Offshore Wind Power Limited

West of Orkney Windfarm Onshore EIA Report

Volume 1, Chapter 15 - Noise and Vibration

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West of Orkney Windfarm

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15 NOISE AND VIBRATION

Chapter summary

This chapter of the Onshore Environmental Impact Assessment (EIA) Report assesses the potential effects from the onshore Project on noise and vibration receptors. This includes direct, indirect, whole project assessment, cumulative, inter-related effects, inter-relationships and transboundary effects.

Onshore receptors most sensitive to noise and vibration include residential receptors (as well as schools and healthcare users). As the onshore Project area is largely rural in nature, the noise environment is dominated by natural and at times agricultural activity sources with limited influence from other environmental noise sources such as heavily trafficked roads.

The following impacts were identified as requiring assessment:

- Construction:
  - Noise and vibration generated by construction activities (including potential Horizontal Directional Drilling (HDD) work at night); and
  - Noise from construction traffic.
- Operation and maintenance
  - Operational noise from the onshore substation.

Predictions of noise and vibration levels for the above activities at the closest sensitive receptor locations identified was undertaken on a worst case basis. The assessment has taken account of embedded mitigation measures for the assessment of potential effects, including the provision of an operational noise control strategy for electrical plant and equipment at the onshore substation and provision of earth bunding.

The main construction management measures include the restriction of most works to daytime working hours (including weekdays and Saturday mornings). These embedded mitigation measures are included within an outline Construction Environmental Management Plan (CEMP) which has been submitted alongside this Onshore EIA Report.

Potential significant impacts were identified for some cases where drilling works may require periods of evening and night activity. However, mitigation measures will be employed for the onshore Project including HDD locations chosen to maximise distances, use of quieter equipment, screening, communication with local residents, restricting noisiest works and temporary rehousing of affected residents. These measures will be finalised at a later stage once the final locations from which drilling works will be conducted and the necessary equipment has been determined and will be detailed within the Noise and Vibration Management Plan (NVMP) (developed post-consent). In addition, for some of the temporary construction compounds, or some rock breaking activities, consideration of their location and use of temporary screening is proposed to avoid potentially significant noise effects. Potential cumulative levels of construction traffic would also be controlled through scheduling of deliveries and traffic to site in liaison with other nearby developments.

Operational substation noise has been assessed based on preliminary plant selections and the results show that the implementation of the noise control strategy results in low noise levels achieved at neighbouring properties. The noise control strategy would be finalised based on final plant selections and layout.

Overall, no significant residual impacts to noise and vibration receptors are predicted, either for the onshore Project alone or cumulatively with other plans or developments.

15.1 Introduction

This chapter of the Onshore Environmental Impact Assessment (EIA) Report presents the noise and vibration receptors of relevance to the onshore Project and assesses the potential impacts from the construction, operation and maintenance as well as decommissioning of the onshore Project on these receptors. Where required, mitigation is proposed, and the residual impacts and their significance are assessed. Potential cumulative and transboundary impacts are also considered.

Table 15-1 below provides a list of all the supporting studies which relate to and should be read in conjunction with the noise and vibration impact assessment. All supporting studies are appended to this Onshore EIA Report and issued on the accompanying Universal Serial Bus (USB).

Table 15-1 Supporting studies

DETAILS OF STUDY	LOCATIONS OF SUPPORTING STUDY
West of Orkney Windfarm Noise Survey Report (REP-1014029-SG-20230330)	Onshore EIA Report, Supporting Study (SS) 12: Noise survey report.
West of Orkney Windfarm Noise Modelling Report (REP_1014029-SG-20230512_WOW)	Onshore EIA Report, SS13: Noise modelling report.

The impact assessment presented herein draws upon information presented within other impact assessments within this Onshore EIA Report. Equally, the noise and vibration impact assessment also informs other impact assessments. This interaction between the impacts assessed within different topic-specific chapters on a receptor is defined as an 'inter-relationship'. The chapters and impacts related to the assessment of potential effects on noise and vibration are provided in Table 15-2.

Where information is used to inform the impact assessment, reference to the relevant Onshore EIA Report chapter is given.

Table 15-2 Noise and vibration inter-relationships

CHAPTER	IMPACT	DESCRIPTION
Terrestrial non-avian ecology (chapter 10, Onshore EIA Report)	Impact of construction noise on sensitive species.	Noise from construction activities may generate temporary disturbance to some species.

CHAPTER	IMPACT	DESCRIPTION
Terrestrial ornithology (chapter 11, Onshore EIA Report)	Impact of construction noise on sensitive species.	Noise from construction activities may generate temporary disturbance to some species.
Access, traffic and transport (chapter 16, Onshore EIA Report)	Noise from construction traffic.	Road traffic generated during construction can impact Noise Sensitive Receptors (NSRs), as assessed in this chapter based on the analysis set out in chapter 16: Access, traffic and transport.

The following specialists have contributed to the assessment:

- Hoare Lea LLP: survey design and implementation of onshore noise surveys, noise modelling, baseline description, impact assessment and Onshore EIA Report chapter write up.

15.2 Legislation, policy and guidance

Over and above the legislation presented in chapter 3: Planning policy and legislative context, the following legislation, policy and guidance are relevant to the assessment from the onshore Project on noise and vibration:

- Legislation:
  - Environmental Protection Act 1990: defines how to control statutory nuisance from noise; and
  - Control of Pollution Act 1974 (CoPA): provides means for local authorities of controlling construction noise and vibration.
- Policy:
  - National Planning Framework 4 (NPF4) (Scottish Government, 2023): sets out key national planning policies that form part of the statutory development plan. It also outlines key policy links with regards to land use and development of land in the north of Scotland and rural areas. Specific policies related to this chapter include: Policy 11 notes impacts of renewable and low-carbon developments on communities and individual dwellings include noise, and that these proposals need to demonstrate how impacts are addressed, and Policy 23 notes developments likely to raise unacceptable noise issues would not be supported;
  - The Highland-wide Local Development Plan (HwLDP) (The Highland Council (THC), 2012): sets out a strategy to support the growth of all communities across THC region. It seeks to enable sustainable Highland communities, safeguard the environment, support a competitive, sustainable and adaptable Highland. Specific policies related to this chapter include: Policy 67 pertaining to renewable energy developments requires consideration of noise generation on building occupants, and Policy 72 considers noise as one form of pollution and requires an assessment demonstrating how significant pollution can be avoided and, if necessary, mitigated; and
  - The Caithness and Sutherland Local Development Plan (CaSPlan) (THC, 2018): guides future development in Highland, particularly in the Caithness and Sutherland area. Specific policies related to this chapter include: Environment and heritage, Caithness settlements – Halkirk, and Forss Business and Energy Park.

- Guidance:
  - British Standard (BS) 5228-1 (British Standards Institution (BSI), 2014a) and BS 5228-2 (BSI 2014b): provide detailed guidance on construction noise and vibration (respectively), its estimation and control;
  - BS 4142 (BSI 2019): provides a method of assessing the operational noise associated with the onshore substation;
  - BS 8233 Guidance on sound insulation and noise reduction for buildings (BSI, 2014c): sets out desirable guideline values in habitable rooms, such as living rooms and bedrooms;
  - Calculation of Road Traffic Noise (CRTN) (Department for Transport (DfT), 1988)): is used to assess road traffic noise;
  - Design Manual for Roads and Bridges (DMRB) (Transport Scotland, 2020): contains information about current design standards relating to the design, assessment and operation of motorway and all-purpose trunk roads in the United Kingdom;
  - Planning Advice Note 1/2011 (PAN1/2011), Scottish Government (2011a): provides advice on the role of the planning system in helping to prevent and limit the adverse effects of noise;
  - Planning Advice Note 50/1996 (PAN50) (Scottish Government, 1996): provides specific advice on controlling noise from ground works; and
  - Technical Advice Note: Assessment of Noise (TAN-Noise) (Scottish Government, 2011b): sets out additional detailed technical advice.

15.3 Scoping and consultation

Stakeholder consultation has been ongoing throughout the EIA and has played an important part in ensuring the scope of the baseline characterisation and impact assessment are appropriate with respect to the onshore Project and the requirements of the regulators and their advisors.

The Scoping Report was submitted to Scottish Ministers (via Marine Scotland - Licensing Operations Team (MS-LOT[1])) and THC on 1st March 2022, who then circulated the report to relevant consultees[2]. A Scoping Opinion was received from THC on the 9th May 2022. Relevant comments from the Scoping Opinion specific to noise and vibration are provided in Table 15-4 below, which provides a response on how these comments have been addressed within the Onshore EIA Report. The Scoping Opinion supersedes any pre-application advice provided by THC which was received on the 10th February 2021. In addition to the Scoping Opinion received for onshore, a Scoping Opinion relating to noise was also received in the offshore response (received on the 29th June 2022) as indicated in Table 15-4.

Further consultation has been undertaken throughout the pre-application stage. Table 15-3 summarises the consultation activities carried out relevant to noise and vibration.

[1] MS-LOT have since been renamed Marine Directorate - Licensing Operations Team (MD-LOT).

[2] The Scoping Report was also submitted to Orkney Islands Council (OIC), as the scoping exercise included consideration of power export to the Flotta Hydrogen Hub, however, this scope is not covered in this Onshore EIA Report and will be subject to a separate Planning Application to OIC.

Table 15-3 Consultation activities for noise and vibration

CONSULTEE AND TYPE OF CONSULTATION	DATE	SUMMARY
THC's Environmental Health Department - email	10th November 2022	Specific engagement with THC was undertaken to outline and agree the proposed assessment methodology for the proposed survey and operational noise assessment, in response to the general comments made in the Scoping Opinions described in Table 15-4. This included providing a plan of the proposed survey locations. A response was received via email on 18th November 2022 from the Case Officer showing agreement with the proposed assessment methodology, providing that the proposals and noise assessment demonstrated compliance with their requirements in relation to electrical substations, which were the requirements as detailed in the scoping response. Details of the noise survey conducted for the onshore Project is provided in SS12: Noise survey report and the noise assessment is provided in section 15.6.
THC's Environmental Health Department - email	7th December 2022	Further clarifications on the proposed survey and operational noise prediction methodology was provided to THC. Agreement was expressed with the proposed approach, providing that the proposals and noise assessment demonstrated compliance with THC requirements in relation to electrical substations. Details of the noise survey conducted for the onshore Project is provided in SS12: Noise survey report and details of the noise modelling is provided in SS13: Noise modelling report
THC's Environmental Health Department - email	13th April 2023	Advice was requested from THC for the operational assessment, in particular for cases where background noise levels reduced below 25 decibels (dB) L_{A90}, at night-time. The general THC requirements expressed in the Scoping Opinions could be interpreted in line with BS 4142 for rated levels to be limited to 25dB (but not any lower), as this represents a low absolute level and provides sufficient protection of amenity. This was agreed in response via email on 17th April 2023 from THC. The noise assessment is provided in section 15.6.

CONSULTEE AND TYPE OF CONSULTATION	DATE	SUMMARY
THC's Environmental Health Department - meeting	28th June 2023	The operational noise modelling conducted for the onshore substation was presented, including the results and proposed mitigation measures and demonstrating that criteria can be achieved. The potential for out-of-hours working for drilling was also discussed and informing potentially affected residents was highlighted as the main relevant mitigation measures. Comments received have been incorporated into the noise modelling conducted for the onshore Project (SS13: Noise modelling report) and the mitigation measures are highlighted in Table 15-16 and Table 15-34.
THC's Environmental Health Department - email	21st July 2023	In follow up correspondence to the above meeting, THC outlined two criteria they would seek to secure via conditions with regards to noise from the onshore substation. These were: • Noise arising from within the operational land of the sub-station, hereby permitted, when measured and/or calculated as an $L_{Aeq, 5min}$, in the 100 Hertz (Hz) one third octave frequency band must not exceed 30 dB, at noise sensitive premises; and • The Rating Level of noise arising from the use of plant, machinery or equipment installed or operated within the operational land of the sub-station, hereby permitted, must not exceed the current background noise levels at noise sensitive premises. The Rating Level should be calculated in accordance with BS 4142: 2014+A1:2019 Methods for rating and assessing industrial and commercial sound.

Table 15-4 Comments from the Scoping Opinion relevant to noise and vibration

CONSULTEE	COMMENT	RESPONSE
Scottish Ministers (via MS-LOT)	Comment provided via Offshore Scoping Response (22/01589/SCOP), however relevant to the onshore application. The EIA Report must provide the estimate of expected residues and emissions, for example drill cuttings were considered in the design envelope. Specific reference should be made to water, air, soil and subsoil pollution, noise, vibration, light, heat, radiation and quantities and types of waste produced during the construction and operation phases, where relevant. This information should be provided in a clear and consistent fashion and may be integrated into the relevant aspect assessments.	This chapter provides the worst case scenario for noise and vibration emissions for the onshore Project in relation to construction and operational noise. An assessment of these noise and vibration emissions is provided in this chapter, section 15.6.
Scottish Ministers (via MS-LOT)	Comment provided via Offshore Scoping Response (22/01589/SCOP), however relevant to the onshore application. The Scottish Ministers are broadly content with the study area identified within section 2.13 of the Scoping Report and that the baseline data gathered for the assessment is appropriate and agree that all impacts, as detailed in Table 2-82 of the Scoping Report, can be scoped out of the EIA Report, although THC response is highlighted in relation to certain circumstances where a noise assessment may be required.	THC's response has informed the assessment of noise and vibration presented within this chapter as some aspects were in response to the onshore elements. Detailed responses to THC comments are provided below.
THC	Comment provided via Onshore Scoping Response (22/00972/SCOP). Given the location, construction noise is unlikely to be an issue at many noise sensitive properties, however, consideration will need to be given to construction traffic and impact of the proposed construction methodology which is not clear at this time. This will include information on and assessments related to blasting and vibration as required.	This chapter has considered the potential noise implications of construction traffic, with the assessment methodology set out in detail in section 15.6. No specific search area is mentioned in the response but based on the response received, it would be considered sufficient to consider the NSRs closest to each construction activity as representative of the worst case potential noise levels received. Consideration has been given to vibration throughout this assessment particularly in relation to HDD and rock breaking works. Blasting is not required for the onshore Project.

CONSULTEE	COMMENT	RESPONSE
THC	Comment provided via Onshore Scoping Response (22/00972/SCOP). Planning conditions are not used to control the impact of construction noise as similar powers are available to the Local Authority under Section 60 of the Control of Pollution Act 1974. However, where there is potential for disturbance from construction noise the application will need to include a noise assessment. A construction noise assessment will be required in the following circumstances: • Where it is proposed to undertake work which is audible at the curtilage of any noise sensitive receptor, outwith the hours Mon-Fri 8am to 7pm; Sat 8am to 1pm; or • Where noise levels during the above periods are likely to exceed 75dB(A) for short term works or 55dB(A) for long term works. Both measurements to be taken as a 1hr L_{Aeq} at the curtilage of any noise sensitive receptor. (Generally, long term work is taken to be more than 6 months).	THC response references "working hours" starting at 08:00 in the morning, therefore the construction hours assumed in the assessment (see embedded mitigation Table 15-16) are on the basis of a 08:00 working hour start. The relevant guidance (BS 5228-1) provides example criteria on the basis of working hours starting at 07:00, however this will not affect the assessment undertaken, as the assumed working hours are more limited and within the scope of the BS 5228 guidance. The assessment of construction noise pays particular attention to work potentially required outside of these hours including at night-time. The assessment also pays attention to activities which are likely to exceed 75 dB(A) for short term works or 55 dB(A) for long term works. No specific search area is mentioned in the response but based on the response received, it would be considered sufficient to consider the NSRs closest to each construction activity as representative of the worst case potential noise levels received.
THC	Comment provided via Onshore Scoping Response (22/00972/SCOP). If an assessment is submitted, it should be carried out in accordance with BS 5228-1:2009 "Code of practice for noise and vibration control on construction and open sites – Part 1: Noise". Details of any mitigation measures should be provided including proposed hours of operation.	An assessment of construction noise in accordance with BS 5228 part 1 (BSI, 2014a) has been undertaken, with details of mitigation measures where required, and presented in section 15.6. Hours of operation are to follow THC guidance. An assessment has been carried out as some working outside of the hours stated will be required, including work during the night.

CONSULTEE	COMMENT	RESPONSE
THC	Comment provided via Onshore Scoping Response (22/00972/SCOP). Regardless of whether a construction noise assessment is required, it is expected that the developer / contractor will employ the best practicable means to reduce the impact of noise from construction activities. Attention should be given to construction traffic and the use of tonal reversing alarms. If construction methodologies are clarified, it may be that noise can be scoped out of the assessment.	The chapter includes methods to employ the best practicable means within embedded mitigation and will be dealt with through a NVMP. The NVMP will be developed post-consent ahead of construction, as more details become available, and contractors are in place. Consideration will be given to the construction plant that will be used (e.g., using broadband reversing alarms instead of tonal models where possible). Further details on construction traffic are outlined in chapter 16: Access, traffic and transport of the Onshore EIA Report.
THC	Comment provided via Onshore Scoping Response (22/00972/SCOP). I have read the relevant sections of the EIA Scoping report - noise, dust and potential nuisance. There are no objections to the proposals and it is acknowledged that further detail will be provided when the subsequent reports are produced.	This chapter includes a detailed assessment of potential noise impacts as provided in section 15.6. For detail on impacts associated with dust, see chapter 14: Air quality.
THC	Comment provided via Onshore Scoping Response (22/00972/SCOP). Activity is planned adjacent to sensitive properties and measures must be in place to enable a swift response to implement the suggested mitigation. For example, water suppression must be on site and ready to action.	The required measures to minimise and control noise impact, identified in this chapter, will be implemented as part of the NVMP. The NVMP will be developed post-consent, ahead of construction as more details become available, and contractors are in place.
THC	Comment provided via Onshore Scoping Response (22/00972/SCOP). Any noisy activity must be monitored and advanced warning of any out of scope work must be submitted to the Council and sensitive premises prior to commencing the work.	The management, notification and monitoring of construction noise will be implemented through the NVMP and any out of scope work will be submitted to THC and sensitive premises prior to commencing the work. The NVMP will be finalised ahead of construction as more details become available, and contractors are in place.

