlogged.

- 10.5.7 NatureScot (formerly Scottish Natural Heritage) produced a Carbon and Peatland map in 2016 (Ref **10-44**) which identifies carbon rich soil, deep peat and priority peatland habitats. This map splits the Carbon and Peatland soils into different classes ranging from nationally important carbon-rich, deep peat and priority peatland habitat to mineral soils and non-soils. The top two classes, 1 and 2, taken together identify nationally-important peat resources. No areas of Class 1 or 2 soils are present within the vicinity of the Proposed Development.

Site History and Potential for Land Contamination

Historic Mining and Quarrying Activity

- 10.5.8 The Mining Remediation Authority map viewer (Ref **10-45**) was reviewed to identify historic mining activity in the vicinity of the Proposed Development (see Figure 10.3 Historic Mining Activity). This shows that the Proposed Development lies within a Development High risk Area.
- 10.5.9 The map viewer and the BGS Onshore Geoindex Viewer (Ref **10-41**) identifies a number of mine entries within the surrounding area. None are located where the substation or new terminal towers are proposed, but Kilbagie Shaft is located in close proximity south of where tower ZCS19 will be removed. The viewer does not identify any areas of surface mining activity are within the vicinity or wider area of the Proposed Development. The viewer also highlighted past shallow coal mine workings to the south east, under which the XL route is aligned, and to the north east under which the ZCS and ZCN routes are aligned.
- 10.5.10 A review of additional reports submitted with the Application (see Section 10.1), historic mapping held by the National Library of Scotland mapping (Ref **10-46**) and the BGS viewer (Ref **10-41**) was undertaken to identify historic mining and quarrying activity at and in the vicinity of the proposed new terminal towers. This confirmed the presence of several historic mines including:
- Hawkhill Colliery to the south east of the Proposed Development which went into production in 1905 and closed in 1907.
 - Kilbagie Coal Pit to the north east
 - Old Pleanmillon Pit to the north
 - New Pleanmillon Pit to the north east
- 10.5.11 Further historical collieries were noted within the wider area. The Mining Stability Report (Ref **10-42**) undertaken for the Proposed Development contains further details of historical mining within the area and has been submitted with the Applications.

Coal Mining Risk Assessment

- 10.5.12 A Mining Stability Report Including Past Mining Risk Assessment (Ref **10-42**) has been undertaken for the Proposed Development and has been submitted with the Application. It provides an overview of historic mining activity and identifies and assesses the risks to the Proposed Development from historic coal mining activities.
- 10.5.13 The mining risk assessment places the following new terminal towers to the north of the proposed substation in the risk category of Very Low: Temporary tower ZCN TT1, new tower

ZCS018A, XL005A and XL004A,). All other new terminal towers and the substation platform are outside of the risk areas identified within the Mining Stability Report.

Mineral Resources

- 10.5.14 A review of the various mineral resource data layers available in the BGS GeoIndex mapping (Ref **10-41**) was undertaken to understand the potential mineral resources within the vicinity of the Proposed Development. The mineral occurrences layer identifies brick clay, fireclay and shallow coal.

Fife Council Historical Land Use Information

- 10.5.15 Fife Council's Historical Land Use and District Landfill map viewer (Ref **10-47**) includes former land use and landfill records relevant to the Proposed Development. This mapping indicates the following areas are present at and in the vicinity of the Proposed Development and may present potential sources of contamination:

- Records identifying mining and quarrying at Hawkhill Colliery to the east of the site;
- Records identifying mining and quarrying along the ZCN/ZCS route;
- Records of unknown filled ground (Pit, quarry etc and pond, marsh, river, stream, dock etc) and mining & quarrying along the A977 to the east of the site;
- Records of unknown filled ground (pond, marsh, river, stream dock etc) to the south of access to Old Tulliallan Castle;
- Stirling-Alloa-Kincardine railway to the east of the site;
- Electricity production & distribution (inc. large transformers) to the south of Hawkhill Road – Kincardine Substation.

Potential Contaminants of Concern

- 10.5.16 Based on historic and current land use sources of contamination and potential contaminants of concern are present in the vicinity of the Proposed Development, and sources include:

- Railway line and sidings adjacent to the east;
- Mine shafts indicated to the east and north-west;
- Chemical manure works adjacent to the north;
- Paper mill adjacent to the north;
- Gasometer to the north (associated with the paper mill); and
- Several circular features to the north, assumed to be tanks (associated with former site wastewater treatment plant for the paper mill).