CONSULTEE	COMMENT	RESPONSE
THC	Comment provided via Offshore Scoping Response (22/01589/SCOP), however relevant to the onshore application. Planning conditions are not used to control the impact of construction noise as similar powers are available to the Local Authority under Section 60 of the Control of Pollution Act 1974. Generally, people are tolerant of construction noise during typical working hours which are taken to be 8am to 7pm Monday to Friday and 8am to 1pm on Saturdays. Works for which noise is inaudible at the curtilage of any noise sensitive property could still be carried out out-with these times.	Construction working hours are to follow THC guidance as per the onshore response above. The assessment of construction noise pays attention to works required outside of these hours including at night-time. This chapter includes an assessment of construction noise in accordance with BS 5228 part 1 (BSI, 2014a), see section 15.6.1.
	Comment provided via Offshore Scoping Response (22/01589/SCOP), however relevant to the onshore application. If the Applicant intends to undertake noisy work outwith the aforementioned times, they will be required to submit a detailed construction noise assessment for the written approval of the Planning Authority. The assessment should include: 1) A description of construction activities with reference to noise generating plant and equipment. 2) A detailed plan showing the location of noise sources, noise sensitive premises and any survey measurement locations. 3) A description of any noise mitigation methods that will be employed and the predicted effect of said methods on noise levels. 4) A prediction of noise levels resultant at the curtilage of noise sensitive receptors. 5) An assessment of the predicted noise levels in comparison with relevant standards.	A description of construction activities in relation to noise generating plant and equipment is provided in section 15.6.1. A detailed plan has not been provided in this assessment as the final locations of landfall, onshore export cable route and onshore substation are not yet fixed, however the assessment considers the worst case scenario for equipment used and separation distances to the nearest NSRs. This chapter includes an assessment of construction noise in accordance with BS 5228 part 1 (BSI, 2014a): this is provided in section 15.6.1. The assessment references typical noise generating plant and involves a prediction of noise levels at NSRs. Noise mitigation methods are included where required, with the resultant predicted noise levels at NSRs. Construction working hours are to follow THC guidance as per the onshore response above. The assessment of construction noise pays attention to works required outside of these hours including at night-time.

CONSULTEE	COMMENT	RESPONSE
	Comment provided via Offshore Scoping Response (22/01589/SCOP), however relevant to the onshore application. Regardless of whether a construction noise assessment is required, it is expected that the developer / contractor will employ the best practicable means to reduce the impact of noise from construction activities. The Applicant will be required to submit a scheme demonstrating how this will be implemented. Particular attention should be given to the use of tonal reversing alarms and ground compaction plant which are often the most intrusive noise generating elements of a large construction project.	As per the onshore response above, this chapter includes methods to employ the best practicable means within embedded mitigation and will be dealt with through the NVMP. Consideration will be given to the construction plant that will be used (e.g. tonal reversing alarms and ground compaction plant). Where possible broadband reversing alarms instead of tonal models will be used. The NVMP will be finalised ahead of construction, as more details become available, and contractors are in place.
THC	Comment provided via Offshore Scoping Response (22/01589/SCOP), however relevant to the onshore application. The proposed site of the windfarm will be over 20 km from the north coast of Caithness. As such, operational noise from the wind turbines will not be a significant issue. However, the development will include onshore infrastructure including a sub-station.	Noise-generating plant will be included as part of the onshore substation, this is assessed in section 15.6.2. In this context, the specific requirements on onshore substation noise made in the response are relevant. A noise survey has been carried out in line with these requirements at properties surrounding the proposed onshore substation as described in section 15.4.4.1. The survey method and scope was agreed with THC as part of consultation during the EIA, see Table 15-3. The proposed requirements in terms of operational noise from the onshore substation were taken into account as part of the assessment of section 15.6.2.

CONSULTEE	COMMENT	RESPONSE
THC	Comment provided via Offshore Scoping Response (22/01589/SCOP), however relevant to the onshore application. Any application will require to be accompanied by a Noise Impact Assessment carried out by a suitably qualified and competent person which assesses the likely impact of noise emanating from the onshore part of the development on neighbouring properties. The assessment should include but is not limited to the following: - 1) A description of the proposed development in terms of noise sources and the proposed locations and operating times of the same. 2) A detailed plan showing the location of noise sources, noise sensitive premises and survey measurement locations.* 3) A description of any noise mitigation methods that will be employed. The effect of mitigation methods on the predicted levels should be reported where appropriate. 4) A survey of current ambient (L_{Aeq}) and background (L_{A90}) noise levels at appropriate locations neighbouring the proposed site. 5) A prediction of noise levels resultant at neighbouring noise sensitive premises, for the operational phase of the proposed development. The raw data and equations used in the calculations should be made available on request. 6) An assessment of the predicted noise levels in comparison with relevant standards.*	Noise-generating plant will be included as part of the onshore substation, this is assessed in section 15.6.2. In this context the specific requirements on onshore substation noise made in the response are relevant. An operational noise assessment has been carried out for the proposed development which includes representative noise sources and is based on an indicative worst case location and design. A noise survey has been carried out at properties surrounding the proposed onshore substation as described in section 15.4.4.1. In response to points 2 and 4, these details are included in the Noise Modelling Report (SS13: Noise Modelling Report) and Noise Survey Report (SS12: Noise Survey Report). The noise assessment predicts noise levels at the neighbouring noise sensitive premises and has assessed in accordance with BS 4142 (BSI, 2019). This includes a description of noise mitigation methods to be employed so that noise from the proposed developed meets the noise requirements as agreed with THC. The proposed requirements in terms of operational noise from the onshore substation were taken into account as part of the assessment of section 15.6.2.

CONSULTEE	COMMENT	RESPONSE
THC	Comment provided via Offshore Scoping Response (22/01589/SCOP), however relevant to the onshore application. *Relevant standards and monitoring locations must be agreed beforehand with the Council's Environmental Health Officer. With regard to substation noise, the assessment should demonstrate the following standards can be achieved: 1. Noise arising from within the operational land of the sub-station, hereby permitted, when measured and/or calculated as an $L_{eq, 5min}$, in the 100 Hz one third octave frequency band must not exceed 30 dB, at noise sensitive premises; and 2. The Rating Level of noise arising from the use of plant, machinery or equipment installed or operated within the operational land of the sub-station, hereby permitted, must not exceed the current background noise levels at noise sensitive premises. The Rating Level should be calculated in accordance with BS 4142: 2014+A1:2019 Methods for rating and assessing industrial and commercial sound.	The proposed requirements in terms of operational noise from the onshore substation were taken into account as part of the assessment of section 15.6.2. The assessment of operational noise from the substation has demonstrated that the aforementioned noise does not exceed 30 dB $L_{eq, 5min}$ in the 100Hz one third octave band at any NSR. Following additional consultation with THC, it was agreed the Rating Level of noise should not exceed 25 dB L_{Aeq} at any NSR. The Rating Levels were calculated in accordance with BS 4142 (BSI, 2019) and the assessment demonstrated that this limit was achievable.

15.4 Baseline characterisation

This section outlines the current baseline for noise and vibration within the noise and vibration onshore study area.

The onshore Project area is sited in a rural area, remote from significant environmental noise sources such as heavily trafficked roads (e.g., motorways and dual carriageways), railways and airports. The rural nature of the area increases the likelihood of potential impacts as a result of relatively low background noise levels and hence the importance of their consideration. The land use in this area consists predominantly of dispersed residential areas and agricultural farmland (particularly on fields immediately inland from the coast). The western portion of the wider study area lies immediately adjacent to the Dounreay Nuclear facilities and Vulcan Naval Reactor Test Establishment (NRTE). For receptors closest to the coast, water movements may also represent a notable influence on the noise environment. An overview of the onshore Project area is provided in Figure 15-1.

To support the assessment of operational noise from the onshore substation, the analysis of the baseline noise environment has been undertaken on a quantitative basis and was characterised through a noise survey at the nearest residential receptors, in line with the Scoping Opinion and pre-application consultation with THC (see section 15.3).

The baseline noise environment in the vicinity of the onshore substation was also observed to be generally rural in nature, with a range of natural noise sources (bird noise, wind in trees, etc.). Noise from agricultural activities will also represent a contribution at times given the nature of the area, although this may be limited during evening and night-time periods. Traffic noise, in particular from the A9, also represents a notable influence in the area, which, although occasional, can be dominant for properties located in proximity to the A9, particularly when vehicles pass as the road is at ground height or slightly elevated along the extent of the site, and more distant or minimal for others.

The analysis of the baseline environment for the assessment of construction and decommissioning noise and vibration along the landfall and onshore export cable corridor has been undertaken on a qualitative basis. A quantitative assessment has been undertaken for the onshore substation using the results of the baseline noise survey and experience of similar environments. The construction and decommissioning noise assessment assumes that NSRs will be similarly located in rural areas, with relatively low baseline noise levels. It was not considered necessary or required as part of the Scoping Opinion to undertake specific monitoring to characterise baseline noise or vibration levels over the wider project area.

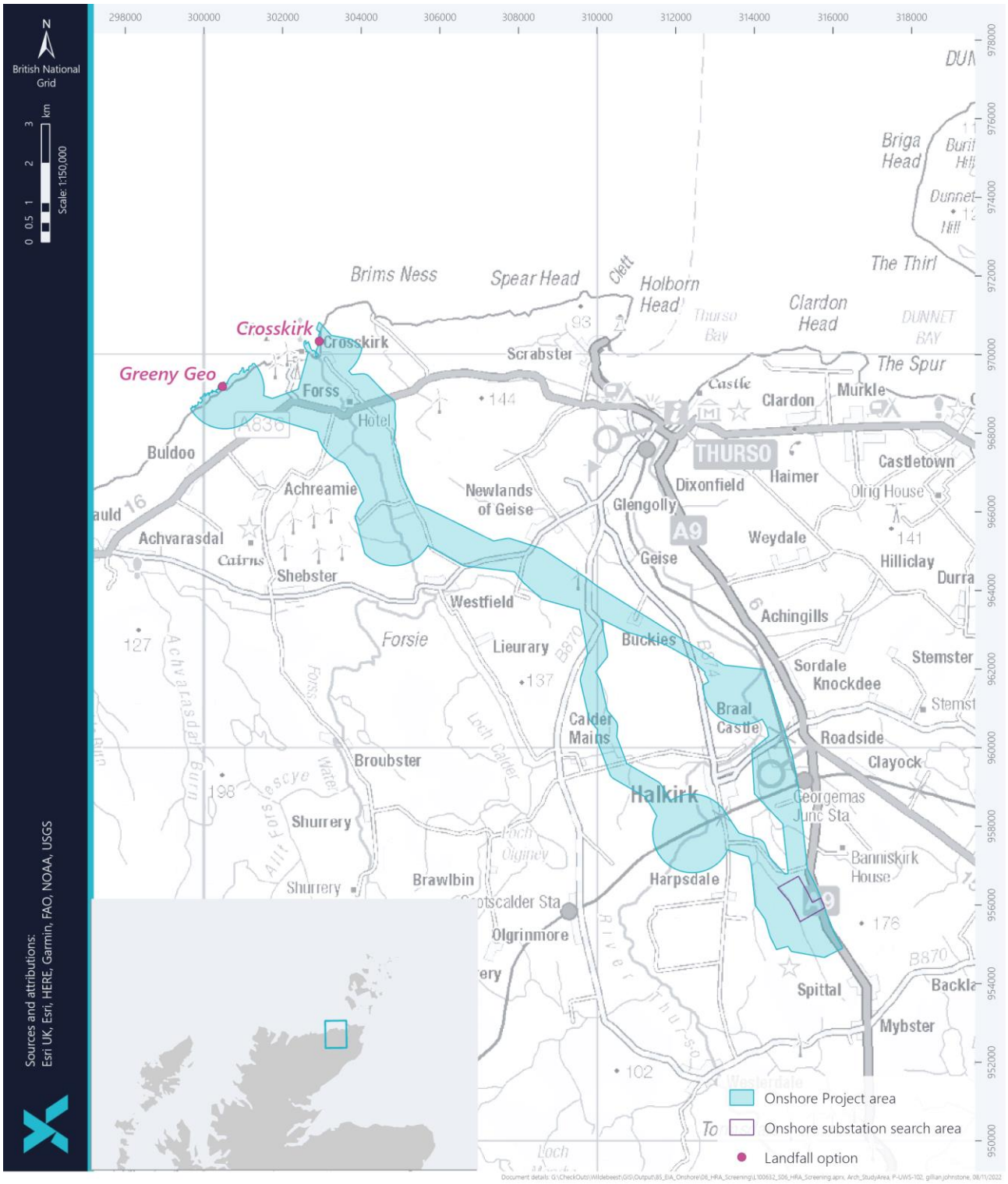

Figure 15-1 Overview of the onshore Project area

15.4.1 Study area

The study area for noise and vibration has been separated into three main areas:

- Landfall;
- Onshore export cable corridor; and
- Onshore substation.

Although the Scoping Report proposed a study area buffer of 2 kilometre (km) around the onshore export cable corridor, based on the Scoping Opinion received and an initial appraisal of potential effects, it was considered sufficient to consider potential effects on the closest receptors identified within a 1 km buffer from the study areas considered. The reason for this is that effects at properties further away (within a 2 km buffer) would be lower than those identified at the closest properties assessed.

For the identified landfall areas, specific receptors closest could be identified. For the onshore export cable corridor study area, in the absence of a final cable route, due to the large area covered and potential variance within the onshore export cable corridor, it is not feasible to identify and list every possible receptor, therefore predictions have been produced for a range of representative separation distances between construction works and the closest residential receptors. The actual distance between construction works and the nearest residential receptor will likely be greater in many cases than the minimum distances considered in this range.

In both cases, the assessment of the landfall and onshore export cable corridor study areas has focused on residential, educational or healthcare receptors as these are considered to be of high sensitivity (see section 15.5.3). There are educational and healthcare receptors located within a 1 km distance from the onshore export cable corridor study area boundary, which include Halkirk Primary School and Halkirk Surgery, however, at over 700 metres (m) from the boundary these are at a greater distance from the activities than residential receptors. Noise sensitive properties located further away than the identified residential receptors would experience reduced effects of noise and vibration from the landfall works, therefore the assessment at the nearest properties is considered sufficiently representative.

These study areas include some non-residential recreational receptors, such as St Mary's Chapel or public rights of way, which are considered to be of reduced (medium) sensitivity due to the transitory nature of the users of these spaces. These study areas also include some non-residential commercial or industrial receptors, such as the Dounreay Nuclear and Vulcan NRTE or the Forss Business and Technology Park. These receptors are of low / very low sensitivity to noise and unlikely to be significantly affected by the onshore Project and have therefore not been considered further in this chapter.

The onshore landfall study area includes the residential properties nearest to the two landfall areas. Table 15-5 lists the noise sensitive properties identified and their position, and these are also shown in Figure 15-2.

Table 15-5 Noise sensitive properties considered in the onshore landfall study area

NSR	PROPERTY	EASTING	NORTHING
NSR A	Crosskirk Cottage	303108	969866
NSR B	Carran, Crosskirk	303129	969808
NSR C	1 Holding, Crosskirk	303213	969898
NSR D	Farmhouse, Borrowston Mains	301645	969067
NSR E	Farm Cottage, Borrowston Mains	301672	968847
NSR F	Balmore Farm	301430	968233
NSR G	Ocean View, Balmore	301295	968128
NSR H	Gunn, Balmore	301022	967928

The onshore substation study area includes the residential properties nearest to the onshore substation search area. Table 15-6 lists the noise sensitive properties identified and their position, which are also represented on Figure 15-3 below. Noise sensitive properties located further away would experience reduced effects of noise and vibration from the onshore substation and therefore the assessment at the nearest properties is considered sufficiently representative. No other receptors of reduced sensitivity were identified in closer proximity that would require specific assessment.

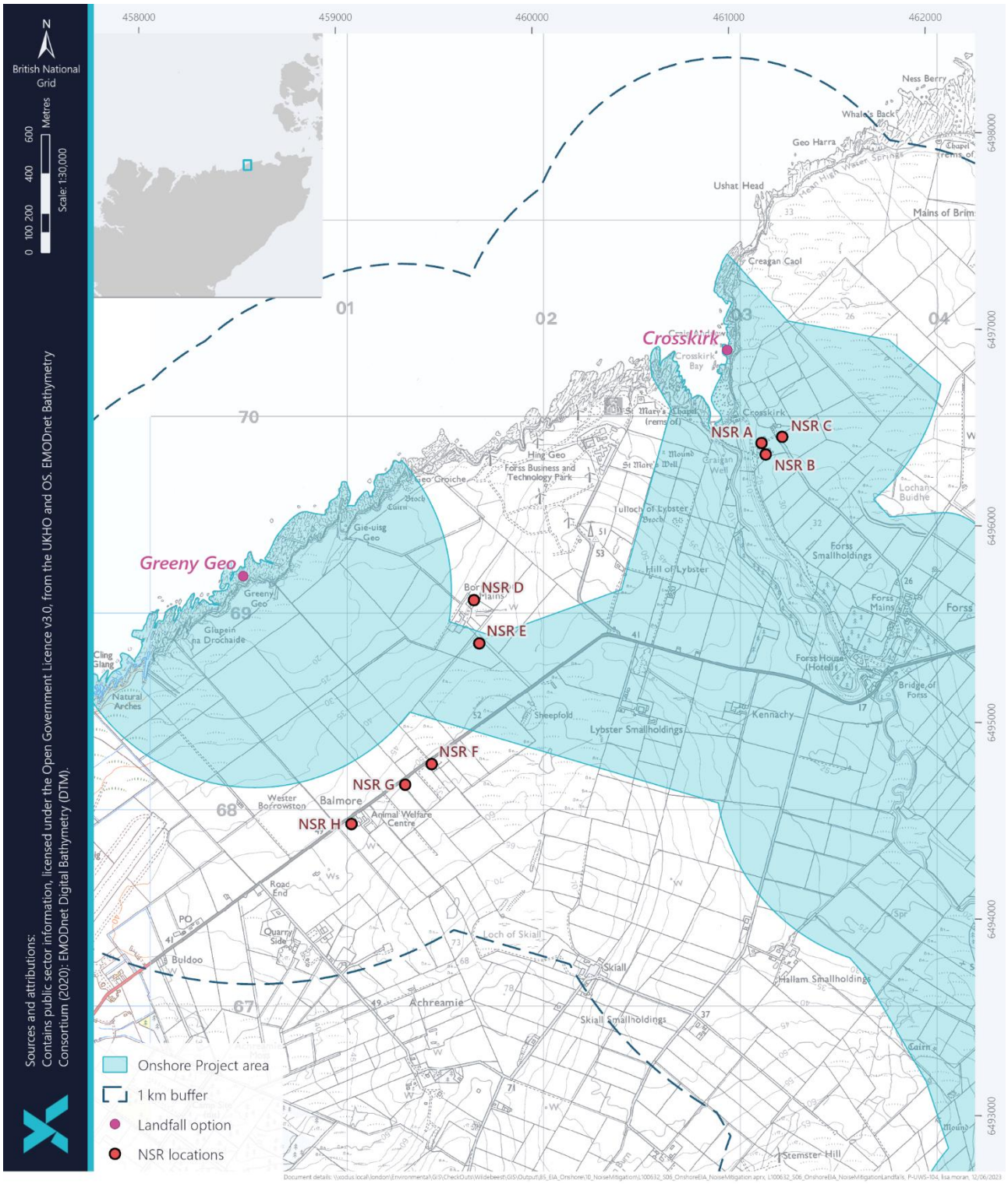

Figure 15-2 Noise sensitive properties considered in the landfall study area

Table 15-6 Noise sensitive properties considered in the onshore substation study area