Radon

- 10.5.17 The UK Health Security Agency's UK Radon Map (Ref **10-48**) was reviewed to determine potential radon risks at and in the vicinity of the Proposed Development. This indicates that the Proposed Development is located within an area where less than 1% of homes are above the action level for radon gas. As a result, no radon protection measures are required.

Preliminary Ground Investigations

- 10.5.18 Ground investigations have been undertaken to inform the Proposed Development. Separate ground investigation reports accompany the Application (see Section 10.1). These reports confirm that the ground conditions are consistent with desk-based information with ground conditions comprising topsoil (with rare localised variable thickness of made ground) overlying Raised Ridal Flat Deposits and glacial Till, with bedrock comprising the Scottish Lower Coal Measures. Rare peat (or organic and plant matter) was recorded at depth within the raised tidal soil in a localised area in the north-east corner of the study area, in an area with no proposed development infrastructure.
- 10.5.19 No visual or olfactory evidence of contamination was noted during the ground investigation.

Ground Gas

- 10.5.20 A preliminary risk assessment (Ref **10-49**) was undertaken for ground gas which indicated that the site lies within a high risk zone with respect to mine gas. There is the potential for preferential pathways for migration of ground gas to the surface subject to the design of foundation works. This report made recommendations for further qualitative assessment on mine gas.
- 10.5.21 A copy of the Phase 2 Geo-environmental and Geotechnical Site Investigation (Ref **10-49**) has been submitted with the Applications.
- 10.5.22 As the above report identified a potential risk for mine gas, a detailed Mine Gas Assessment (Ref **10-50**) was further undertaken for the Proposed Development with the results indicating that the site is of low risk to mine gas. The results of the gas monitoring have shown that mine gas is not being generated due to the flooded nature of the mines. A copy of the report has been submitted with the Applications.

Geology Designations

- 10.5.23 At its nearest point the Firth of Forth Site of Special Scientific Interest (SSSI) is located approximately 580m south west of the closest new terminal tower, and 650m from the substation. This can be seen on Figure 10.4 Designated Sites Relating to Geology. The geological conservation purposes the SSSI is designated for include:
- Lower Carboniferous: The coastal margins demonstrate a variety of rocks and fossils important in understanding the palaeogeography and palaeoecology of Scotland during the Carboniferous geological period.
 - Upper Carboniferous: Westphalian rock layer sequences illustrate the palaeogeography and palaeoenvironment, when the great coal forests flourished around 308 million years ago, and document the start of desert conditions over the area as a prelude to the Permian period.
 - Igneous Petrology: Nationally significant volcanic rocks, features and structures.
 - Mineralogy: Occurrence of xenocrysts of pyrope garnet.
 - Palaeontology: The sedimentary rock sequence has world-wide significance for fossil remains.
 - Quaternary Geology & Geomorphology: Erosional character of shorelines demonstrated by coastal change during the late glacial and postglacial periods.

- Geomorphology: Rocky coastal landforms related to the variety of sedimentary and volcanic rock types.

10.5.24 The distance between the Firth of Forth SSSI and the Proposed Development means that the designation would not be impacted.

Future Baseline in the Absence of the Proposed Development

10.5.25 It is not expected that the future baseline, with respect to geology would change in the absence of the Proposed Development. The underlying superficial and drift geology would be expected to remain the same. Areas of historic mining activity and/or contamination would be expected to remain the same or be remediated by others, however, such changes would be highly localised and relate to other developments or activities. This assumes that any future development or activities undertaken within the study area would be permitted or controlled in accordance with current contaminated land legislation.

Issues Scoped Out of Further Assessment

10.5.26 Potential reconductoring of the XL route has not been considered within this chapter as no significant ground works are proposed.

10.6 Embedded Mitigation

Design Mitigation

10.6.1 Embedded design measures typically relate to seeking to avoid sensitive geological receptors through the design of the Proposed Development or the selection of the construction method. The Proposed Development has been designed to avoid areas of sensitive geology or ground-related risk as much as possible. Key design measures include:

- Ground investigations have been undertaken to evaluate ground risks and inform the design of the Proposed Development including any specific design requirements with regard to previous mining activity. A specialist piling contractor will be sought to the most suitable type of pile for the prevailing ground conditions and as to their lengths and diameters to support the required design loads.
- In line with the current assessment of mineral stability, in relation to new terminal towers in close proximity to known mine workings, the condition of the coal workings, and where applicable, the depth to and condition of the coal horizon, will be confirmed by means of targeted rotary boreholes.
- Further ground investigation work will be undertaken in the presumed areas of the old pit shafts to effectively delineate their locations. When physically located, a safety platform and a sink a rotary borehole, using water flush, will be used within the confines of the shaft, in order to establish the nature of the infill material (if any). The information from the investigation would then allow an assessment of the most suitable means of treatment, which could be capping at rockhead and/or, provided the shaft contains adequate fill material, full depth consolidation by drilling and pressure grouting.
- No works will occur in or within close proximity to the Firth of Forth SSSI.

Sustainable Development

10.6.2 The design of temporary construction components such as laydown areas, welfare facilities, temporary compounds and temporary access tracks have been aligned as far as possible for

each development component (KINN, Overhead Line Works and Scottish Power Distribution Works). This approach ensures that impacts on the environment are minimised and a reduction in use of construction materials.

Control and Management Measures

- 10.6.3 Construction works will be undertaken in accordance with a Construction Environmental Management Plan (CEMP) that will describe the management arrangements for Proposed Development and the principles of mitigation that will be adopted. Embedded control and management measures comprise the following.

General Environmental Management

- 10.6.4 Inductions and Training: All construction personnel to receive site-specific induction including environmental information. All personnel will be suitably trained on emergency procedures, including the use of spill kits.
- 10.6.5 Environmental Monitoring: Regular monitoring, auditing and reporting to ensure effective implementation of mitigation measures and environmental performance. A designated Site Environmental Manager will conduct regular checks of works areas, record environmental incidents and corrective measures, and monthly audits recording compliance with the CEMP and relevant environmental legislation.
- 10.6.6 Spill Response: Spill kits will be available, and personnel will be trained in their use. In the event of a spill/leak the flow of pollution will be stopped (if safe to do so) using spill kits or other means to prevent the spill reaching watercourses. Spill kit contents will be checked weekly, and their contents replaced if used. Contaminated materials from spill kits will be disposed of according to the Site Waste Management Plan (SWMP). The cause of any spill/ leak/ incident will be investigated and reported to prevent recurrence.
- 10.6.7 Fuel Storage and Refuelling: All fuel will be stored within double-skinned bowzers, kept in a secure building. Refuelling areas will be on hardstanding to prevent infiltration to ground. Spill kits will be located at storage and refuelling areas. Refuelling lines will be fitted with automatic shutoffs. Only vehicles which do not regularly use public roads will be refuelled on site. Refuelling will only be undertaken by suitably trained personnel within designated areas. Plant nappies will be kept beneath stationary mechanical plant. Regular inspections will be undertaken, and plant removed offsite where maintenance is required.
- 10.6.8 Non-fuel items, e.g., hydraulic oil, will be stored in appropriate labelled containers/bunded areas. Where possible, biodegradable oils will be used when working over watercourses.
- 10.6.9 Storage of fuel and chemicals will be in accordance with GPP 2: Above ground oil storage.
- 10.6.10 Any containers/tanks of contaminating substances (e.g. fuel) onsite will be leak-proof and kept in a safe and secure building or compound from which they cannot leak, spill or be open to vandalism. The containers will be protected by temporary impermeable bunds (or drip trays for small containers) with a capacity of 110% of the maximum stored volume. Areas for transfer of contaminating substances (including refuelling areas) will be similarly protected.
- 10.6.11 Any permanent oil storage tanks and temporary storage of 201 litres or more of oil in drums and mobile bowzers, and ancillary pipe work, valve, filters, sight gauges and equipment will have secondary containment (e.g. bunding or drip trays).

- 10.6.12 No oil/chemical tanks will be stored within 50 m of a water feature and potentially further if ground is angled towards a water feature except for fixed/large plant associated with works that must occur close to water features or hand tools that must be placed in that location. Such chemical storage will be on flat, impermeable hard standing, and with an isolated drainage system.
- 10.6.13 Potential impacts specific to construction workers during site preparation and construction works would be controlled and mitigated by the following measures and through working in accordance with CIRIA C811:
- measures to minimise dust generation,
 - provision of Personal Protective Equipment (“PPE”), such as gloves, barrier cream, overalls etc. to minimise direct contact with soils,
 - provision of adequate hygiene facilities and clean welfare facilities for all construction site workers,
 - monitoring of confined spaces for potential ground gas accumulations, restricting access to confined spaces, i.e., to suitably trained personnel only, and use of specialist PPE, where necessary, and
 - preparation and adoption of a site and task specific health and safety plan as is required under Health and Safety legislation.