NSR	PROPERTY	EASTING	NORTHING
NSR 1	Milton Farm	314993	956735
NSR 2	Hayfold Cottage	314717	956786
NSR 3	Maldon, Achalone	314991	956948
NSR 4	Cruachan, Achalone	315006	956908
NSR 5	Just Home, Achalone	315084	956859
NSR 6	Achalone View	315164	956910
NSR 7	Achalone Gill	315225	956930
NSR 8	Achalone Cottage	315533	956539
NSR 9	Mossgiel	315566	956434
NSR 10	Achomhairle Farm	315458	956216
NSR 11	The Cottage, Achalone	315671	956190
NSR 12	Spittal Mains Farm	316096	954650
NSR 13	Spittal Mains Cottage	316115	954519
NSR 14	Achanarras Farm	315134	955115

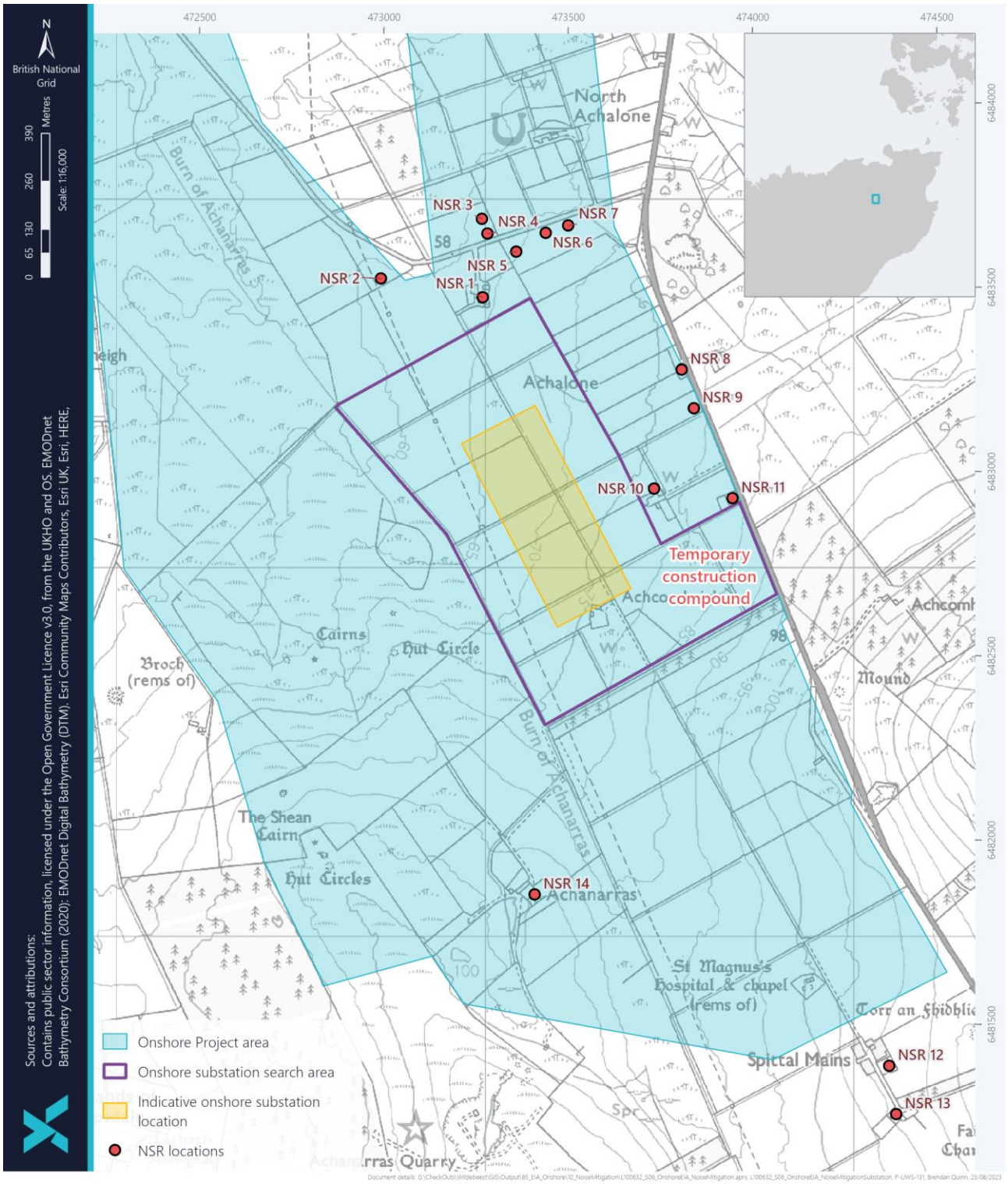

Figure 15-3 Noise sensitive properties considered in the onshore substation study area

15.4.2 Data sources

A review was undertaken of the key literature and data relevant to this assessment relating to noise and vibration and was used to give an overview of the existing baseline. The main data sources used in the preparation of this chapter are listed below in Table 15-7. Any other sources used are referenced in the text.

The properties set out in Table 15-5 and Table 15-6 were identified based on planning records and Ordnance Survey (OS) mapping of the area.

The data source used for the construction noise assessment was BS 5228-1 (BSI, 2014a). This has been supplemented with information in the Project Design Envelope (PDE), outlined in chapter 5: Project description, on the likely type of construction machinery to be adopted for the onshore Project, vehicle usage of the proposed construction access and indicative construction schedule.

The data sources used for the noise survey undertaken as part of the operational assessment, include wind data and weather records which were used to remove survey data gathered during periods of inclement weather.

Table 15-7 Summary of key datasets and reports

TITLE	SOURCE	YEAR	AUTHOR
Code of practice for noise and vibration control on construction and open sites – Part 1: Noise	https://www.warrington.gov.uk/sites/default/files/2020-08/cf53_bs_5228_pt1-2009a1-2014.pdf	2014a	BSI
Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration'	https://www.nottinghamshire.gov.uk/media/110052/british-standard-bs5228-2009.pdf	2014b	BSI
Guidance on sound insulation and noise reduction for buildings	https://images.reading.gov.uk/2021/10/CD-6.25-BS8233_2014-Guidance-on-Sound-Insulation-and-Noise-Reduction-for-Buildings.pdf	2014c	BSI
Methods for rating and assessing industrial and commercial sound	https://www.warrington.gov.uk/sites/default/files/2020-08/cf54_bs_4142_2014_a1_2019.pdf	2019	BSI
Electricity Supply Board (ESB) Spittal Synchronous Compensator Environmental Report	https://wam.highland.gov.uk/wam/	2020	ESB Asset Development (UK) Ltd

TITLE	SOURCE	YEAR	AUTHOR
Forss Windfarm Extension EIA Report	https://wam.highland.gov.uk/wam/	2020	Abbey Properties Cambridgeshire Ltd
OS Map	https://osmaps.ordnancesurvey.co.uk/	2021	OS
Google Earth	https://www.google.co.uk/intl/en_uk/earth/	2023	Google
Weather Underground	https://www.wunderground.com	2023	Weather Underground

15.4.3 Project site-specific surveys

The methodology for determining baseline background noise levels in the vicinity of the onshore substation was discussed at scoping stage, as well as after scoping directly with THC (see section 15.3). It was agreed to undertake a noise survey at representative residential properties around the onshore substation search area.

The baseline noise survey was undertaken over a two-week period in December 2022, at locations representative of the nearest NSRs, as agreed in consultation. This included one long-term unattended logger which was in place for two weeks and three short-term attended measurements each undertaken over two 15-minute periods at other nearby properties to supplement the longer-term data acquired. The noise survey report (SS12: Noise survey report) sets out the results, including measurement locations.

Baseline survey measurements were conducted in accordance with current guidance, including BS 4142:2014+A1:20198 Method for Rating and Assessing Industrial and Commercial Sound, and BS 7445-2:1991 Description and Measurement of Environmental Noise. The noise survey was accompanied by the acquisition of rainfall data which was gathered by installing a rain gauge with the noise monitor for the duration of the noise survey, and wind data obtained from publicly available historical weather records.

The desk study has also identified baseline noise measurements previously undertaken at some properties within the study areas defined above such as those reported for example in the Forss Windfarm Extension EIA Report (Abbey Properties, 2020), and those in the Spittal Synchronous Compensator Environmental Report (ESB, 2020).

15.4.4 Existing baseline

An environmental baseline noise survey in the vicinity of the onshore substation site, augmented by a review of mapping data and available data sources has been undertaken to describe the current baseline environment for noise.

The study areas and their surroundings are generally rural in character, and the noise environment is mostly characterised by intermittent traffic along main roads such as the A9 and local roads as well as agricultural vehicle movements in the area. Other sources of noise include 'natural' sources, such as wind-disturbed vegetation, sea

waves, birds and farm animals. The baseline noise environment is considered to be typical of rural locations, with relatively low levels particularly during quiet periods, but with the aforementioned localised sources which will increase the noise levels at times. No significant baseline sources of vibration have been identified in the study areas and baseline levels are therefore considered to be negligible.

15.4.4.1 Baseline noise survey

A noise survey was undertaken, as part of the operational noise assessment for the onshore substation, at one long-term fixed location over the period of Tuesday 6th December 2022 to Tuesday 20th December 2022, and supplemented by short-term attended monitoring at five locations on Tuesday 20th December 2022. The methodology within BS 4142:2014 was considered in the survey, to assist with determining prevailing background noise levels at the closest NSRs to the onshore substation search area. The survey locations and results are detailed in SS12: Noise survey report.

The survey demonstrated that in the daytime, a range of 21 to 48 dB L_{A90} for background levels, with a representative (typical lowest) value of 27 dB L_{A90} derived in line with BS 4142, could be typically experienced at properties neighbouring the onshore substation search area, with higher noise levels for locations closer to the A9. During evening periods, levels tended to decrease as activity levels decreased, and a range of 18 to 39 dB L_{A90} for background levels, with a representative (typical lowest) value of 22 dB L_{A90} could typically be experienced at night-time. This is considered typical of rural properties, for the majority of periods not affected by agricultural activities.

Results were also considered at the 100 Hz third octave frequency band, as requested during consultation with THC, with typical lowest background levels of 23 dB $L_{90,100\ Hz}$ during the daytime and 19 dB $L_{90,100\ Hz}$ during the night-time.

Comparison of the results of levels at the short-term attended locations with levels measured concurrently at the long-term location, shows that similar levels or lower were measured at the long-term location. This shows that the long-term measurements are representative of the typical noise at the other noise sensitive properties, and where measured levels at the long-term position are lower, this represents a conservative assumption. Any difference between measurements at the short-term and long-term locations are also as expected, particularly when considering their respective distances from the A9. This was supported by on-site observations of the noise climate whilst undertaking measurements at each position, as being largely influenced by road traffic noise from the A9 to the east.

Short-term spot measurements were also undertaken along the boundary of the existing Scottish Hydro Electric Transmission Plc (SHET-L) Spittal substation. These short-term measurements showed levels only marginally higher than those measured at the long-term position, which indicates that noise emissions from the existing SHET-L Spittal substation were low, which is consistent with on-site observations that existing substation noise was not perceptible at any of the NSR measurement locations.

The application for the ESB Asset Development Synchronous Compensator (planning reference 20/05118/FUL, see section 15.7) includes a noise impact assessment with baseline monitoring undertaken in the area, where similar results were obtained in terms of background noise levels for day and night periods, therefore reinforcing the conclusions of the survey reported in SS12: Noise survey report.

The representative (typical lowest) background noise levels at the long-term logger location derived according to BS 4142 based on the above analysis is summarised below in Table 15-8. Detailed results of the survey, and determination of background levels are set out in SS12: Noise survey report.

Table 15-8 Measured representative L_{90} background noise levels: both broadband (A-weighted) and 100 Hz 1/3 octave (unweighted) at the long-term logger location

MONITORING LOCATION	WEIGHTING	$L_{90,15\ MIN}$ BACKGROUND NOISE LEVEL (dB) MEASUREMENT PERIOD (T) RESULT	
		DAY	NIGHT
Milton Farm (NSR 1, north of the onshore substation)	Broadband, A-weighted	27	22
	100 Hz, unweighted	23	19

15.4.5 Future baseline

It is important to note that the future baseline is a projection, with a range of possible future conditions, and it is subject to uncertainty associated with the available projections. Across the lifetime of the Project, it is considered highly likely that the future baseline will be broadly comparable to the existing baseline described above in the absence of significant developments in the area. Specific and known developments which may affect the baseline environment in the future are considered and fully assessed in section 15.7 as part of the cumulative effects assessment.

15.4.6 Summary and key issues

The key sensitive receptors are residential and other highly sensitive receptors in the onshore study areas and are summarised below in Table 15-9.

Table 15-9 Summary and key issues for noise and vibration

SUMMARY AND KEY ISSUES	ONSHORE PROJECT AREA
	• Proximity to sensitive receptors including residential, schools and healthcare buildings and residential homes; • Out of hours work during the construction stage (e.g. HDD works); • Noise effects from construction traffic; and • Operational noise from the onshore substation.

15.4.7 Data limitations and uncertainties

Baseline noise levels along the onshore export cable corridor have not been measured due to the large study area. This means that assessment of construction noise is carried out as a qualitative assessment at this stage. Conservative assumptions have been made on the basis of the largely rural character of the area, data gathered during the onshore substation baseline noise survey and experience of similar developments.

The level of construction noise that occurs at the surrounding properties will be highly dependent on a number of factors, such as the final construction programme, equipment types used for each process, and the operating conditions that prevail during construction. It is not practically feasible to specify each and every element of the factors that may affect noise levels, therefore reasonable allowance is made for the level of noise emissions that may be associated with key stages of construction.

The construction noise calculations have been based on specific construction plant noise levels provided as guidance in BS 5228-1. It is stated in BS 5228-1 that:

"Values of the sound power levels for a particular type and size of machine and the equivalent continuous sound pressure levels for the site activities... will apply in the majority of cases, but can be lower or higher due to the make and maintenance of the machines, their operation and the procedures adopted when work is carried out."

Therefore, there is the possibility of uncertainty regarding the actual construction source noise levels.

There are some uncertainties regarding the precise layout and specification of the onshore substation and associated electrical equipment, final details of which will not be known until the pre-construction stage. Consequently, the operational noise assessment undertaken for this chapter has been carried out on the basis of a noise modelling exercise that has taken into consideration:

- An indicative onshore substation location (as shown in Figure 15-3) and indicative layout (as provided in SS13: Noise modelling report);
- Distances to the nearest residential receptors from the indicative onshore substation location; and
- Equipment specification for the onshore substation which is considered representative of the final layout and reflecting a maximum adverse (worst case) scenario, and this will be refined at the detailed design stage.

Whilst some assumptions have been identified, it is considered that there is sufficient information to enable an informed decision to be taken in relation to the identification and assessment of likely significant noise and vibration effects.

15.5 Impact assessment methodology

15.5.1 Impacts requiring assessment

The impacts identified as requiring consideration for noise and vibration are listed in Table 15-10. Information on the nature of impact (i.e. direct or indirect) is also described.

Table 15-10 Impacts requiring assessment for noise and vibration

POTENTIAL IMPACT	NATURE OF IMPACT
Construction and decommissioning*	
Onshore construction noise associated with construction of onshore components for the landfall, onshore export cables and onshore substation	Direct, temporary
Ground-borne vibration associated with construction of onshore components for the landfall, onshore export cables and onshore substation	Direct, temporary
Onshore construction noise and ground-borne vibration associated with vehicle use	Direct, temporary
Operation and maintenance	
Onshore operational noise associated with operation and maintenance of onshore components at the substation	Direct, long-term

**** In the absence of detailed information regarding decommissioning works, and unless otherwise stated, the impacts during the decommissioning of the onshore Project considered analogous with, or likely less than, those of the construction stage as detailed in section 15.6.3.***

15.5.2 Impacts scoped out of the assessment

The impacts scoped out of the assessment during EIA scoping, and the justification for this, are listed in Table 15-11.

Table 15-11 Impacts scoped out for noise and vibration

IMPACT SCOPED OUT	JUSTIFICATION
Operation and maintenance	
Onshore operational noise impacts on commercial or industrial receptors	As noted in section 15.4.1, commercial or industrial receptors are of low / very low sensitivity to noise and unlikely to be significantly affected by the onshore Project and are therefore not considered further in this chapter.
Onshore operational noise associated with the landfall and onshore export cable corridor	Components of the onshore Project at landfall and along the onshore export cable corridor will not include any perceptible sources of noise and vibration during the operational stage of the Project, therefore the assessment of operational noise will focus solely on the onshore substation.

IMPACT SCOPED OUT	JUSTIFICATION
Onshore operational noise associated with vehicle use	Operational road traffic would be limited to low numbers of light goods vehicles or cars which would occur sporadically for maintenance and safeguarding purposes, see chapter 16: Access, traffic and transport. This would have no appreciable effect on noise and was not raised in the Scoping Opinion and as a result, the associated effects have been scoped out.
Onshore ground-borne vibration associated with operation and maintenance traffic	Whilst occasional momentary vibration can arise when some vehicles pass dwellings at very short separation distances (i.e. 10 m or less), this is not sufficient to constitute a risk of significant effects. This was not raised in the Scoping Opinion and as a result, the vibration effects associated with vehicles used during the operation and maintenance stage have been scoped out.
Ground-borne vibration associated with operation of onshore components and maintenance activities	The equipment proposed as part of the onshore Project would generate minimal levels of vibration during operation: these would rapidly dissipate and be such that levels would be imperceptible at neighbouring properties, based on experience of similar plant (which do not include large moving parts). Similarly, maintenance activities would generate either limited localised or negligible vibration. Furthermore, this was not raised in the Scoping Opinion as a potential effect to consider. Therefore, operational vibration is scoped out of further assessment in this chapter.

15.5.3 Assessment methodology

An assessment of potential impacts is provided separately for the construction, operation and maintenance and decommissioning stages.

The assessment for noise and vibration is undertaken following the broad principles set out in chapter 7: EIA methodology, in that the sensitivity of the receptor (which for the purposes of this assessment is high, as only residential, educational and healthcare receptors are being considered) is combined with the magnitude to determine the consequence of effect. Topic-specific sensitivity and magnitude criteria (see Table 15-13) are assigned based on professional judgement (see Table 15-12).

The sensitivity of the receptors to noise and vibration (from high to low) was determined based on occupancy and using guidance provided in TAN-Noise. The most sensitive receptors considered are the residential properties set out in Table 15-5 and Table 15-6 as well as other residential / education / healthcare receptors in the study areas: these are considered to have a high sensitivity in all cases. Based on advice provided in TAN-Noise, the consequence of effect assessment approach applicable for the assessment is set out in Table 15-12. For this assessment, major and moderate effects are considered to be significant in the context of the EIA Regulations. Most available guidance documents on noise referenced provide criteria for these highly sensitive receptors, and the magnitude of impact thresholds were therefore determined such that significant effects would correspond to a medium or high magnitude of impact.