Soil Management and Waste Management

- 10.6.14 Prior to construction, a strategy will be prepared as part of the design development, which will set out how the earthworks stage of the construction phase will be undertaken. Where necessary the strategy will consider what excavated materials can be reused or are required for the various components of the Proposed Development, and what materials are surplus and require either off site disposal to a suitably licensed facility or onward management to ensure appropriate re-use (with reference to SEPA’s (2024) Land Remediation and Waste Management Guidelines).
- 10.6.15 In order to avoid or reduce adverse effects on soil a range of good site practice and management measures will be followed:
- Soil resources would be protected and conserved where possible through adherence to best practice guidance such as DEFRA’s 2009 ‘Construction Code of Practice for the Sustainable Use of Soils on Construction Sites’, (Ref 10-36).
 - To minimise the effects on soil resources during any earthworks, including materials management following foundation construction in relation to the Proposed Development, high standards of soil handling and management will be employed with a view to minimise, where possible, the double handling of soils and the extent to which exposed soils will be left vulnerable to erosional processes. For example, topsoil and subsoil movements will only be undertaken in suitable conditions, avoiding extreme wet weather.
 - Soils will not be placed beneath the water table or new contaminants introduced as this may represent a direct discharge of substances to groundwater.
 - Soil stripping will be undertaken with care and will be restricted to as small a working area as practicable.

- Soil will be stripped using appropriate machinery (to prevent compaction) and stored in bunds adjacent to the area stripped/excavated to ensure the soil is returned to approximately the same area during reinstatement.
- Excavated material will be stored separately to prevent mixing of topsoil and subsoil during construction.
- During reinstatement subsoil ripping will be undertaken to reduce potential compaction prior to topsoil replacement.
- Stockpiling of contaminated soil materials should be avoided where practicable. Soils are to be placed within suitable constructed bunded areas and covered to prevent migration of contaminants via rainwater run-off and leaching.
- The disposal of soil waste, contaminated or otherwise, to landfill sites would be mitigated by minimisation of the overall quantities of waste generated during construction, and by considering whether that excavated material consigned to landfill, as an alternative, could be re-used either on the Proposed Development or on other development sites.
- Where there is a requirement to dispose of surplus excavated materials off site as waste, the material will be characterised to determine firstly whether it is Hazardous or Non-Hazardous waste in accordance with the SEPA's (2018) Technical Guidance WM3 (Ref **10-51**) and then once this is established, the appropriate disposal facility will be determined through Waste Acceptance Criteria analysis, as required.

Contaminated land

- 10.6.16 Further ground investigation will be undertaken prior to construction to inform detailed design of the Proposed Development. This will also inform an assessment of the nature and extent of contaminated land present, the risks it poses to the environment and human health and design of appropriate mitigation and/or remediation. A mitigation/remediation strategy will be agreed with Fife Council and SEPA prior to the commencement of construction.
- 10.6.17 A protocol will be developed setting out the steps for managing contamination encountered during the course of construction. A watching brief will be maintained in the absence of potential sources of contamination such as Made Ground, visual or olfactory evidence of hydrocarbons or other potential contaminants. Where areas of potentially contaminated ground and/ or water are encountered these will be sampled and undergo appropriate sampling and laboratory analysis.
- 10.6.18 Subsequently a risk assessment will be undertaken to identify if these areas of potential contaminants pose a risk to construction workers and/or groundwater. Where appropriate a remediation strategy will be devised and agreed with Fife and/or Clackmannanshire Council prior to any remedial works.
- 10.6.19 Measures to prevent the creation of contaminant linkages include:
- Risk assessments in accordance with the Health and Safety at Work Act to restrict exposure to potentially harmful substances to a safe level for construction workers. Personal Protective Equipment will be used as appropriate. Construction Design and Management (CDM) practices will be applied;

- Preparation and adoption of a site and task specific health and safety plan as is required under Health and Safety legislation;
- Dust suppression measures to reduce the generation of dust from excavated contaminated soils, for example impermeable covers spread over mounds of bare contaminated soil. Implementation of these measures can reduce the risk of effects to construction workers and adjacent site users from potentially contaminated dusts;
- Should contaminated material be identified that requires removal it will be disposed of appropriately. Material to be disposed offsite will be analysed to determine the appropriate waste classification and disposal location;
- In the event contaminated water (for example from dewatering) is encountered it may not be suitable for direct discharge to the water environment. Water may need to be treated prior to discharge or taken off-site for disposal;
- In the event contaminated soils are identified and material requires to be exported from site, vehicles carrying contaminated soils off-site will only be loaded to appropriate levels and be covered to prevent contaminated materials dropping onto roads; and
- Any material imported to site, such as stone for access roads will be natural quarried stone or, if recycled, the material will undergo chemical testing. The suite of contaminants and site use criteria will be agreed with Fife and/or Clackmannanshire Council, in order to demonstrate that the material is suitable for use on site and does not pose a risk to construction workers or the environment.

Mining

10.6.20 In locations where micro-siting of towers is not sufficient to mitigate mining risk, localised treatment of mine entries or mine workings may be required. The treatment of the mine entries or workings by infill grouting can have an effect on a number of other receptors such as superficial deposits, hydrology, hydrogeology, and soils. Should the treatment of mine entries or workings be required to facilitate the construction of the Proposed Development, additional mitigation measures will be required to ensure the control of grout. Mitigation measures as below should be implemented if required:

- Control grout run-off on the ground surface and prevent grout reaching agricultural soils, watercourses or causing contamination of groundwater
- Minimise disturbance to superficial deposits and agricultural soils during grouting by use of appropriate construction controls such as perimeter bunds, soil protection matting, silt traps and the like and best practice during drilling
- Prevent grout leaks into the surrounding environment below ground from mine workings or mine entries that are being infilled with grout
- Implement monitoring to detect displacement of mine gases and potentially contaminated mine waters

10.6.21 Where mine entry and / or mine workings treatment is required, SEPA shall be consulted to obtain their agreement with the proposals. The contractor shall comply with the guidance from SEPA including BRE (2009) (Ref **10-52**). Additionally, SEPA's local team will have to be notified when the grouting works start, what works are involved and what watercourse / ditches they may affect.

- 10.6.22 The Mining Remediation Authority shall be consulted to obtain their agreement and permission to proceed with proposed works relating to the stabilisation of coal mine workings and mine entries.

10.7 Assessment of Effects

- 10.7.1 The impacts on soil and ground conditions of the Overhead Line Works and Kincardine North Substation are considered to be similar. No impacts are considered likely from the Scottish Power Distribution Works given the limited nature of the works.

- 10.7.2 No or limited contact with or disturbance of soils will be required during the operational phase and therefore this element has been scoped out.

Construction

- 10.7.3 Potential impacts on geology and ground conditions will occur during the construction of the Proposed Development. Effects are considered to be similar for both construction of the substation and the overhead line works. Construction works will require ground disturbance including excavation of foundations for permanent development comprising tower foundations and the substation platform as well as disturbance associated with temporary works such as the compound or access tracks.

- 10.7.4 No effects on geology and ground condition receptors are anticipated as a result of the XL route uprating and potential reconductoring works, should it be required, as works are limited to temporary access tracks, working areas around each tower and two areas of hardstanding for the pulling positions at XL12 and XL20, with limited groundworks proposed. Potential impacts on ground conditions will be mitigated through industry good practice as set out within Section 10.5 Embedded Mitigation, above.

- 10.7.5 Pathways by which the identified geology and ground conditions receptors have the potential to be impacted by construction of the substation and overhead line tower works (construction of temporary and new towers and removal of existing towers along the XL, ZCN and ZCS Routes) during the construction phase include:

- Release of substances to ground (e.g. fuel spills) resulting in contamination of currently uncontaminated underlying receptors such as soils or affecting workers;
- Reduction in soil quality by heavy trafficking or handling/storage of excavated soils;
- Disturbance of potentially contaminated soils and perched groundwater (if present) and creation of new pathways allowing migration of such contaminants to reach sensitive receptors;
- Creation of new pathways to groundwater as a result of groundworks (e.g. foundations/piling required for installation of temporary and new towers);
- Release of ground gas associated with made ground or historic mine workings; and
- Ground stability issues associated with crossing areas of compressible ground or shallow workings associated with historic mining activity.

- 10.7.6 Table 10-7 presents a preliminary assessment of potential impacts and the likely significance of effects during construction taking account of embedded mitigation measures.