As detailed in section 15.4.1, public rights of way or other external amenity areas in the study areas have not been considered to be NSRs in the context of this noise assessment, as they would not be expected to be occupied by any individual for a long enough period of time for a significant noise effect to occur. Other potential receptors in the study areas include commercial or industrial facilities, which are considered to have a low sensitivity to noise and are therefore not considered in further detail in this chapter, as significant effects are considered unlikely (in accordance with Table 7-3 in chapter 7: EIA methodology, even medium or high impact magnitudes on low sensitivity receptors would correspond to minor effects at most).

Table 15-12 Consequence of effect and associated significance for residential, educational and healthcare receptors

MAGNITUDE OF IMPACT	CONSEQUENCE OF EFFECT	SIGNIFICANCE IN EIA TERMS
High	Major	Significant
Medium	Moderate	Significant
Low	Minor	Not significant
Negligible	Negligible	Not significant

This chapter considers adverse effect descriptions only, as the introduction of noise and vibration sources to a receptor location is unlikely to be viewed as beneficial.

15.5.3.1 Construction noise and vibration assessment method

The methodology adopted for the assessment of construction noise is outlined below:

- Determine the reasonable worst case working location of construction plant items;
- Assign sound power levels appropriate to the activity of the construction plant items;
- Predict the average sound pressure level for the daily construction working period at the sensitive receptor location, taking into account the percentage on-time, distance attenuation and screening attenuation;
- Compare the predicted sound pressure levels to the assessment criteria and consider any cumulative effects;
- Recommend mitigation and enhancement methods; and
- Determine the residual effects.

BS 5228-1 informative Annex E provides various example criteria of absolute noise limits for construction activities which have been used to determine the significance of any construction noise effects within this assessment (see Table 15-13). The criteria do not represent mandatory limits but rather a set of example approaches intended to reflect the type of methods commonly applied to construction noise. In broad terms, the example criteria are based on a set of fixed limit values which, if exceeded, may result in a significant effect unless ambient noise levels are sufficiently high to provide a degree of masking of construction noise.

The range of guidance values detailed in BS 5228-1 Annex E has been used to numerically define the magnitude levels, as per Table 15-13, based in part on consideration of the largely rural nature of the baseline noise environment. The presented levels have been normalised to free-field daytime noise levels occurring over a time period, T, equal to the duration of a working day. BS 5228-1 Annex E provides varied definitions for the range of daytime working hours which can be grouped for equal consideration.

The values presented in Table 15-13 have been chosen to relate to different working periods of a week based on BS 5228-1 guidance (see chapter 5: Project description, for the proposed working periods). As noted in Table 15-4, the working hours assumed include starting at 8 am, in line with the THC response. The criteria in Table 15-13 are based on the BS 5228-1 guidance which refers to construction starting at 7 am, however following guidance is considered a suitable basis for the assessment.

Furthermore, BS 5228 guidance advises that the nature and duration of the works should be taken into account. This is reflected in the criteria of Table 15-13 which consider both sustained construction work and shorter-duration works; for construction activities which may be expected to occur for less than four weeks in a year, the magnitude of corresponding effects would be reduced. Works lasting for very brief durations of less than one week are unlikely to be significant, but this is considered in each case based on professional judgement.

Table 15-13 Magnitude of impact criteria for the construction noise assessment

MAGNITUDE OF IMPACT	CONSTRUCTION NOISE – DAYTIME ACTIVITY (08:00 TO 19:00 ON WEEKDAYS) AND SATURDAY (AM, 08:00 TO 13:00),	CONSTRUCTION NOISE – NIGHT-TIME ACTIVITY (23:00 TO 07:00)	CONSTRUCTION TRAFFIC NOISE INCREASE
High	4 weeks or more: > $L_{Aeq(working)}$ 75 dB 1-4 weeks: > $L_{Aeq(working)}$ 85 dB	Levels of construction noise are above 50 dB $L_{Aeq, T}$ for **more than** 10 days in any 15 day period; OR Levels of construction noise are above 55 dB $L_{Aeq, T}$ for **less than** 10 days in any 15 day period.	> 5 dB

MAGNITUDE OF IMPACT	CONSTRUCTION NOISE – DAYTIME ACTIVITY (08:00 TO 19:00 ON WEEKDAYS) AND SATURDAY (AM, 08:00 TO 13:00),	CONSTRUCTION NOISE – NIGHT-TIME ACTIVITY (23:00 TO 07:00)	CONSTRUCTION TRAFFIC NOISE INCREASE
Medium	4 weeks or more: > $L_{Aeq(working)}$ 65 dB ≤ $L_{Aeq(working)}$ 75 dB 1-4 weeks: > $L_{Aeq(working)}$ 75 dB ≤ $L_{Aeq(working)}$ 85 dB	Levels of construction noise are above 45 dB $L_{Aeq, T}$ and less than or equal to 50 dB $L_{Aeq, T}$ for **more than** 10 days in any 15 day period; OR Levels of construction noise are above 50 dB $L_{Aeq, T}$ and less than or equal to 55 dB $L_{Aeq, T}$ for **less than** 10 days in any 15 day period.	3 to 5 dB
Low	4 weeks or more: > $L_{Aeq(working)}$ 55 dB ≤ $L_{Aeq(working)}$ 65 dB 1-4 weeks: > $L_{Aeq(working)}$ 65 dB ≤ $L_{Aeq(working)}$ 75 dB	Levels of construction noise are above 40 dB $L_{Aeq, T}$ and less than or equal to 45 dB $L_{Aeq, T}$ for **more than** 10 days in any 15 day period; OR Levels of construction noise are above 45 dB $L_{Aeq, T}$ and less than or equal to 50 dB $L_{Aeq, T}$ for **less than** 10 days in any 15 day period.	1 to 3 dB
Negligible	4 weeks or more: ≤ $L_{Aeq(working)}$ 55 dB 1-4 weeks: ≤ $L_{Aeq(working)}$ 65 dB	Levels of construction noise are not above 40 dB $L_{Aeq, T}$ for **more than** 10 days in any 15 day period; OR Levels of construction noise are not above 45 dB $L_{Aeq, T}$ for **less than** 10 days in any 15 day period.	< 1 dB

15.5.3.1.1 HDD works

Where night-time working is required for HDD works at the landfall and onshore export cable corridor, this would fall outside of the assumed daytime hours (i.e. evening, Sundays, Bank Holidays or at night): therefore, Table 15-13 also includes criteria applicable to the most sensitive night-time period. These criteria account for the potential duration of the HDD drilling as it could be limited in time and therefore affect the magnitude of impact.

15.5.3.1.2 Construction traffic noise

The prediction method of CRTN (DfT, 1988) has been used where possible to calculate the possible noise effects of construction related traffic passing to and from the onshore Project area along local surrounding roads. This is assessed in terms of relative changes with reference to the DMRB (Transport Scotland, 2020): see change criteria in Table 15-13. The CRTN methodology requires a minimum flow volume of 1,000 vehicles per day to enable reliable predictions, and calculations of relative noise change for traffic flows below 3,000 vehicles per day considered subject

to high levels of uncertainty: in these cases, the prediction methodology of BS 5228 for haulage routes is used instead. This provides predicted absolute levels of noise from Heavy Goods Vehicle (HGV) movements, which are then considered in relation to the impact magnitude criteria for general construction activities of Table 15-13.

15.5.3.1.3 Construction vibration

Some construction activity and associated plant could generate significant vibration: the magnitude of Peak Particle Velocity (PPV) has been estimated for these activities based on reasonable worst case working locations using BS 5228-2 guidance (BSI, 2014b). The criteria of Table 15-14 for the assessment of the magnitude of construction vibration are based on the guidance in Section B.2 of BS 5228-2 which provides advice on human response to vibration. BS 5228-2 notes that elevated vibration levels above 1 millimetre per second (mm/s) may be tolerated for brief periods and/or if prior warning has been given to residents. BS 5228-2 also advises that any risk of building damage, even for sensitive buildings, would only occur at much stronger vibration levels (above 10 mm/s), therefore the proposed criteria would also provide protection in this regard.

Table 15-14 Magnitude of impact criteria for the construction vibration assessment

MAGNITUDE OF IMPACT	CONSTRUCTION VIBRATION (PPV)
High	>10 mm/s
Medium	>1 mm/s and ≤10 mm/s
Low	≥0.3 mm/s and <1 mm/s
Negligible	<0.3 mm/s

The consequence and significance of effect is then determined using the methodology set out above in 15.5.3 with reference to Table 15-12.

15.5.3.2 Operational noise assessment method

The main potential source of operational noise for the onshore Project will be mechanical and electrical equipment associated with the onshore substation. The assessment has focused on the nearest residential receptors as detailed in Table 15-6.

Prediction of sound propagation has been undertaken in accordance with International Organization for Standardization (ISO) 9613-2 (ISO, 1996) and adopting the rating methodology of BS 4142 (BSI, 2019). The assumptions made for the noise modelling and detailed methodology are set out in SS13: Noise modelling report.

BS 4142 guidance criteria have been used to establish the magnitude criteria for the assessment of operational noise. BS 4142 defines the impact of an excess level obtained by the subtraction of the background level (L_{A90}, dB) from the

Rating Level determined, subject to context (see SS13: Noise modelling report, for a full description of this methodology). The Rating Level L_{Ar} (dB) is the predicted L_{Aeq} sound pressure level over the assessment period (daytime being a 1-hour period between 07:00 and 23:00 hours and night being a 15-minute period between 23:00 and 07:00 hours). The rating level also accounts for the potential character in the noise (such as tonality from equipment such as transformers) by applying a penalty to the calculated noise levels.

Table 15-15 outlines the assessment of effects based on the BS 4142 guidance and corresponding impact magnitudes.

A contextual analysis is fundamental in BS 4142, and this requires consideration of factors such as the nature of the area, nature of the sound (specific and background), the sensitivity of the receptor and mitigation adopted, as well as the absolute level of the noise, particularly at night-time.

When considering noise from the onshore substation, the following additional criteria were specified by THC in their Offshore Scoping Opinion, as detailed in Table 15-4:

1. Noise from the substation in the 100 Hz one-third octave frequency band should not exceed 30 dB $L_{Aeq, 5min}$ at any NSR.
2. The Rating Level of noise must not exceed the current background levels at NSRs.

Additional consultation with THC clarified that, where background noise levels reduced below 25dB L_{A90}, at night-time, this could be interpreted in line with BS 4142 for rated levels to be limited to 25dB, as this represents a low absolute level and provides sufficient protection of amenity. This was agreed by THC, and as such the assessment of operational noise reflects this. Exceeding these criteria was considered to represent a significant impact (in addition to the analysis detailed in section 15.3).

Table 15-15 Magnitude of impact criteria for the operational noise assessment according to BS 4142

MAGNITUDE OF IMPACT	OPERATIONAL NOISE
High	Rating level (L_{Ar}) 10 dB or more above the background sound level: is likely to be an indication of a significant adverse impact, depending on context.
Medium	Rating level (L_{Ar}) between 5 dB and 10 dB above the background sound level: likely to be an indication of an adverse impact, depending on context.
Low	Rating level (L_{Ar}) between 5 dB below and 5 dB above the background sound level: unlikely to represent an adverse impact, depending on the context.
Negligible	Where the rating level (L_{Ar}) is 5 dB lower or more than the background noise levels, depending on context.

The consequence and significance of effect is then determined using the methodology set out above in section 15.5.3 with reference to Table 15-12.

15.5.4 Embedded mitigation

As described in chapter 7: EIA methodology, certain measures referred to as embedded mitigation have been adopted as part of the Project development process in order to reduce the potential for impacts to the environment, as presented in Table 15-16. These have been accounted for in the assessment presented below. The requirement for additional mitigation measures will be dependent on the consequence and significance of the effects on noise and vibration receptors. In accordance with the onshore Planning Permission in Principle (PPP) application, the embedded mitigations listed below have been attributed to particular Development Zones within the onshore Project area. These are detailed in Table 15-16 and the Development Zones shown in Figure 15-4.

15.5.5 Worst case scenario

As detailed in chapter 7: EIA methodology, this assessment considers the worst case scenario for the onshore Project parameters which are predicted to result in the greatest environmental impact, known as the 'worst case scenario'. The worst case scenario represents, for any given receptor and potential impact on that receptor, the design option (or combination of options) that would result in the greatest potential for change.

Given that the worst case scenario is based on the design option (or combination of options) that represents the greatest potential for change, the development of any alternative options within the design parameters will give rise to no worse effects than those assessed in this impact assessment. Table 15-17 presents the worst case scenario for potential impacts on noise and vibration receptors during construction, operation and maintenance and decommissioning.

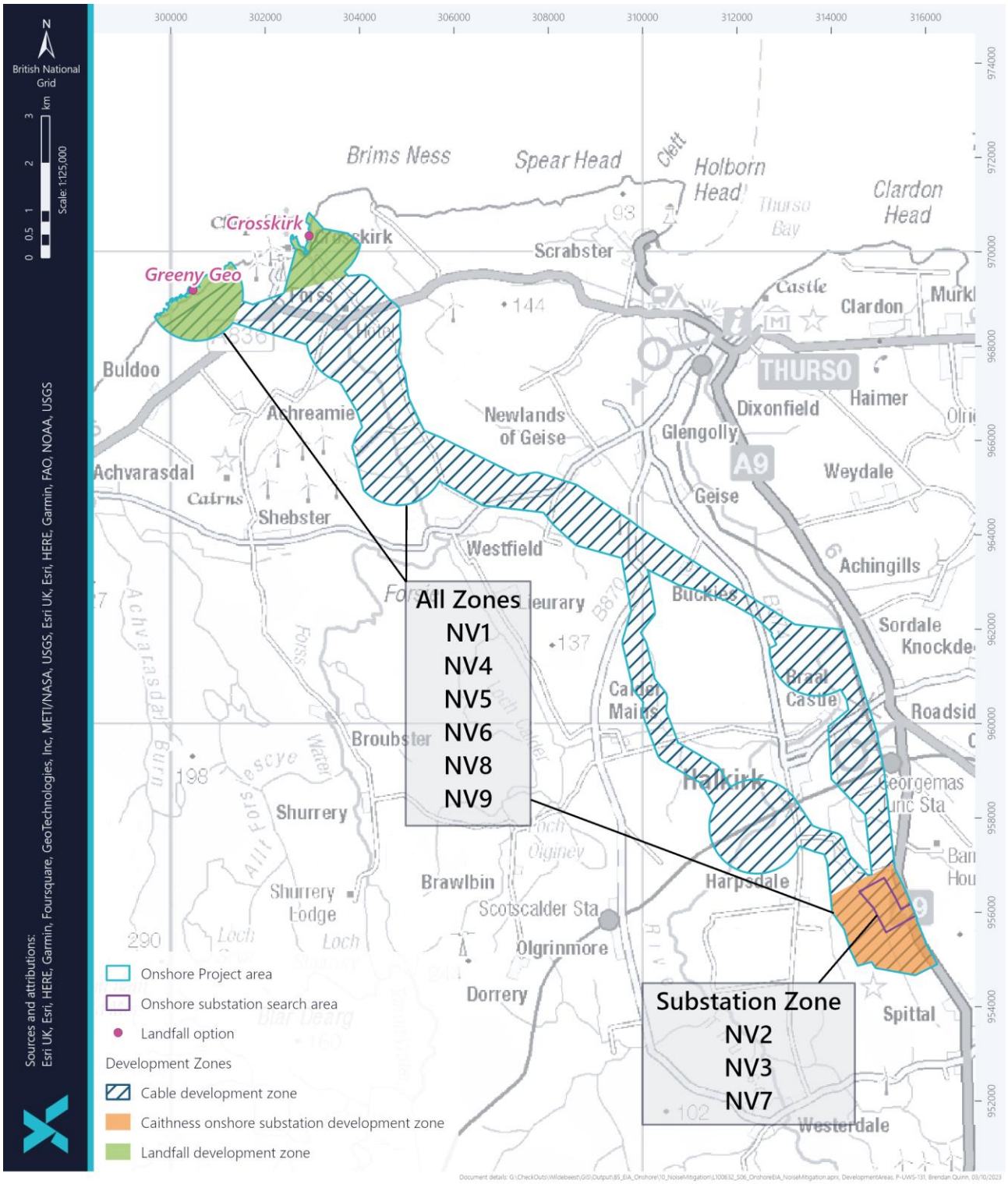

Figure 15-4 Development Zones for the onshore PPP Application

Table 15-16 Embedded mitigation measures relevant to noise and vibration

ID	MITIGATION MEASURE	TYPE	DESCRIPTION	HOW MITIGATION WILL BE SECURED	DEVELOPMENT ZONE
NV1	Core working hours	Primary	Core working hours for the construction of the onshore Project will be typical working hours which are taken to be 8 am to 7 pm Monday to Friday and 8 am to 1 pm on Saturdays, as stated by THC. This will also apply to HGV movements. In certain circumstances, specific works may have to be undertaken outside the normal working hours e.g. HDD works. In these instances, working hours will be agreed in advance with THC's Environmental Health Department Section 61 of the Control of Pollution Act 1974. Activities carried out during mobilisation and maintenance, which will not generate significant noise or vibration levels, may continue outside the core working hours. Requirements of working hours during construction are detailed within Outline Management Plan (OMP) 1: Outline Construction Environment Management Plan (CEMP) and OMP2: Outline Construction Traffic Management Plan (CTMP). These plans are submitted alongside the Application for PPP.	As per OMP1: Outline CEMP and OMP2: Outline CTMP these measures will be established within the final CEMP and final CTMP. The CEMP and CTMP will be secured through conditions attached to the PPP.	All zones.
NV2	Onshore substation bunding	Primary	The onshore substation will include bunding with appropriate planting. Indicative landscape design plans have been developed for the indicative location and layout of the onshore substation. Detailed design will take place post-consent. Further details of the design principles of the landscape bunding and planting are provided in chapter 17: Landscape and visual.	Established within the design principles (secured through the Construction Method Statements (CMSs)) and secured through conditions attached to the PPP.	Substation zone.

ID	MITIGATION MEASURE	TYPE	DESCRIPTION	HOW MITIGATION WILL BE SECURED	DEVELOPMENT ZONE
NV3	Substation equipment specifications	Primary	For the onshore substation equipment, specification of low noise plant, engineering acoustic measures and specialist noise enclosures, such that the following criteria are achieved at surrounding noise-sensitive properties: • Noise from the onshore substation in the 100 Hz one-third octave frequency band does not exceed 30 dB $L_{Aeq, 5min}$; and • The Rating Level of noise would not exceed 25 dB L_{Aeq}. The final specification of the acoustic measures required would be determined through further studies when the final onshore substation design and equipment specifications are known and will be designed to meet the thresholds as part of the detailed design process. These specifications will be detailed within the NVMP and developed post-consent.	Established within the design principles (secured through the CMSs) and within the NVMP. The NVMP will be secured through a condition attached to the PPP.	Substation zone.
NV4	CEMP	Tertiary	The CEMP will outline how the onshore Project will ensure the suitable implementation and control of the mitigation measures during construction. An outline CEMP (OMP1: Outline CEMP) is provided alongside the Application for PPP.	As per OMP1: Outline CEMP, the final CEMP will be provided at post-consent. The CEMP will be secured through a condition attached to the PPP.	All zones.

ID	MITIGATION MEASURE	TYPE	DESCRIPTION	HOW MITIGATION WILL BE SECURED	DEVELOPMENT ZONE
NV5	CTMP	Tertiary	The management of construction traffic within the onshore Project area is detailed within OMP2: Outline CTMP, which is provided alongside the Application for PPP. The CTMP will be finalised post-consent once the design of the onshore Project is finalised. This will include the implementation and control of mitigation measures related to construction traffic noise. Further details of the CTMP are provided in chapter 16: Access, traffic and transport.	As per OMP2: Outline CTMP, the final CTMP will be provided at post-consent. The CTMP will be secured through a condition attached to the PPP.	All zones.
NV6	Best Practicable Means (BPM) to limit the impacts of noise and vibration during construction	Tertiary	Best Practicable Means (BPM) to limit the impacts of noise and vibration at sensitive receptors during construction. This includes: selection of quieter equipment where reasonably practicable; all plant when not in use is to be switched off; operate only well-maintained construction plant selected for the specific activity; consideration will be given to construction plant that will be used (e.g., use of broadband tonal reversing alarms instead of tonal models where possible (without compromising health and safety); mobile plant and stationary plant items to be routed or located to maximise separation distance from noise-sensitive receptors (where possible), accounting for site-specific constraints.	These measures will be established within the NVMP and within the CTMP (in relation to vehicles). These plans will be secured through conditions attached to the PPP.	All zones.
NV7	Vibration isolation pads and anti-vibration mounts	Tertiary	Installation/use of vibration isolation pads and anti-vibration mounts, if required, from equipment located within the onshore substation. The equipment will be detailed within the NVMP and developed post-consent.	Established within the design principles (secured through the CMSs) and within the NVMP. The NVMP will be secured through a condition attached to the PPP.	Substation zone.

ID	MITIGATION MEASURE	TYPE	DESCRIPTION	HOW MITIGATION WILL BE SECURED	DEVELOPMENT ZONE
NV8	Engagement with affected landowners, asset owners and members of the public	Tertiary	Close liaison with affected landowners, asset owners and members of the public will be maintained during planning, and construction stages to ensure they are fully aware of proposals and sequence of construction activities and how parties can contact the Project.	External communication with the community, landowners and asset owners will be undertaken by the Community Liaison Officer (CLO). The requirement for a CLO will be secured through a condition attached to the PPP.	All zones.
NV9	Decommissioning, Restoration and Aftercare Plan.	Tertiary	A Decommissioning, Restoration and Aftercare Plan will be prepared for the onshore Project and agreed with THC prior to decommissioning works being undertaken. The plan will include any measures required to protect noise sensitive receptors during decommissioning which are likely to be similar to those proposed within the CEMP.	Established within the design principles (secured through the CMSs) and the Decommissioning, Restoration and Aftercare Plan which will be secured through a condition attached to the PPP.	All zones.

Table 15-17 Worst case scenario specific to noise and vibration impact assessment

POTENTIAL IMPACT	WORST CASE SCENARIO	JUSTIFICATION
Construction and decommissioning		
General	In determining the emissions levels over the working day, it has generally been assumed that the construction plant will operate for between 50% and 100% of the working day. The prediction of construction activities has been carried out using the prediction methodology outlined in BS 5228, assuming that the maximum height of the noise sources involved is 4 m, the ground between the source and receiver is acoustically hard up to 25 m from the source and acoustically soft thereafter.	In many instances, this plant would actually be expected to operate for a reduced percentage of the working day, thus resulting in noise levels lower than predicted in this assessment. A 4 m height is representative or higher than the effective emission point of most of the sources considered, and results in precautionary predictions. Although the ground conditions near the source may effectively be soft (cultivated land), assuming locally hard ground near the source accounts for locally tamped ground or hard surfaces.
Landfall – noise and vibration impacts		
General	Two different areas are considered as potential landfalls in Caithness – Crosskirk and Greeny Geo.	The worst case scenario for each landfall area has been considered based on an expected likely footprint. For the purpose of this assessment, each of the two landfall areas has been considered when looking at potential impact.
Site access works	Landfall site access works have assumed that existing tracks will need to be repaved. Equipment assumed includes a tracked excavator, wheeled backhoe, dozer, dump truck, and delivery trucks, with a combined maximum sound power level of 111 dB(A). These works are assumed to take place for a short period of time, of less than one week. Minimum separation distance of 5 m between site access works and nearest residential receptor locations at Crosskirk, assuming that existing tracks will need to be repaved. A new permanent access track of approximately 775 m long will be required to access the HDD site.	The assumed sound power level of 111 dB(A) is based on reference data contained within BS 5228 and considered representative of the upper range of noise levels that are likely to be generated by site access works. The assumed duration of works is based on previous experience of similar developments. Tracks have assumed to be repaved as separation distances are smaller in this instance.

POTENTIAL IMPACT	WORST CASE SCENARIO	JUSTIFICATION
	Minimum separation distance of 60 m between site access works and nearest residential receptor locations at Greeny Geo, assuming that existing tracks will need to be repaved.	The closest receptor to site access works at Crosskirk is Crosskirk Cottage (NSR A), and the closest receptor to site access works at Greeny Geo is Farmhouse Borrowston Mains (NSR D).
Site compound works	Construction compounds are anticipated to be 7,500 m^2. For the construction of site compounds, the equipment assumed includes a tracked excavator, dump truck, tippers, rollers, delivery trucks and a mobile crane, with a combined maximum sound power level of 114 dB(A). These works are assumed to take place for a period of less than four weeks. Minimum separation distance of 80 m between site compound works and nearest residential receptor locations at Crosskirk. Minimum separation distance of 530 m between site compound works and nearest residential receptor locations at Greeny Geo.	The assumed sound power level of 114 dB(A) is based on reference data contained within BS 5228 and considered representative of the upper range of noise levels that are likely to be generated by site compound works. The assumed duration of works is based on the anticipated size of the compound and previous experience of similar developments. The closest residential to site compound works at Crosskirk is Crosskirk Cottage (NSR A) and the closest receptor to site compound works at Greeny Geo is Farmhouse Borrowston Mains (NSR D).
Earthworks	For earthworks at landfall, the equipment assumed includes a tracked excavator, wheeled backhoe loader, dozer, dump truck and delivery trucks, with a combined maximum sound power level of 110 dB(A). These works could take place for a period of four weeks or more. Minimum separation distance of 80 m between earthworks and nearest residential receptor locations at Crosskirk. Minimum separation distance of 530 m between earthworks and nearest residential receptor locations at Greeny Geo.	The assumed sound power level of 110 dB(A) is based on reference data contained within BS 5228 and considered representative of the upper range of noise levels that are likely to be generated by earthworks. The assumed duration of works is based on the anticipated size of the works area, as detailed in the PDE, and previous experience of similar developments. The closest receptor to site compound works at Crosskirk is Crosskirk Cottage (NSR A) and the closest receptor to site compound works at Greeny Geo is Farmhouse Borrowston Mains (NSR D).

POTENTIAL IMPACT	WORST CASE SCENARIO	JUSTIFICATION
HDD works	Activities associated with the offshore export cable(s) at landfall are likely to include HDD. A construction compound for HDD infrastructure will be required at the Crosskirk and Greeny Geo locations. Once an HDD bore has been started, it is sometimes not possible to stop until it is completed, depending on several factors including ground conditions and drilling technique, hence the potential need for some night-time working. The equipment assumed includes an HDD power unit and drill, HDD generator, bentonite pump, bentonite mixer and a generator for site offices, with a combined maximum sound power level of 115 dB(A). These works are assumed to take place at ground level as a worst case and not down in a pit. These works are scheduled to take place over a period of six months, however the drilling itself is assumed to take place for a period of less than four weeks, during the daytime period. If works take place during the night-time, it is assumed to take place for a period of more than 10 days. The worst case location has been used: • Minimum separation distance of 80 m between HDD works and nearest residential receptor locations at Crosskirk; and • Minimum separation distance of 530 m between HDD works and nearest residential receptor locations at Greeny Geo.	Night-time working, whilst avoided wherever possible, may be necessary. Therefore, potential night-time noise impacts of HDD works have been considered. The HDD areas at Crosskirk and Greeny Geo are unlikely to be located further back from the shoreline than detailed in the PDE, but they could be located anywhere within the landfall areas. The assumed duration of works was determined on a precautionary basis accounting for the proposed scale of the works and previous experience of similar developments involving HDD. The assumed sound power level of 115 dB(A) is based on available manufacturer data for typical HDD plant and equipment and considered representative of the upper range of noise levels that are likely to be generated. The closest receptor to site compound works at Crosskirk is Crosskirk Cottage (NSR A) and the closest receptor to site compound works at Greeny Geo is Farmhouse Borrowston Mains (NSR D).
TJB construction	Up to five Transition Joint Bays (TJBs) are required (one per cable). The TJBs will either be located wholly at a single location, or if constrained split over the two landfalls. The maximum TJB comprises an area of 30 m long x 6 m wide x 5 m deep. TJB construction at landfall has assumed rock-breaking activity to be necessary. Rock-breaking activity will take place during daytime hours only and is assumed to involve the use of a backhoe mounted hydraulic breaker with an assumed maximum sound power level of 115 dB(A). These works are assumed to take place over a period of less than four weeks. Minimum separation distance of 80 m between TJB construction works and nearest residential receptor locations at Crosskirk. Minimum separation distance of 530 m between TJB construction works and nearest residential receptor locations at Greeny Geo.	A backhoe mounted hydraulic breaker has been chosen as this presents a worst case for noise in terms of rock-breaking activity. The assumed sound power level of 115 dB(A) is based on reference data contained within BS 5228 and considered representative of the upper range of noise levels that are likely to be generated by rock-breaking activity. The assumed duration of works is based on previous experience of similar developments. The closest receptor to Site compound works at Crosskirk is Crosskirk Cottage (NSR A) and the closest receptor to site compound works at Greeny Geo is Farmhouse Borrowston Mains (NSR D).

POTENTIAL IMPACT	WORST CASE SCENARIO	JUSTIFICATION
Vibration	HDD works are commonly considered to be similar to auger boring in terms of vibration generation from rotary boring. TJB works have been considered as potentially associated with percussive piling, with predictions made using the maximum energy in the range set out in guidance of BS 5228-2 (BSI, 2014b), assuming piles at refusal. The same minimum distances as those considered above have been assumed for this assessment.	The type of activities assumed represent the worst case vibration emissions potentially associated with these works.
Onshore export cable corridor – noise and vibration impacts		
General	It is assumed that the onshore export cable route could be located anywhere within the onshore Project area. This will also be assumed for Cable Joint Bays (CJBs) required along the onshore cable route, as well as site access tracks. Due to the large area covered and potential variance within the onshore Project area, it is not feasible to identify and list every possible receptor, therefore calculations for a range of distances have been provided. Due to the unknown nature of separation distances, calculations have been made for distances between 10 m and 800 m between the works and the nearest residential property have been given to consider the potential range of impact which may be experienced.	The actual separation distances are likely to be greater than 50 m in many cases. The assessment considers the effect of separation distances <50 m as a worst case approach.
Site access tracks and compounds	Laydown compounds will be 100 x 100 m and required at every 2 km along the onshore cable route. For the construction of site tracks and compounds, the equipment assumed includes delivery trucks, tracked excavator, wheeled backhoe loader, tamper, roller, dozer, and an asphalt paver + tipper lorry, with a combined maximum sound power level of 111 dB(A). Site access track works are assumed to take place for a very brief period of time in proximity to any particular receptor, likely to be less than one week. Site compound works are assumed to take place for a period of less than four weeks.	The assumed sound power levels of 111 dB(A) is based on reference data contained within BS 5228 and considered representative of the upper range of noise levels that are likely to be generated during the construction of site tracks and compounds. The assumed duration of works are based on the anticipated size of the works area, and previous experience of similar developments.

POTENTIAL IMPACT	WORST CASE SCENARIO	JUSTIFICATION
HDD / main crossing works	The cable laying works will require trenchless techniques to cross certain obstacles, including watercourses, railway line, certain roads and utilities (see chapter 5: Project description). Although other techniques such as cased auger boring / pipe jacking could be used, data for an HDD rig has been assumed to represent a worst case scenario. HDD will be likely required throughout the onshore export cable corridor onshore Project area for major crossings such as the River Thurso, Forss Water and the single-track Network Rail Scotland railway line. It is anticipated if the cables are laid in flat formation the maximum working areas that are required is 100 m x 30 m. Where HDD is required to cross sensitive features within the onshore export cable corridor, in the absence of a defined route and schedule of crossings, a range of distances from HDD drilling areas has been used to predict impact. Excavation rate for HDD crossings is <10 m per day. Works duration will depend on several factors such as the exact trenchless technique used, ground conditions etc., although for some of the smaller crossings, actual works duration is likely to be less than one week. However, for the River Thurso crossing a representative distance of 70 to 80 m was assumed (from pit to pit), this could take approximately 7-8 days per circuit based on the assumed excavation rate, or of up to 40 days in total. Therefore, these works could take between just over four weeks in duration as a worst-case. Furthermore, HDD works may need to continue through the night, such that a continuous operation can be completed, therefore works duration is assumed to be more than 10 days in some cases if drilling continuously during the night-time period. For HDD works along the onshore export cable corridor, the equipment assumed includes an HDD power unit and drill, HDD generator, bentonite pump, bentonite mixer and a generator for site offices, with a combined maximum sound power level of 115 dB(A).	Night-time working, whilst avoided wherever possible, may be necessary at some HDD locations. Therefore, potential night-time noise impacts of HDD works have been considered. The excavation rate is assumed to be <10 m per day as a worst-case. A worst-case crossing distance of 70 to 80 m (from pit to pit) has been assumed and therefore the duration of works is likely to be between 7-8 days per circuit, or up to 40 days with 5 circuits, therefore representing more than 10 days if drilling continuously during the night-time period. The assumed sound power level of 115 dB(A) is based on available data for typical HDD plant and equipment.
Cable trenching and backfilling / joint bay excavation and installation	A maximum of five onshore export cables laid in five separate trenches. A maximum of 288 CJBs in total for all five onshore export cables. An approximate separation distance of 700 m between CJBs is anticipated. These works are assumed to take place for a brief period of time, likely to be less than one week for any single CJB. Where works involve rock-breaking activity, the duration is assumed to be between one to four weeks.	The assumed sound power levels of 110 dB(A) is based on reference data contained within BS 5228 and considered representative of the upper range of noise levels that are likely to be generated during cable trenching and backfilling, and joint bay excavation and installation.

POTENTIAL IMPACT	WORST CASE SCENARIO	JUSTIFICATION
	For cable trenching and backfilling, and CJB excavation and installation, the equipment assumed includes a tracked excavator, wheeled backhoe loader, dump truck, and roller, with a combined maximum sound power level of 110 dB(A). Where cable trenching involves rock-breaking, a backhoe mounted hydraulic breaker has also been assumed with a maximum sound power level of 115 dB(A).	The assumed sound power level of 115 dB(A) is considered representative of the noise levels that may be generated by rock-breaking activity. The assumed duration of works are based on previous experience of similar developments.
Vibration	HDD works are commonly considered to be similar to auger boring in terms of vibration generation from rotary boring. Vibration may also be generated by activities such as ground compaction: indicative predictions are based on the worst case parameters of Table E.1 in BS 5228-2 (BSI, 2014b). The same range of minimum distances as those considered above (under 'General') have been assumed for this assessment.	The type of activities assumed represent the worst case vibration emissions potentially associated with these works.
Onshore substation – noise and vibration impacts		
General	An Air Insulated Switchgear (AIS) onshore substation (23.92 hectares) and construction compound and welfare facilities of 62,500 m^2. For the onshore substation construction, an indicative location within the onshore substation search area has been provided. This is shown in Figure 15-3. The construction noise assessment has considered the 14 nearest receptors to the indicative onshore substation location, which are located in each direction. These are detailed in Table 15-5. Exact items of plant and equipment that will be used during construction will not be known until the pre-construction stage. However, typical items of plant and equipment have been assumed. Calculations have been undertaken for the minimum separation distances between the various boundaries of the onshore substation.	The largest possible extent (hectares) of the onshore substation has been assumed, as this results in the largest number of vehicle movements and presents a worst case. Typical items of plant and equipment have been assumed based on experience from similar developments and the advice in BS 5228 and the construction works that are likely to be necessary. The minimum separation distances used in calculations presents a worst case in terms of noise levels predicted.

POTENTIAL IMPACT	WORST CASE SCENARIO	JUSTIFICATION
Site access works	For the construction of site access tracks, the equipment assumed includes a tracked excavator, wheeled backhoe, dozer, dump truck, and delivery trucks, with a combined maximum sound power level of 111 dB(A). These works are assumed to take place for a brief period of time. Minimum separation distance of 270 m between site access construction works and nearest residential receptor locations.	The assumed sound power levels of 111 dB(A) is based on reference data contained within BS 5228 and considered representative of the upper range of noise levels that are likely to be generated by construction of site access tracks. The assumed duration of works is based on previous experience of similar developments. The closest receptor to the onshore substation site access track is The Cottage, Achalone (NSR 11).
Site compound works	For the construction of site compounds, the equipment assumed includes a tracked excavator, dump truck, tippers, rollers, delivery trucks and a mobile crane, with a combined maximum sound power level of 116 dB(A), with more quantities of equipment assumed, than at landfall and site compounds along cable route. These works are assumed to have the potential to take place for a period of four weeks or more. Minimum separation distance of 20 m between site compound construction works and nearest residential receptor locations.	The assumed sound power levels of 116 dB(A) is based on reference data contained within BS 5228 and considered representative of the upper range of noise levels that are likely to be generated by construction of site compounds. The assumed duration of works is based on the anticipated size of the compound area, and previous experience of similar developments. The separation distance from The Cottage, Achalone (NSR 11), the nearest sensitive receptor to the closest edge of the associated construction compound, would be approximately 20 m. Therefore, all construction works have been assumed to take place at the minimum allowable separation distance.
Earthworks – general	For general earthworks at the onshore substation, the equipment assumed includes a backhoe mounted hydraulic breaker, wheeled backhoe loader, dozer, dump truck and delivery trucks, with a combined maximum sound power level of 115 dB(A). These works are assumed to have the potential to take place for a period of four weeks or more. Minimum separation distance of 35 m between construction earthworks and nearest residential receptor locations.	The assumed sound power levels of 115 dB(A) is based on reference data contained within BS 5228 and considered representative of the upper range of noise levels that are likely to be generated by general earthworks which may include rock-breaking activity. The assumed duration of works is based on the size of the works area, as detailed in the PDE and previous experience of similar developments. The closest receptor to the onshore substation earthworks activity is Achomhairle Farm (NSR 10).