Table 10-7 Assessment of Construction Impacts

Potential Impact	Description	Receptor(s)	Receptor Sensitivity	Impact Magnitude	Significance
During construction: Potential adverse impact and / or damage to sensitive receptors (i.e. bedrock geology)	There are no geologically designated sites within immediate vicinity of the Proposed Development. Superficial deposits are present across the majority of the Proposed Development.	Bedrock Geology	Low	Negligible	Negligible (Not significant)
Release of substances to the ground causing pollution	Potential for plant to leak or spill oil and/ or fuel. Leaks and spillages could occur in any working area or compound at tower locations in which plant is operated or stored, including refuelling. Additionally, the potential exists for spills and drips to occur associated with stored fuels and chemicals brought onto the site to facilitate construction. There is potential that such spillages could enter the underlying uncontaminated strata and contaminate soils and shallow groundwater, as well as presenting a risk to human health. Mitigation measures are proposed including training, pollution prevention measures, responsible storage and handling and spill response measures which would reduce the risk or likelihood of such an impact, as well as likely reduce the magnitude of impact.	Underlying soils and geology	Low	Low	Negligible (Not significant)
		Human health (construction workers)	Medium	Low	Minor adverse (Not significant)
Reduction of soil quality during handling and storage	During the excavation and temporary storage of soils as part of creation of construction compounds, stone access track installation (if required), the substation platform and ground preparation for towers, minor changes to soil characteristics, could occur due to handling and storage of topsoil and subsoil in inappropriate conditions. Soils stored in bunds are also susceptible to erosion from runoff during heavy rainfall or wind erosion during prolonged dry periods. The reduction in the quality of the soils could lead to the loss or alteration to one or more key important features. Mitigation measures are included including only handling soil in suitable conditions, separate storage of top and subsoil, controls on	Underlying soils	Low	Low	Negligible (Not significant)

Potential Impact	Description	Receptor(s)	Receptor Sensitivity	Impact Magnitude	Significance
	temporary storage bunds as well as the use of appropriate machinery. These are measures which will reduce the magnitude of the impact.				
Reduction of soil quality due to heavy trafficking	The tracking of heavy plant during construction could compact the ground surface/soils causing degradation of soil quality. In addition, compaction could lead to a decrease in infiltration and, therefore, potential water logging and increase of surface water runoff, and a reduction of local groundwater levels. Mitigation measures are proposed including strict controls on the movement of plant and machinery along clearly demarcated temporary access tracks and primarily the use of trackways wherever possible and crushed stone for stone access tracks where necessary. Soils underlying temporary roads will be stripped and stored separately in accordance with soil handling and storage mitigation measures and then be used in reinstatement of temporary haul roads and other working areas.	Underlying soils	Low	Low	Negligible (Not significant)
Disturbance of potentially contaminated soils or ground water	Much of the land within the area of the Proposed Development has been subject to historic mining activity. There is the potential for contamination to be encountered in excavated materials e.g. soils or infill material/made ground or in dewatering. The potential presence of contaminated soils or water encountered during construction could lead to adverse impacts including:	Underlying soils and geology	Low	Low	Negligible (Not significant)

Potential Impact	Description	Receptor(s)	Receptor Sensitivity	Impact Magnitude	Significance
	- Exposure of construction workers to potentially harmful contaminants and ground gases through direct contact or inhalation of vapours. - Disturbance of soils may alter the chemical conditions within the site soils resulting in mobilisation of potential contaminants - Contaminated material may be exposed in excavations, which could cause dissolution and/ or mobilisation of contaminants - Arisings from excavations could potentially result in the stockpiling and/or re-use of contaminated soils on the site. The exposure of contaminated soils could lead to migration of potential contaminants both on-site and off the site through dust generation, to underlying soils and to the water environment through leaching or surface runoff. - Potential exposure of buried structures (building foundations and infrastructure) to aggressive ground conditions. Mitigation measures are proposed including further ground investigation, risk assessment, remediation (as appropriate) as well as working practices including the CEMP which will prevent or reduce impacts resulting from the disturbance of contaminated land.	Human health (construction workers)	Medium	Low	Minor adverse (Not significant)
Import of potentially contaminated materials	Without controls in place, imported construction materials, including natural or recycled stone to create temporary access tracks and other working areas could be contaminated and present a potential risk to construction workers, underlying uncontaminated strata and groundwater. Imported materials will be required during construction. Mitigation measures are proposed including suitable chemical testing of any imported material which will prevent contaminated material being brought to site.	Underlying soils and geology	Low	Negligible	Negligible (Not significant)
		Human health (construction workers)	Medium	Negligible	Negligible (Not significant)