POTENTIAL IMPACT	WORST CASE SCENARIO	JUSTIFICATION
Earthworks – including piling	Regards the noisiest activity, piling rigs have been included as potentially being necessary during the onshore substation for foundation work, in the platform area itself or for retaining walls on the edge of the platform. A steel sheet vibratory piling rig has been considered as a worst case with an assumed maximum sound power level of 116 dB(A). These works are assumed to have the potential to take place for a period of four weeks or more as a worst case. Minimum separation distance of 170 m between construction works involving piling and nearest residential receptor locations. Although limited piling work may be employed for fencing construction, in closer proximity to some receptors, this would be much more limited in extent and in terms of noise emissions and therefore the above assumptions for earthworks are considered representative.	The maximum sound power level of 116 dB(A) during piling is considered to be representative of the likely upper levels of piling noise that could be produced. The assumed duration of works is based on the anticipated size of the works area, and previous experience of similar developments. The closest receptor to the onshore substation earthworks piling activity is Achomhairle Farm (NSR 10).
Civil works	For onshore substation civil works construction, an on-site concrete batching facility has been included; other equipment assumed includes a tracked excavator with rock breaker, delivery trucks, mobile cranes, generators, compressors, and dump trucks, with an assumed combined maximum sound power level for civil works of 114 dB(A). These works are assumed to have the potential to take place for a period of four weeks or more. Minimum separation distance of 160 m between construction civil works and nearest residential receptor locations.	The assumed sound power levels of 114 dB(A) is based on reference data contained within BS 5228 and considered representative of the upper range of noise levels that are likely to be generated by civil works, where an onsite concrete batching facility is included. The assumed duration of works is based on previous experience of similar developments. The closest receptor to the onshore substation civil works activity is Achomhairle Farm (NSR 10).
Mechanical and electrical (M&E) works	For M&E works at the onshore substation, the equipment assumed includes delivery lorries, mobile cranes, generator, compressor, tractor towing equipment and hammering, with an assumed combined maximum sound power level of 110 dB(A). These works are assumed to have the potential to take place for a period of four weeks or more. Minimum separation distance of 160 m between construction M&E works and nearest residential receptor locations.	The assumed sound power levels of 110 dB(A) is based on reference data contained within BS 5228 and considered representative of the upper range of noise levels that are likely to be generated by general earthworks. The assumed duration of works is based on previous experience of similar developments. The closest receptor to the onshore substation M&E works activity is Achomhairle Farm (NSR 10).

POTENTIAL IMPACT	WORST CASE SCENARIO	JUSTIFICATION
Vibration	Sheet piling works have been considered as potentially associated with percussive piling (as a worst case for vibration). The same minimum distances as those considered above have been assumed for this assessment.	Predictions made using the maximum energy in the range set out in guidance of BS 5228-2, assuming piles at refusal. Vibration may also be generated by activities such as ground compaction: indicative predictions are based on the worst case parameters of Table E.1 in BS 5228-2. The type of activities assumed represent the worst case vibration emissions potentially associated with these works.
Traffic noise impacts (including cumulative)		
General	The assessment of potential noise from construction traffic has been based on the assumption and assessment presented in chapter 16: Access, traffic and transport. Chapter 16: Access, traffic and transport has been used to ascertain the future daily projected traffic flows for scenarios with and without the onshore Project, based on the worst case construction traffic flows, considering a future baseline year in 2027. The most intensive traffic is expected to occur between Year 2 Q2 and Year 3 Q2, with the maximum predicted in the 3rd quarter of the second year of construction with an average of 632 construction HGV vehicle trips per day, or an average maximum of 53 two-way HGV vehicle movements each hour, based on a 12-hour working day. Chapter 16: Access, traffic and transport were used to establish future daily projected traffic flows for a cumulative scenario with the onshore Project and other schemes when compared to the future baseline (without the onshore Project and other developments), with a maximum of 921 HGV vehicle trips per day predicted on some portions of the A9. The measures included in the outline CTMP which is submitted alongside this PPP Application (OMP2: Outline Construction Traffic Management Plan), include control of working hours and use of agreed construction routes. These have been assumed as embedded measures.	The maximum traffic flows have been determined based on worst case assumptions for deliveries of materials to site (e.g. concrete, aggregates etc.). Since materials deliveries generally constitute the bulk of the HGV movements that would be necessary, this is likely to result in the maximum impact. This is considered representative of the worst case effects that may occur, even though, for the cumulative assessment scenario in particular, lower flows are likely in practice for a majority of the time. For roads where total traffic levels are below the minimum flow volume of 1,000 vehicles required by the CRTN methodology, a calculation was undertaken using the haul route calculation methodology of BS 5288, assuming that large HGV vehicles can generate noise levels in the order of 108 dB (sound power level) when in motion, were moving at 50 miles per hour, with the nearest dwellings at a distance of 8 m from the road centre-line. For the cumulative assessment, the assumption is that that worst case construction stage from the other schemes considered and the onshore Project will overlap resulting in maximum level of construction traffic.

POTENTIAL IMPACT	WORST CASE SCENARIO	JUSTIFICATION
Operation and maintenance - Onshore substation noise impacts		
Onshore substation – noise	For the onshore substation operation, an indicative location and design within the onshore substation search area has been provided. See indicative location of onshore substation in Figure 15-3 and indicative layout shown in Appendix B of the SS13: Noise modelling report. The assessment has considered the worst case scenario in respect of numbers of equipment and cables, with all equipment assumed to be run simultaneously at full duty, based on a representative layout for the onshore substation and likely equipment required. Noise emission levels for each equipment modelled have been determined as robustly representative of the potential noise emissions. Representative octave band spectral data has been used for each item of equipment. Predictions have been produced for the nearest residential receptor location to the onshore substation (Table 15-6). It was assumed that the grid transformers, reactors and harmonic filters have noise emissions which are tonal and strongly dominated by the 100 Hz one-third octave frequency band, with this tonal character that may be potentially clearly audible. Following implementation of the embedded mitigation strategy for operational noise, a low residual tonal audibility has still been assumed. Full details of the assumptions for the operational assessment are laid out in the SS13: Noise modelling report.	Assumptions in relation to the quantity, scale and specification of the items of plant that are likely to be included within the onshore substation have been made on the basis of the upper end likely to result from typical equipment that would be needed for the type and size of substation required, but with implementation of the proposed embedded mitigation strategy. Predictions have been undertaken for the minimum separation distances between the onshore substation and the nearest residential receptors. Receptors further from the onshore substation will experience lower noise levels.

15.6 Assessment of potential effects

15.6.1 Potential effects during construction

During the construction of the onshore Project, noise from construction activities will inevitably be generated and will, during certain stages of construction, be audible at residential receptors in the vicinity of construction activities. The purpose of this section is therefore to:

- Quantify the likely levels of construction noise that can be expected at the nearest residential receptor locations to construction works;
- Provide comment as to the magnitude of the potential construction noise impacts and resultant consequence; and
- Where relevant, identify those impacts that would require specific mitigation measures in order for the potential noise effects to be reduced to a level considered acceptable.

In order to determine representative emission levels for this assessment, reference has been made to the sound power data available for the likely items of construction plant and equipment that will be used during the various stages of construction. Based on experience of the types and number of equipment associated with the stages of construction considered, the scheduled sound power data has been used to deduce the upper sound emission level over the course of a working day.

Due to the uncertainties that are currently associated with the exact locations at which some construction activities will be necessary (in particular, works along the onshore export cable corridor), the potential noise impacts of a range of possible scenarios have been assessed.

15.6.1.1 Construction stage noise effects – landfall

Two different areas are being considered as potential landfalls in Caithness: Crosskirk and Greeny Geo. It is therefore necessary to consider the potential noise impacts of construction works on the nearest residential properties to the two landfall areas. It is also understood that there is the possibility for both Crosskirk location and the Greeny Geo location to be used in conjunction, with construction works being necessary in both areas.

The construction tasks necessary as part of landfall works include site access works, site compound works, earthworks, HDD works and TJB construction, which will each be assessed separately.

Table 15-18 below provides worst case predictions of noise levels from site access enabling works at each landfall area at the nearest residential properties, which assumes that existing tracks will be re-paved as a worst case.

Table 15-18 Predicted noise levels from site access enabling works at landfall

PLANT / EQUIPMENT	UPPER COLLECTIVE SOUND EMISSION $L_W(A)$	NEAREST SENSITIVE RECEIVER TO LANDFALL AREA	MINIMUM DISTANCE TO NEAREST RECEIVER (m)	PREDICTED UPPER DAYTIME NOISE LEVEL (dB) $L_{Aeq, T}$
Tracked excavator, wheeled backhoe, dozer, dump truck, delivery trucks	111	Crosskirk - Crosskirk Cottage (NSR A)	5	89 (very brief period)
		Greeny Geo – Farmhouse Borrowston Mains (NSR D)	60	67

For site access enabling works at the Crosskirk landfall location, although a high noise level is predicted at Crosskirk Cottage (NSR A), this will be for a short period of time of less than one week when the activity is closest to the receptor, and noise levels will quickly diminish as construction progresses, moving the activity further from the property. Furthermore, the works will take place during the daytime hours specified in Table 15-16. Taking these factors into account and based on professional judgement, the associated impact magnitude is considered low.

Similarly, with worst case predicted levels below 70 dB and with a similar short duration, the impact magnitude of site access enabling works at Greeny Geo will also be low.

Table 15-19 below provides worst case predictions of noise levels from site compound enabling works at each landfall area at the nearest residential properties.

Table 15-19 Predicted noise levels from site compound enabling works at landfall

PLANT / EQUIPMENT	UPPER COLLECTIVE SOUND EMISSION $L_W(A)$	NEAREST SENSITIVE RECEIVER TO LANDFALL AREA	MINIMUM DISTANCE TO NEAREST RECEIVER (m)	PREDICTED UPPER DAYTIME NOISE LEVEL (dB) $L_{Aeq, T}$
Excavator, dump truck, tippers, rollers, delivery trucks, mobile crane	114	Crosskirk - Crosskirk Cottage (NSR A)	80	67
		Greeny Geo – Farmhouse Borrowston Mains (NSR D)	530	49

For site compound enabling works at the Crosskirk and Greeny Geo landfall(s), these works will likely take place for a period of less than four weeks in total. Noise levels at Crosskirk are also expected to be lower than 65 dB for the majority of the time, with noise levels likely to approach the worst case level of 67 dB for a brief duration, and therefore

the associated impact magnitude is considered to be low. The impact magnitude for these works at the Greeny Geo location is predicted to be negligible.

Table 15-20 below provides worst case predictions of noise levels from earthworks enabling works at each landfall area at the nearest residential properties.

Table 15-20 Predicted noise levels from earthworks enabling works at landfall(s)

PLANT / EQUIPMENT	UPPER COLLECTIVE SOUND EMISSION $L_W(A)$	NEAREST SENSITIVE RECEIVER TO LANDFALL AREA	MINIMUM DISTANCE TO NEAREST RECEIVER (m)	PREDICTED UPPER DAYTIME NOISE LEVEL (dB) $L_{Aeq, T}$
Tracked excavator, wheeled backhoe, dozer, dump truck, delivery trucks	110	Crosskirk - Crosskirk Cottage (NSR A)	80	63
		Greeny Geo – Farmhouse Borrowston Mains (NSR D)	530	45

For earthworks enabling works at the Crosskirk landfall location, even if the works continue for four weeks or more, this will at worst result in a low noise impact magnitude based on the criteria of Table 15-13. The impact magnitude for these works at the Greeny Geo location is predicted to be negligible.

Table 15-21 below provides worst case predictions of noise levels from HDD works at each landfall area at the nearest residential properties.

Table 15-21 Predicted noise levels from HDD works at landfall

PLANT / EQUIPMENT	UPPER COLLECTIVE SOUND EMISSION $L_W(A)$	NEAREST SENSITIVE RECEIVER TO LANDFALL AREA	MINIMUM DISTANCE TO NEAREST RECEIVER (m)	PREDICTED UPPER DAYTIME NOISE LEVEL (dB) $L_{Aeq, T}$
HDD power unit and drill, HDD generator, bentonite pump, bentonite mixer, generator for site offices	115	Crosskirk - Crosskirk Cottage (NSR A)	80	68
		Greeny Geo – Farmhouse Borrowston Mains (NSR D)	530	50

For HDD works at the Crosskirk landfall location, based on the above worst case assumptions, if HDD activity is restricted to the daytime period only, for a duration of less than four weeks then the predicted impact will be low. However, it is possible that HDD works could extend to night-time hours where continuous drilling is required. If drilling at Crosskirk operates continuously during the night-time period, based on the worst case assumptions made, this could result in a high impact magnitude if unmitigated (based on Table 15-13 criteria).

For HDD works at the Greeny Geo landfall location, based on the above worst case assumptions, if HDD activity is restricted to the daytime period only, the predicted impact will be negligible. However, if HDD works take place during the night-time period at the Greeny Geo landfall location, and the duration of this night-time work is for more than 10 days (worst case assumption), this will result in a medium impact magnitude, if unmitigated.

Table 15-22 below provides worst case predictions of noise levels from TJB construction works at each landfall option at the nearest residential properties.

Table 15-22 Predicted noise levels from TJB construction works at landfall

PLANT / EQUIPMENT	UPPER COLLECTIVE SOUND EMISSION $L_W(A)$	NEAREST SENSITIVE RECEIVER TO LANDFALL AREA	MINIMUM DISTANCE TO NEAREST RECEIVER (m)	PREDICTED UPPER DAYTIME NOISE LEVEL (dB) $L_{Aeq, T}$
Backhoe mounted hydraulic breaker	115	Crosskirk Cottage (NSR A)	80	68
		Farmhouse Borrowston Mains (NSR D)	530	50

TJB construction involves rock-breaking activity, assumed through the use of a backhoe mounted hydraulic breaker, with rock-breaking works (the noisiest activity assessed) likely to take place over a period of less than four weeks. Taking this duration, the restriction of works to daytime hours and the predicted noise levels into account, the impact magnitude of these works at the Crosskirk will be low under worst case assumptions. The impact magnitude for these works at the Greeny Geo location is predicted to be negligible.

Evaluation of significance

Each of the tasks associated with the landfall construction works and the worst case predictions are provided below, which summarises the impact magnitude, consequence and significance for the worst affected receptors, prior to mitigation. Although each activity was assessed in turn, due to the likely sequencing and the approach which considered the closest affected property in each case, the works would not combine in such a way that it would result in higher impact magnitudes.

For both landfall areas, taking the high sensitivity of residential receptors and the negligible to low magnitude of impact for most activities considered, the overall effect is considered to be negligible to minor and not significant in EIA terms.

However, for HDD works at night at each of the landfalls, the overall effect is considered greater:

- Crosskirk landfall area – taking the high sensitivity of residential receptors and the high magnitude of the impact, the overall potential effect of HDD works at landfall during construction is considered to be **major** and **significant** in EIA terms; and
- Greeny Geo landfall area – taking the high sensitivity of residential receptors and the medium magnitude of the impact, the overall potential effect of HDD works at landfall during construction is considered to be **moderate** and **significant** in EIA terms.

IMPACT	RECEPTOR	SENSITIVITY	MAGNITUDE OF IMPACT	CONSEQUENCE AND SIGNIFICANCE
Enabling works – site access (Crosskirk)	Crosskirk Cottage (NSR A)	High	Low	Minor – NOT SIGNIFICANT
Enabling works – site access (Greeny Geo)	Farmhouse Borrowston Mains (NSR D)	High	Low	Minor – NOT SIGNIFICANT
Enabling works – site compound (Crosskirk)	Crosskirk Cottage (NSR A)	High	Low	Minor – NOT SIGNIFICANT
Enabling works – site compound (Greeny Geo)	Farmhouse Borrowston Mains (NSR D)	High	Negligible	Negligible – NOT SIGNIFICANT
Enabling works – earthworks (Crosskirk)	Crosskirk Cottage (NSR A)	High	Low	Minor – NOT SIGNIFICANT
Enabling works – earthworks (Greeny Geo)	Farmhouse Borrowston Mains (NSR D)	High	Negligible	Negligible – NOT SIGNIFICANT
HDD works – landfall (Crosskirk) – daytime only	Crosskirk Cottage (NSR A)	High	Low	Minor – NOT SIGNIFICANT
HDD works – landfall (Crosskirk) – night-time	Crosskirk Cottage (NSR A)	High	High	Major – SIGNIFICANT
HDD works – landfall (Greeny Geo) – daytime only	Farmhouse Borrowston Mains (NSR D)	High	Negligible	Negligible – NOT SIGNIFICANT
HDD works – landfall (Greeny Geo) – night-time	Farmhouse Borrowston Mains (NSR D)	High	Medium	Moderate – SIGNIFICANT
TJB construction works – landfall (Crosskirk)	Crosskirk Cottage (NSR A)	High	Low	Minor – NOT SIGNIFICANT
TJB construction works – landfall (Greeny Geo)	Farmhouse Borrowston Mains (NSR D)	High	Negligible	Negligible – NOT SIGNIFICANT

The effects of HDD works at landfall at night are predicted to be significantly adverse, in the absence of specific mitigation. However, the worst case noise levels predicted for HDD works assumed a location for the drilling rig at ground level and not down in a pit and at the closest potential point to the NSRs identified. Furthermore, the assumed noise levels for this activity may not arise in practice based on many factors, including ground conditions and type of equipment used.

Therefore, the suitability of the proposed secondary mitigation measures as discussed below (based on a worst case) will need to be determined at a later stage during detailed design, in particular once the final locations of the HDD works (if required) and the necessary equipment have been determined following site investigations.

The following secondary mitigation measures (i.e. beyond those measures described in Table 15-16) are proposed to minimise the significant effects associated with HDD works during night-time activity:

- HDD locations should be chosen to maximise distance from nearby residential properties as far as possible, whilst considering other constraints. For example, if HDD works are located at Crosskirk West or Crosskirk East instead of the worst case location (Crosskirk Central) assumed, this could be associated with noise reductions of 12 to 16 dB;
- The assessment has assumed high noise levels for the equipment to be used, and it is possible that quieter equipment could be used. This would be reviewed by the contractor following initial ground investigations;
- If solid site boundary screening is employed around the HDD works area, this could offer around 10 dB reduction, depending on the height of the barrier and position of the receptor relative to the works area. Please note however, that it is likely to be impractical to provide noise barriers that are high enough to screen an entire HDD drilling rig, for example;
- The duration of any HDD works will be minimised within practical and safety constraints. Local residents potentially affected will be kept informed of the likely period during which the work will take place, the times and durations of planned works and the measures that are being taken to avoid unnecessary noise. On completion of the works at a particular location, local residents will be informed that the works are complete and noise effects due to HDD works will cease;
- If HDD works are likely to result (following consideration of the above factors) in noise levels at the nearest receptors above 45 dB $L_{Aeq, T}$ for more than 10 days in a 15 day period, or above 50 dB $L_{Aeq, T}$ for less than 10 days in a 15 day period, then the following should be investigated:
  - Restricting the noisiest works, if possible, to the standard daytime working hours detailed in Table 15-16 and suspended at night. Alternatively, noise levels may be monitored at the affected property during the works, with the noisiest activities suspended (if possible) if these noise levels are exceeded; and
  - Failing this, offering affected residents temporary re-housing for the duration of the HDD works.