Potential Impact	Description	Receptor(s)	Receptor Sensitivity	Impact Magnitude	Significance
Export of potentially contaminated materials	In the event of encountering contaminated soil or other materials that can neither be reused elsewhere for the Proposed Development or remediated onsite there may be a requirement to remove materials from site for disposal. Mitigation measures are proposed including testing of materials to be disposed of offsite to identify waste classification and disposal locations as well as measures to prevent overloading of vehicles removing waste.	Human health	Medium	Low	Minor adverse (Not significant)
Creation of new pathways for contamination to migrate	Subject to further ground investigation and final design of the Proposed Development there is the potential for intrusive construction activities (for example tower foundations) to create new migration pathways between made ground and deeper superficial strata and groundwater. As part of further ground investigation and design, risk assessment in accordance with Land Contamination Risk Management (LCRM) guidance (Ref 10-53 & Ref 10-54) should be undertaken to identify if these areas of potential contaminants pose a risk to construction workers and/or groundwater. Where appropriate a remediation strategy will be devised and agreed with Fife and/or Clackmannanshire Council and SEPA prior to any remedial works. If the requirement for remediation due to contamination (if any) is carried out on potentially contaminated sites identified within the Proposed Development boundary, there will, in most instances, be overall beneficial effects.	Underlying soils and geology	Low	Low	Negligible (Not significant)
		Human health (construction workers)	Medium	Low	Minor adverse (Not significant)
Release of ground gas associated with made ground and historic mine workings	There is the potential for excavation works to cause the release of ground gases which could be inhaled by construction workers. Investigation undertaken to date indicates that the risk of encountering gas is low, however additional mitigation, such as the use of personal gas alarms, will be used if required.	Human health (construction workers)	Medium	Low	Minor adverse (Not significant)

Potential Impact	Description	Receptor(s)	Receptor Sensitivity	Impact Magnitude	Significance
Ground stability/subsidence as a result of ground conditions	The Proposed Development is located in an area with historic mining activity. The substation platform and towers ZCN018B, ZCSTT1, ZCS019A and ZCS019B, are in close proximity to known historic mine entrances. Where the Proposed Development crosses shallow underground coal mine workings and treatment has not been determined to be required, i.e. for infrastructure with limited additional loading or which is not sensitive to settlement, recognition that these workings may collapse potentially causing surface subsidence and damage to the Proposed Development should be noted with the result of this being maintenance and remediation to repair any potential damage caused. There is the potential for subsidence to occur, leading to towers collapsing, where the load bearing capacity of infilled ground is insufficient. The detailed design of the Proposed Development will be informed by ground investigation and ground improvement measures will be applied as appropriate to reduce the risk of subsidence. Mitigation includes maintenance and remediation to repair any potential damage caused.	Human health (construction workers)	Medium	Low	Minor adverse (Not significant)
		The treatment of existing mine workings by infill grouting can have an effect on a number of other receptors (such as superficial deposits, hydrology, hydrogeology, and agricultural soils)	Low	Negligible	Minor adverse (Not significant)
Loss of coal and other mineral resources.	The extent of mineral resources which will be affected and potentially lost / sterilised by the Proposed Development is minimal in comparison to their overall extent.	Mineral resources	Low	Negligible	Negligible (Not Significant)

Operation

- 10.7.7 As noted above, no or limited contact with or disturbance of soils will be required during the operational phase and therefore this element has been scoped out. Once operational there will be regular inspection and maintenance of the Proposed Development, however, this will not result in likely significant effects on geology or ground conditions.

Decommissioning

- 10.7.8 During the operational lifetime of the Proposed Development, it is likely that refurbishment and plant replacement will extend its life rather than decommissioning. However, in the event that the Proposed Development ceases to be required then it could be decommissioned. A Decommissioning Plan will be prepared and planning permission obtained, if required, in accordance with the relevant legislation in place at the time.
- 10.7.9 Dependent on specific requirements the foundations / supports would be removed to a minimum depth of 1m below ground level and the ground reinstated to the satisfaction of the landowner. The substation and tower components would be removed for re-use where possible or taken for recycling. Where recycling is not possible removed components will be disposed of in accordance with the relevant waste disposal regulations at the time of decommissioning.
- 10.7.10 The scale and nature of activities undertaken during decommissioning will be similar to those described for construction, and will be temporary during the period of decommissioning activities. Following removal of the substation, towers and the reinstatement of the land there will be no further potential effects on geological and hydrogeological receptors. The potential effects from decommissioning should therefore be regarded as being the same as for construction.

10.8 Additional Mitigation

- 10.8.1 The preliminary assessment has not identified any likely significant effects because of the mitigation embedded in the design and construction of the Proposed Development, no additional mitigation, compensation and enhancement measures are anticipated to be required for geology, soils and mining (other than those specified in Section 10.5 Embedded Mitigation).