The above measures will be implemented in the NVMP, as part of the HDD drilling schedule and mitigation plan, which will be produced post-consent. Following implementation of the above measures, it is anticipated that the resultant magnitude of impact will be low.

Evaluation of significance (with secondary mitigation)

Taking the high sensitivity of residential receptors and the low magnitude of the impact with secondary mitigation in place, the overall effect of HDD works occurring during the night-time at the landfall during construction is considered to be minor and not significant in EIA terms.

IMPACT	RECEPTOR	SENSITIVITY	MAGNITUDE OF IMPACT	CONSEQUENCE AND SIGNIFICANCE
Landfall works (Crosskirk)	Crosskirk Cottage (NSR A)	High	Low	Minor – NOT SIGNIFICANT
Landfall works (Greeny Geo)	Farmhouse Borrowston Mains (NSR D)	High	Low	Minor – NOT SIGNIFICANT

15.6.1.2 Construction stage vibration effects – landfall

BS 5228-2 indicates that vibration from auger boring (representative of HDD) falls to below 1 mm/s within a distance of approximately 10 m to 15 m. It is estimated that for distances of 80 m or more, representative of worst case separation distances for this work, levels would reduce to less than 0.3 mm/s which would therefore represent a negligible impact magnitude (see Table 15-14). Similarly, percussive piling which may be associated with sheet piling at the TJBs is predicted to result in levels less than 0.3 mm/s at a distance of 80 m or more, therefore representing a negligible impact magnitude based on the criteria of Table 15-14.

Vibration may also be generated by ground compaction activities for some of the ancillary works required, but this would be for very brief periods when works occur in proximity (less than 50 m) from receptors, resulting in a negligible impact magnitude.

The table below summarises the associated effects, and in the absence of significant adverse vibration effects for these activities, no further mitigation is proposed.

Evaluation of significance

Taking the high sensitivity of residential receptors and the negligible magnitude of the impact, the overall effect of vibration at the landfalls during construction is considered to be negligible and not significant in EIA terms.

IMPACT	RECEPTOR	SENSITIVITY	MAGNITUDE OF IMPACT	CONSEQUENCE AND SIGNIFICANCE
Landfall works (Crosskirk)	Crosskirk Cottage (NSR A)	High	Negligible	Negligible – NOT SIGNIFICANT
Landfall works (Greeny Geo)	Farmhouse Borrowston Mains (NSR D)	High	Negligible	Negligible – NOT SIGNIFICANT

15.6.1.3 Construction stage noise effects – onshore export cable corridor

Due to the large area covered within the onshore export cable corridor and the potential variance within the route to the onshore substation, it is not feasible to identify and list every possible affected receptor.

The construction tasks necessary as part of onshore export cabling works include site access / compound works, HDD / main crossing works, cable trenching and backfilling and CJB excavation and installation, and cable trenching involving rock-breaking, which will each be assessed separately.

Due to the unknown nature of separation distances, predictions of noise along the onshore export cable corridor for the various tasks have been carried out for a range of various separation distances, from 10 m to 800 m, to give an indication of the possible noise impacts that could theoretically occur during these works. Table 15-23 below provides the sound power levels (L_w(A)) for each construction task activity, and the resulting predictions of noise levels based on these assumptions.

Table 15-23 Source levels assumed (L_w(A)) and predicted noise levels (dB(A)) from construction works activity along the onshore export cable corridor

DISTANCE ASSUMED	CONSTRUCTION TASK / ACTIVITY			
	ENABLING WORKS: SITE ACCESS TRACKS / COMPOUNDS	HDD / MAIN CROSSING WORKS	CABLE TRENCHING AND BACKFILLING / CJB EXCAVATION & INSTALLATION	CABLE TRENCHING INVOLVING ROCK-BREAKING
L_W(A), DB	111	115	110	115
10 m	83	87	82	87
20 m	77	81	76	81
30 m	73	77	72	77
40 m	71	75	70	75
50 m	68	72	67	72
60 m	67	71	66	71
70 m	65	69	64	69
80 m	64	68	63	68

DISTANCE ASSUMED	CONSTRUCTION TASK / ACTIVITY			
	ENABLING WORKS: SITE ACCESS TRACKS / COMPOUNDS	HDD / MAIN CROSSING WORKS	CABLE TRENCHING AND BACKFILLING / CJB EXCAVATION & INSTALLATION	CABLE TRENCHING INVOLVING ROCK-BREAKING
L_W(A), DB	111	115	110	115
90 m	63	67	62	67
100 m	62	66	61	66
150 m	58	62	57	62
200 m	55	59	54	59
250 m	53	57	52	57
300 m	51	55	50	55
350 m	50	54	49	54
400 m	48	52	47	52
450 m	47	51	46	51
500 m	46	50	45	50
600 m	44	48	43	48
700 m	43	47	42	47
800 m	42	46	41	46

For site access tracks, cable trenching and backfilling, and CJB excavation and installation works along the onshore export cable corridor, noise levels above 75 dB L_{Aeq} are sometimes predicted for activities occurring within distance of less than 30 m from some properties. However, works at this close proximity near any specific NSR would be occurring for very brief periods of time, during restricted daytime hours (specified in Table 15-16), and noise levels will quickly diminish as construction progresses, moving the activity further from the property. Taking these factors

into account and based on professional judgement, the associated impact magnitude for these activities is considered low.

Construction of temporary site compounds along the onshore export cable corridor may occur for slightly longer periods in any location, although for a duration of less than four weeks in any particular location. If occurring within separation distances of 20 m or less from sensitive receptors, with predicted worst case levels above 75 dB, this would result in a medium impact magnitude, if unmitigated.

Trenchless cable installation works (which may comprise HDD or other techniques) will need to take place along the onshore export cable corridor, to cross some features (e.g. watercourse crossings, drains, railway lines, utilities) that may be identified during construction.

For these trenchless works along the onshore export cable corridor, assuming use of HDD as a worst case, if the activity is restricted to daytime period only, at a minimum separation distance of at least 40 m, then the predicted impact magnitude would be medium (accounting for a total duration of just over four weeks). In addition, as with landfall operations, it is possible that HDD works could extend to night-time hours where continuous drilling is required. If drilling operates continuously during the night-time period, based on the worst case assumptions made, the duration of works could be more than 10 days in some cases. This could result in a high impact magnitude for receptors within 450 m of HDD works and a medium impact magnitude for receptors within 800 m of HDD works.

Where rock-breaking activity is needed during cable trenching, at a minimum separation distance of at least 40 m, the predicted impact magnitude would be low (accounting for a potential duration of one to four weeks for the activity within 100 m of the property). However, if rock-breaking occurring within separation distances of 30 m or less from sensitive receptors, for a duration of one to four weeks with predicted worst case levels above 75 dB, this would result in a medium impact magnitude, if unmitigated.

There are educational and healthcare receptors located within a 1 km distance from the onshore export cable corridor study area boundary, which include Halkirk Primary School and Halkirk Surgery, however, at over 700 m from the boundary of the onshore export cable corridor these are at a greater distance from the activities than residential receptors. As predicted levels are lower than those of Table 15-23 a negligible impact magnitude is predicted.

Each of the tasks associated with the onshore export cable construction works have been considered, and the worst case predictions can be seen below, which details the impact, consequence and significance for the worst case receptors along the onshore export cable corridor.

Evaluation of significance

Taking the high sensitivity of residential receptors and the low magnitude of the impact, the overall effect from site access tracks enabling works, cable trenching and backfilling, CJB excavation and installation, along the onshore export cable corridor during construction is considered to be minor and not significant in EIA terms.

Taking the high sensitivity of residential receptors and the medium magnitude of the impact, the worst case overall effect of site compounds enabling works, cable trenching involving rock-breaking and HDD / main crossings (daytime only) along the onshore export cable corridor is considered to be moderate and significant in EIA terms.

Taking the high sensitivity of residential receptors and the high magnitude of the impact, the overall effect of HDD / main crossing works at night along the onshore export cable corridor during construction is considered to be major and significant in EIA terms.

IMPACT	SENSITIVITY	MAGNITUDE OF IMPACT	CONSEQUENCE AND SIGNIFICANCE
Site access tracks enabling works	High	Low	Minor – NOT SIGNIFICANT
Site compounds enabling works	High	Medium	Moderate – SIGNIFICANT
HDD / main crossing works (daytime only)	High	Medium	Moderate – SIGNIFICANT
HDD / main crossing works (night-time)	High	High	Major – SIGNIFICANT
Cable trenching and backfilling	High	Low	Minor – NOT SIGNIFICANT
CJB excavation and installation	High	Low	Minor – NOT SIGNIFICANT
Cable trenching involving rock-breaking	High	Medium	Moderate – SIGNIFICANT

The effects of site compound, HDD works (daytime and night-time) along the onshore export cable corridor and cable trenching involving rock breaking are predicted to be significant adverse, in the absence of secondary mitigation activity.

For construction of site compounds along the onshore export cable corridor route, locations should be chosen to maximise distance from nearby residential properties as far as practicable, with a minimum separation distance of at least 20 m from the nearest NSR. For cable trenching, if rock-breaking activities are required as part of cable trenching, and likely to last more than one week within 30 m from the nearest NSR, then measures such as temporary screening shall be implemented to reduce noise levels below 75 dB over the working day.

For HDD works, other trenchless techniques, such as micro-bore or pipe jacking, should be used where possible. Similar to the mitigation measures proposed for landfall (see section 15.6.1.1), where HDD is required, and where works will need to be continuous operating through the night, HDD locations should be chosen to maximise distance from nearby properties as far as possible. Further measures include using equipment with lower noise levels where possible, employing solid site boundary screening around the HDD works which could offer up to 10 dB reduction. The duration of any night-time HDD works should be minimised where possible, keeping local residents informed.

If, following consideration of the above, HDD works are likely to result in noise levels at the nearest receptors above 45 dB $L_{Aeq, T}$ for more than 10 days in a 15 day period, or above 50 dB $L_{Aeq, T}$ for less than 10 days in a 15 day period, then the noisiest works should be restricted to the standard daytime working hours of Table 15-16 and interrupted at

night. This also could be established by noise monitoring at the affected property during the works, with the noisiest activities interrupted (if possible) if these noise levels are exceeded. If it is not possible to cease operations at night or controlling noise levels to the noise limits described, then affected residents could be offered temporary re-housing for the duration of the HDD works.

The above measures will be implemented in the NVMP (post-consent), as part of the HDD drilling schedule and mitigation plan.

Following implementation of the above measures, it is anticipated that the resultant magnitude of impact will be low.

Evaluation of significance (with secondary mitigation)

Taking the high sensitivity of residential receptors and the low magnitude of the impact, the overall effects of site compounds works, HDD / main crossing works (daytime and night-time), and cable trenching involving rock-breaking during construction is considered to be minor and not significant in EIA terms.

IMPACT	SENSITIVITY	MAGNITUDE OF IMPACT	CONSEQUENCE AND SIGNIFICANCE
Site compounds enabling works	High	Low	Minor – NOT SIGNIFICANT
HDD / main crossing works (daytime)	High	Low	Minor – NOT SIGNIFICANT
HDD / main crossing works (night-time)	High	Low	Minor – NOT SIGNIFICANT
Cable trenching involving rock-breaking	High	Low	Minor – NOT SIGNIFICANT

15.6.1.4 Construction stage vibration effects – onshore export cable corridor

As noted in section 15.6.1.2, vibration from HDD drilling activities falls to below 1 mm/s within a distance of approximately 10 m to 15 m. Therefore, in the absence of further information, as a worst case, this would represent low impact magnitude based on the criteria of Table 15-14. Vibration may also be generated by activities such as ground compaction for some of the ancillary works required, but this would be for very brief periods when works occur in proximity (less than 50 m) from receptors, resulting in a negligible impact magnitude.

Evaluation of significance

Taking the high sensitivity of residential receptors and the low magnitude of the impact, the overall effect of vibration along the onshore export cable corridor from HDD works during construction is considered to be minor and not significant in EIA terms. In the absence of significant adverse vibration effects for these activities, no further mitigation is proposed.

IMPACT	SENSITIVITY	MAGNITUDE OF IMPACT	CONSEQUENCE AND SIGNIFICANCE
HDD	High	Low	Minor – NOT SIGNIFICANT

15.6.1.5 Construction stage noise effects – onshore substation

In common with the landfall construction, predictions of noise levels that would be experienced at residential receptor locations in the vicinity of the onshore substation have been carried out in accordance with the prediction methodology outlined in BS 5228-1 (BSI, 2014a). These calculations have been undertaken for the minimum separation distances between the various boundaries of the onshore substation, which include the site access, temporary construction compound, earth bunding and substation platform, and the nearest residential receptors, as referred to in Table 15-6.

The construction tasks necessary as part of the onshore substation works to be included in the assessment include site access works, site compound works, earthworks, civil works and M&E works, which will each be assessed separately.

Table 15-24 below provides predictions of noise levels from site access enabling works at the onshore substation at the nearest residential property.

Table 15-24 Predicted noise levels from site access enabling onshore substation construction works

PLANT / EQUIPMENT	UPPER COLLECTIVE SOUND EMISSION $L_W(A)$	NEAREST SENSITIVE RECEIVER	MINIMUM DISTANCE TO NEAREST RECEIVER (m)	PREDICTED UPPER DAYTIME NOISE LEVEL (dB) $L_{Aeq, T}$
Tracked excavator, wheeled backhoe, dozer, dump truck, delivery trucks	111	The Cottage, Achalone (NSR 11)	270	52

For site access enabling works at the onshore substation, predicted levels are low and this will be for a short period of time when the activity is closest to the receptor and noise levels will quickly diminish as construction progresses, moving the activity further from the property. Therefore, the magnitude of impact is considered negligible. Table 15-25 below provides predictions of noise levels from site compound enabling works at the onshore substation at the nearest residential property.

Table 15-25 Predicted noise levels from site compound enabling onshore substation construction works

PLANT / EQUIPMENT	UPPER COLLECTIVE SOUND EMISSION $L_W(A)$	NEAREST SENSITIVE RECEIVER	DISTANCE TO NEAREST RECEIVER (m)	PREDICTED UPPER DAYTIME NOISE LEVEL (dB) $L_{Aeq, T}$
Excavator, dump truck, tippers, rollers, delivery trucks, mobile crane	116	The Cottage, Achalone, (NSR 11)	20 – 330	55 – 82

For the onshore substation site compound enabling works, a range of distances has been provided for the closest and furthest points that construction activity could take place. Although a high noise level is predicted for lower separation distances, this will be for a brief period of time during the restricted daytime hours and noise levels will diminish as activity moves further from the property. Noise levels are likely to be lower than 75 dB for the majority of the time, pertaining to a separation distance of more than 40 m, with noise levels likely to approach the worst case level of 82 dB for a brief duration. However, it is possible that these works could take more than four weeks in total and in the absence of definitive information on duration of the work, at worst this could result in a medium impact magnitude.

Table 15-26 below provides predictions of noise levels from earthworks enabling works at the onshore substation at the nearest residential properties. Earthworks for the site will include forming the earth bunding around the substation platform, and this will be conducted over the duration that the onshore export cable are being installed, the excavated material will be used to create the bunds. It is considered likely that some periods of earthworks could take several weeks to undertake. Earthworks potentially involving steel sheet vibratory piling may be required for works on the substation platform, but not for bunding earthworks; as such these works will take place at a greater distance from the receptor as seen in Table 15-26 below.

Table 15-26 Predicted noise levels from earthworks enabling onshore substation construction works

TASK NAME	PLANT / EQUIPMENT	UPPER COLLECTIVE SOUND EMISSION $L_W(A)$	NEAREST SENSITIVE RECEIVER	MINIMUM DISTANCE TO NEAREST RECEIVER (m)	PREDICTED UPPER DAYTIME NOISE LEVEL (dB) $L_{Aeq, T}$
Earthworks (including bunding and rock-breaking activity)	Backhoe mounted hydraulic breaker, wheeled backhoe, dozer, dump truck, delivery trucks	115	Achomhairle Farm (NSR 10)	35	76
			Milton Farm (NSR 1)	50	72
Earthworks for substation platform (with piling)	Steel sheet vibratory piling (if necessary)	116	Achomhairle Farm (NSR 10)	170	62
			Milton Farm (NSR 1)	285	57

For earthworks enabling works at the onshore substation, these works could take place for periods of four weeks or more in total. However, in the predictions of Table 15-26, minimum separation distances have been used in the calculation, and works at these distances will be for a shorter duration. At Achomhairle Farm (NSR 1), predicted worst case noise levels are only just above 75 dB, meaning that worst case noise levels would only exceed this threshold for a very brief period of time (less than one week). In addition, the likely period where levels would exceed 65 dB (with rock-breaking activity) would likely be for a short period of less than four weeks. Noise levels are expected to

be lower than 65 dB for the majority of the time, during the restricted daytime hours (Table 15-16), consequently the impact magnitude is considered to be low.

Table 15-27 below provides predictions of noise levels from civil works and M&E works at the onshore substation at the nearest residential properties.

Table 15-27 Predicted noise levels from civil and M&E onshore substation construction works

TASK NAME	PLANT / EQUIPMENT	UPPER COLLECTIVE SOUND EMISSION $L_W(A)$	NEAREST SENSITIVE RECEIVER	MINIMUM DISTANCE TO NEAREST RECEIVER (m)	PREDICTED UPPER DAYTIME NOISE LEVEL (dB) $L_{Aeq, T}$
Civil works (with onsite concrete batching)	Excavator, delivery truck, cranes, generators, compressors, dump truck, onsite concrete batching	114	Achomhairle Farm (NSR 10)	160	60
M&E works	Delivery lorry, mobile crane, generator, compressor, tractor towing equipment, club hammer	110	Achomhairle Farm (NSR 10)	160	56

For civil works and M&E works at the onshore substation, even if these works take place for a period of four weeks or more, the impact magnitude is considered low.

Each of the tasks associated with the onshore substation construction works have been considered, and the worst case predictions can be seen below, which details the impact, consequence and significance for the worst case receptors to the onshore substation. Although each activity was assessed in turn, due to the likely sequencing and the approach which considered the closest affected property in each case, the works would not combine in such a way that it would result in higher impact magnitudes.

Evaluation of significance

Taking the high sensitivity of residential receptors and the negligible to low magnitude of the impact, the overall effect of most works at the onshore substation during construction is considered to be negligible to minor and not significant in EIA terms.

Taking the high sensitivity of residential receptors and the medium magnitude of the impact, the overall effect of site compound enabling works at the onshore substation during construction is considered to be moderate and significant in EIA terms.