10.9 Residual Effects

- 10.9.1 The residual effects are those effects taking into account all mitigation i.e. embedded and additional mitigation. As noted above, no additional mitigation is deemed necessary with embedded mitigation as part of the design of the Proposed Development and application of standard construction measures during its construction, no likely significant effects are expected to occur. As such, effects are as per Section 10.6 Assessment of Effects.

10.10 Monitoring

- 10.10.1 As set out within paragraphs 10.6.5 and 10.6.18, Environmental monitoring will be carried out. Regular monitoring, auditing and reporting will be undertaken to ensure effective implementation of mitigation measures and environmental performance. A designated Site Environmental Manager will conduct regular checks of works areas, record environmental incidents and corrective measures, and monthly audits recording compliance with the CEMP

and relevant environmental legislation. Monitoring will also be implemented to detect displacement of mine gases and potentially contaminated mine waters

10.11 Cumulative Assessment

- 10.11.1 Effects from the Proposed Development on geology and ground conditions are limited to within the construction footprint (as defined within Chapter 2 Project Description) therefore with mitigation measures in place no cumulative effects are likely to occur.

10.12 Summary and Conclusions

- 10.12.1 This chapter assesses the potential impacts and likely significant effects of the Proposed Development on geology and ground conditions. This includes underlying soils, superficial and bedrock geology, existing sources of land contamination including those associated with historic mining or quarrying activity, and sites designated for geological conservation purposes.
- 10.12.2 Baseline conditions at, and in the vicinity of the Proposed Development have been established through a combination of desk study and preliminary ground investigation at targeted locations.
- 10.12.3 Underlying geology comprises raised tidal flat deposits with the strata predominantly sandstone, siltstone and mudstone. Coal seams are common. Historical mining activity is present with the Proposed Development within a Development High risk Area, with the potential to encounter contaminated soil.
- 10.12.4 An assessment of potential impacts and likely significant effects was undertaken. The majority of potential impacts are associated with the construction of the Proposed Development as this is when most impactful or disturbing works such as excavations and activities such as piling could occur. Potential impacts could affect underlying geology and soils, groundwater (addressed in Chapter 9 Water Environment) as well as human health.
- 10.12.5 The assessment does not identify any likely significant effects as a result of measures embedded in the design of the Proposed Development or standard mitigation applied during its construction
- 10.12.6 Overall, the likely effects of the Proposed Development are assessed as negligible to minor Adverse and therefore are not significant.

10.13 References

- Ref 10-1 Scottish Government (2021) European Union (Continuity) (Scotland) Act 2021
<https://www.legislation.gov.uk/asp/2021/4/contents>
- Ref 10-2 HM Government. (2009). The Environmental Liability (Scotland) Regulations
<https://www.legislation.gov.uk/ssi/2009/266/contents>
- Ref 10-3 HM Government. (2005). Contaminated Land (Scotland) Regulations
<https://www.legislation.gov.uk/ssi/2005/658/contents/made>
- Ref 10-4 HM Government. (2014). The Environmental Protection (Duty of Care) (Scotland) Regulations <https://www.legislation.gov.uk/ssi/2014/4/contents/made>
- Ref 10-5 HM Government. (2015). The Construction (Design and Management) Regulations
<https://www.legislation.gov.uk/uksi/2015/51/contents>
- Ref 10-6 HM Government. (2004). Nature Conservation (Scotland) Act
<https://www.legislation.gov.uk/asp/2004/6/contents>
- Ref 10-7 HM Government (1997) Town and Country Planning (Scotland) Act 1997
<https://www.legislation.gov.uk/ukpga/1997/8/contents>
- Ref 10-8 HM Government. (1990) Environmental Protection Act.
<https://www.legislation.gov.uk/ukpga/1990/43/contents>
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<https://www.legislation.gov.uk/asp/2003/3/contents>
- Ref 10-10 Scottish Environmental Protection Agency (2025. Environmental Authorisations (Scotland) Amendments Regulations
<https://www.legislation.gov.uk/ssi/2025/165/introduction>
- Ref 10-11 European Parliament. (2000). Water Framework Directive (WFD) 2000/60/EC.
<https://eur-lex.europa.eu/eli/dir/2000/60/oj/eng>
- Ref 10-12 European Parliament. (2006). Groundwater Directive (GWD) 2006/118/EC
<https://eur-lex.europa.eu/eli/dir/2006/118/oj/eng>
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