IMPACT	SENSITIVITY	MAGNITUDE OF IMPACT	CONSEQUENCE AND SIGNIFICANCE
Enabling works – site access	High	Negligible	Negligible – NOT SIGNIFICANT
Enabling works – site compound	High	Medium	Moderate – SIGNIFICANT
Enabling works – earthworks	High	Low	Minor – NOT SIGNIFICANT
Civil works (with onsite concrete batching)	High	Low	Minor – NOT SIGNIFICANT
M&E works	High	Low	Minor – NOT SIGNIFICANT

The effects of site compound works at the onshore substation are predicted to be significantly adverse, in the absence of secondary mitigation. However, using a temporary solid barrier, installed between the site compound area and NSR 11, which can provide acoustic screening of at least 10 dB, reducing worst case levels potentially to 72 dB (for a short period of time) and to less than 65 dB for the majority of this construction stage, consequently the residual impact magnitude is considered to be low.

The above secondary mitigation measure will be implemented in the NVMP, which will be developed post-consent. Following implementation of the above measure, the table below sets out the residual impacts for the works associated with construction at the onshore substation.

Evaluation of significance (with secondary mitigation)

Taking the high sensitivity of residential receptors and the low magnitude of the impact, the overall effects of site compounds works during construction is considered to be minor and not significant in EIA terms.

IMPACT	SENSITIVITY	MAGNITUDE OF IMPACT	CONSEQUENCE AND SIGNIFICANCE
Enabling works – site compound	High	Low	Minor – NOT SIGNIFICANT

15.6.1.6 Construction stage vibration effects – onshore substation

Percussive piling at distances of 150 m or more from the nearest NSRs is predicted to result in levels less than 0.3 mm/s, therefore representing a negligible magnitude of impact.

Ground compaction activities which may be used for some of the earthworks could occur at 35 m from the nearest receptors: based on guidance in BS 5228-2, this is predicted to result in vibration levels of less than 1 mm/s, resulting in a low magnitude of impact based on the criteria of Table 15-14.

Evaluation of significance

Taking the high sensitivity of residential receptors and the low to negligible magnitude of the impact, the overall effect of vibration at the onshore substation during construction is considered to be **minor** and **not significant** in EIA terms.

IMPACT	SENSITIVITY	MAGNITUDE OF IMPACT	CONSEQUENCE AND SIGNIFICANCE
Earthworks	High	Low to negligible	Minor – NOT SIGNIFICANT

15.6.1.7 Construction stage traffic noise effects

Road traffic associated with construction will also represent a potential source of noise to surrounding properties. Chapter 16: Access, traffic and transport, sets out an assessment of the potential traffic flows associated with different stages of the construction and the associated impacts on roads in the relevant study area. The assumptions made are summarised in Table 15-17, including consideration of embedded measures set out in the outline CTMP which is submitted along with this PPP Application (OMP2: Outline CTMP).

Where possible, the methodology set out in CRTN (DfT, 1988) has been used to determine the associated maximum total change in the average day time traffic noise for dwellings located along the identified routes (in terms of a relative change in noise levels) (see Table 15-28). The road links references used in chapter 16: Access, traffic and transport are also provided in Table 15-28.

As noted in section 15.5.3.1, for Average Annual Daily Flow (AADF) traffic flows below 3,000 vehicles per day, the CRTN calculation of relative change in noise level is subject to a high uncertainty, and a calculation of absolute noise levels associated with the HGV movements (which dominate the noise generation) was undertaken instead. For roads where total traffic levels are below or close to the minimum flow volume of 1,000 vehicles required by the CRTN methodology, considering the predicted noise levels that CRTN suggests for this lowest flow value, it can be deduced that the associated L_{Aeq} for the working day associated with the construction traffic will not exceed 60 dB L_{Aeq}, even for properties located in close proximity (less than 10 m) from the relevant road. For other roads, the haul route calculation methodology of BS 5288 was used. These results are also included in the relevant column of Table 15-28.

Table 15-28 Predicted construction traffic noise impact

ROAD LINK	ROAD	TOTAL VEHICLE FLOW (AADF)*	HGV CONSTRUCTION FLOW (DAILY)	CHANGE IN TRAFFIC NOISE LEVEL, DB(A)	PREDICTED ABSOLUTE NOISE LEVEL (L_{AEQ}, DB)
1	U2090 north of A836	236	156	n/a	≤60
2	A836 west of Thurso	3,121	273	2.7	n/a

ROAD LINK	ROAD	TOTAL VEHICLE FLOW (AADF)*	HGV CONSTRUCTION FLOW (DAILY)	CHANGE IN TRAFFIC NOISE LEVEL, DB(A)	PREDICTED ABSOLUTE NOISE LEVEL (L_{AEQ}, DB)
3	U2105 between A836 and C1001	539	273	n/a	≤60
4	C1001 between B874 and U2105	1,354	0	No site traffic	No site traffic
5	B874 between A9 and C1001	3,579	299	2.2	n/a
6	B874 between C1001 and Halkirk	1,654	84	n/a	≤60
7	B780 between B874 and U1871	568	299	n/a	≤60
8	B874 between Halkirk and Roadside	1,891	358	n/a	62
9	C1018 south of C1014	569	0	No site traffic	No site traffic
10	A9 between Roadside and Thurso	4,326	429	2.4	n/a
11	C1014 south of A825	381	0	No site traffic	No site traffic
12	U1871 between B871 and B870	638	333	n/a	≤60
13	U2010 west of U2015	29	0	No site traffic	No site traffic
14	U2052 south of B836	298	156	n/a	≤60
15	A9 south of C1014	2,404	632	n/a	64
16	A9 within Thurso (between A836 and Princess St)	13,402	429	0.8	n/a

Total vehicle flow equates to the 2027 baseline AADF plus the construction traffic AADF as detailed in Table 16-19 of chapter 16: Access, traffic and transport.

Table 15-28 shows that, where relevant, the worst case predicted traffic noise increase associated with the construction traffic on roads with existing elevated traffic noise levels is between 0.8 and 2.7 dB(A). Based on the criteria of Table 15-13, this represents a negligible to low magnitude of change. Some road links are not expected to experience construction traffic, therefore representing a negligible magnitude of change. For other roads where traffic levels

remain low, predicted noise levels of up to 65 dB may be experienced due to the construction HGV traffic, which corresponds to a low magnitude of change according to Table 15-13.

Evaluation of significance

Taking the high sensitivity of residential receptors and the negligible magnitude of the impact, the overall effect of construction traffic for dwellings along the A9 within Thurso or road links with no construction traffic (road links 4, 9, 11 and 13) is considered to be negligible and not significant in EIA terms.

Taking the high sensitivity of residential receptors and the low magnitude of the impact, the overall effect of construction traffic for dwellings along the other road links (road links 1, 2, 3, 5, 6, 7, 8, 10, 12, 14, 15 and 16) are considered to be minor and not significant in EIA terms.

In the absence of significant effects identified, no further mitigation is considered to be required.

IMPACT	RECEPTOR	SENSITIVITY	MAGNITUDE OF IMPACT	CONSEQUENCE AND SIGNIFICANCE
Construction traffic	Dwellings along A9 within Thurso or road links with no construction traffic (road links 4, 9, 11 and 13).	High	Negligible	Negligible – NOT SIGNIFICANT
Construction traffic	Dwellings along other road links (road links 1, 2, 3, 5, 6, 7, 8, 10, 12, 14, 15 and 16)	High	Low	Minor – NOT SIGNIFICANT

15.6.2 Potential effects during operation and maintenance

15.6.2.1 Operational stage noise effects – onshore substation

Noise modelling relating to the onshore substation is presented in SS13: Noise modelling report. This presents the calculations and predictions undertaken based on the type, quantity, and size of plant that is likely to be required at an onshore substation of this size, on a precautionary basis. It should, however, be noted that the final design of the onshore substation will not to be finalised until the pre-construction stage of the project.

The noise modelling report (SS13: Noise modelling report) provides predictions of operational noise from the onshore substation both with and without mitigation. For the avoidance of doubt, mitigation measures such as those identified, based on the indicative onshore substation design and equipment selections, will be applied to the design principles (secured through the CMSs) of the onshore substation and can therefore be considered embedded mitigation.

Embedded mitigation in the form of earth bunding was included in the noise modelling. Embedded mitigation was also specified, in the form of low noise plant, engineering acoustic measures and specialist noise enclosures. The final specification of the acoustic measures required would be determined based on the final substation design and equipment specification. These should be determined such as to achieve the following criteria:

- Noise from the onshore substation in the 100 Hz one-third octave frequency band would not exceed 30 dB $L_{Aeq,\ 5min}$ at any NSR; and
- The Rating Level of noise would not exceed 25 dB L_{Aeq} at any NSR.

The final specification of the acoustic measures required would be determined through further studies when the final onshore substation design and equipment specifications are known and will be designed to meet the thresholds as part of the detailed design process.

Table 15-29 below details the predicted rating noise levels, and the predicted noise level at 100 Hz, with embedded mitigation measures implemented at the five representative NSRs. Full details of the noise assessment in accordance with BS 4142 at all NSRs of Table 15-6, including calculations and predictions, are detailed in SS13: Noise modelling report.

Table 15-29 Noise model prediction results at the nearest dwellings to the onshore substation

SENSITIVE RECEIVER	POSITION IN RELATION TO SITE	PREDICTED RATING LEVEL (L_{AR}), dB	PREDICTED L_{eq} NOISE LEVEL AT 100 HZ (UNWEIGHTED), dB
Milton Farm (NSR 1)	North	23	27
Achomhairle Farm (NSR 10)	East	25	30
The Cottage, Achalone (NSR 11)	East	25	28
Spittal Mains Farm (NSR 12)	South	12	17
Achanarras Farm (NSR 14)	South-west	20	23

In summary, the highest predicted levels of 25 dB at the worst affected receptors, demonstrate that a low magnitude of impact can be achieved at the most affected receptors, based on the assessment in accordance with BS 4142 and compliance with the associated THC requirements (Table 15-4).

For the predicted levels at 100 Hz, following embedded mitigation, predicted noise does not exceed 30 dB in the 100 Hz one-third octave frequency band at any NSR, therefore also complying with the relevant THC requirement.

Evaluation of significance

Taking the high sensitivity of residential receptors and the low magnitude of the impact, the overall effect of operational noise at the onshore substation is considered to be minor and not significant in EIA terms. In the absence of significant effects identified, no further mitigation is considered to be required.

IMPACT	SENSITIVITY	MAGNITUDE OF IMPACT	CONSEQUENCE AND SIGNIFICANCE
Onshore substation operational noise	High	Low	Minor – NOT SIGNIFICANT

15.6.3 Potential effects during decommissioning

In the absence of detailed information regarding decommissioning works, the impacts during the decommissioning of the onshore Project are considered analogous with, or likely less than, those of the construction stage.

Decommissioning operations will be based on strategies that minimise environmental impacts and maximise efforts to recycle materials where possible and will be developed in consultation with the local authorities. The preference will be to remove infrastructure where possible, however the impact of removal will be assessed against environmental impacts. Whilst the detail of the decommissioning strategy is yet to be established, this assessment is based on the decommissioning strategy proposed in Table 5-7 of chapter 5: Project description, which is as close to full removal as possible, whilst recognising that this is subject to assessments and consultation closer to the time of decommissioning. It is expected that decommissioning follows a reverse order of the installation activities with some infrastructure potentially left *in situ*, therefore lessening the noise impact, as there is no requirement for intrusive works and therefore less noisier activities will be required. In particular, there will be no requirement for additional HDD which was identified as one of potentially significant adverse effects for the construction stage. As the landscape bunds and proposed planting will be mature at the time of decommissioning, it is expected these will be retained.

For the onshore export cables, the impacts would be localised to the areas where cables are pulled and removed, and/or all aspects of the onshore substation would be dismantled and removed, both resulting in very localised impacts that are broadly comparable with those identified for the construction stage.

Throughout the operation and maintenance and construction stages, new and forthcoming legislation and policies would be acknowledged and adhered to, supporting, and guiding the decommissioning process. A Decommissioning Restoration and Aftercare Plan will be prepared prior to decommissioning which will include a financial guarantee to secure decommissioning and site restoration. Decommissioning will be undertaken in accordance with applicable guidance at the relevant time. As per the embedded mitigation measures the Project will seek to maximise recycling where possible of components which are recovered to ensure sustainable decommissioning. As such, it would be expected that any potential impact would not be significant.

The overall impact on noise during decommissioning is therefore considered to be, at worst, minor and not significant, in line with the impacts assessed for the construction stage.

15.6.4 Summary of potential effects

A summary of the outcomes of the assessment of potential effects from the construction, operation and maintenance and decommissioning of the onshore Project is provided in Table 15-30.

Table 15-30 Summary of potential effects

POTENTIAL EFFECT	RECEPTOR	SENSITIVITY OF RECEPTOR	MAGNITUDE OF IMPACT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY REQUIREMENTS	MITIGATION	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
Construction and decommissioning*							
Landfall noise: enabling works – site access (Crosskirk)	Crosskirk Cottage (NSR A)	High	Low	Minor (not significant)	None required above embedded mitigation measures.		Minor (not significant)
Landfall noise: enabling works – site access (Greeny Geo)	Farmhouse Borrowston Mains (NSR D)	High	Low	Minor (not significant)	None required above embedded mitigation measures.		Minor (not significant)
Landfall noise: enabling works – site compound (Crosskirk)	Crosskirk Cottage (NSR A)	High	Low	Minor (not significant)	None required above embedded mitigation measures.		Minor (not significant)
Landfall noise: enabling works – site compound (Greeny Geo)	Farmhouse Borrowston Mains (NSR D)	High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.		Negligible (not significant)
Landfall noise: enabling works – earthworks (Crosskirk)	Crosskirk Cottage (NSR A)	High	Low	Minor (not significant)	None required above embedded mitigation measures.		Minor (not significant)

POTENTIAL EFFECT	RECEPTOR	SENSITIVITY OF RECEPTOR	MAGNITUDE OF IMPACT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
Landfall noise: enabling works – earthworks (Greeny Geo)	Farmhouse Borrowston Mains (NSR D)	High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Landfall noise: HDD works – landfall (Crosskirk) – daytime only	Crosskirk Cottage (NSR A)	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Landfall noise: HDD works – landfall (Crosskirk) – night-time	Crosskirk Cottage (NSR A)	High	High	Major (significant)	Mitigation measures may include: HDD locations chosen to maximise distances, quieter equipment, screening, communication with local residents, restricting noisiest works or temporary rehousing of affected residents.	Minor (not significant)
Landfall noise: HDD works, landfall (Greeny Geo) – daytime only	Farmhouse Borrowston Mains (NSR D)	High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)

POTENTIAL EFFECT	RECEPTOR	SENSITIVITY OF RECEPTOR	MAGNITUDE OF IMPACT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
Landfall noise: HDD works (Greeny Geo) – night-time	Farmhouse Borrowston Mains (NSR D)	High	Medium	Moderate (significant)	Mitigation measures available include: HDD locations chosen to maximise distances, quieter equipment, screening, communication with local residents, restricting noisiest works or temporary rehousing of affected residents.	Minor (not significant)
Landfall noise: TJB construction works (Crosskirk)	Crosskirk Cottage (NSR A)	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Landfall noise: TJB construction works (Greeny Geo)	Farmhouse Borrowston Mains (NSR D)	High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Landfall vibration: (Crosskirk)	Crosskirk Cottage (NSR A)	High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Landfall vibration: (Greeny Geo)	Farmhouse Borrowston Mains (NSR D)	High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)

POTENTIAL EFFECT	RECEPTOR	SENSITIVITY OF RECEPTOR	MAGNITUDE OF IMPACT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
Onshore export cable corridor – noise: site access tracks enabling works	Residential receptors	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Onshore export cable corridor – noise: site compounds enabling works	Residential receptors	High	Medium	Moderate (significant)	Locations chosen to maximise distances, with minimum separation distance of 20 m.	Minor (not significant)
Onshore export cable corridor – noise: HDD / main crossing works (daytime only)	Residential receptors	High	Medium	Moderate (significant)	Mitigation measures may include: locations chosen to maximise distances, quieter equipment, screening, communication with local residents, restricting noisiest works or temporary rehousing of affected residents.	Minor (not significant)
Onshore export cable corridor – noise: HDD / main crossing works (night-time)	Residential receptors	High	High	Major (significant)	Mitigation measures may include: locations chosen to maximise distances, quieter equipment, screening, communication with local residents, restricting noisiest works or temporary rehousing of affected residents.	Minor (not significant)

POTENTIAL EFFECT	RECEPTOR	SENSITIVITY OF RECEPTOR	MAGNITUDE OF IMPACT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
Onshore export cable corridor – noise: cable trenching and backfilling	Residential receptors	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Onshore export cable corridor – noise: CJB excavation and installation	Residential receptors	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Onshore export cable corridor – noise: cable trenching involving rock-breaking	Residential receptors	High	Medium	Moderate (significant)	Temporary acoustic screening (when activity lasts >1 week within 30 m of an NSR).	Minor (not significant)
Onshore export cable corridor – vibration: HDD	Residential receptors	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Onshore substation – noise: enabling works – site access	Nearest residential receptors	High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Onshore substation – noise: enabling works – site compound	Nearest residential receptors	High	Medium	Moderate (significant)	Acoustic screening between the site compound area and NSR 11.	Minor (not significant)

POTENTIAL EFFECT	RECEPTOR	SENSITIVITY OF RECEPTOR	MAGNITUDE OF IMPACT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
Onshore substation – noise: enabling works – earthworks	Nearest residential receptors	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Onshore substation – noise: civil works (with onsite concrete batching)	Nearest residential receptors	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Onshore substation – noise: M&E works	Nearest residential receptors	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Onshore substation – vibration: earthworks	Nearest residential receptors	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Construction traffic – noise	Dwellings along A9 within Thurso or road links with no construction traffic (links 4, 9, 11 and 13)	High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)

POTENTIAL EFFECT	RECEPTOR	SENSITIVITY OF RECEPTOR	MAGNITUDE OF IMPACT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
Construction traffic – noise	Dwellings along other road links (road links 1, 2, 3, 5, 6, 7, 8, 10, 12, 14, 15 and 16)	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Operation and maintenance						
Onshore substation operational noise	Nearest residential receptors	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)

**** In the absence of detailed information regarding decommissioning works, and unless otherwise stated, the impacts during the decommissioning of the onshore Project are considered comparable with, or likely less than, those of the construction stage.***

15.7 Assessment of cumulative effects

15.7.1 Introduction

Potential impacts from the onshore Project have the potential to interact with those from other developments, plans and activities, resulting in cumulative impacts on noise and vibration receptors. The approach to the cumulative effects assessment is described in chapter 7: EIA methodology (see Figure 7-4), detailing the developments considered in relation to the onshore Project area. A summary of the approach is provided below.

The list of relevant developments for inclusion within the cumulative effects assessment is outlined in Table 15-31. This has been informed by a screening exercise, undertaken to identify relevant developments for consideration within the cumulative effects assessments for each topic-specific, based on defined Zones of Influence (ZoI).

Developments which are located within 1 km of the study areas have the potential to result in a cumulative effect for noise and vibration receptors. The existing SHET-L Spittal Substation (previously known as "Caithness converter substation", planning reference 11/02459/FUL) is operational and part of the baseline noise environment. The baseline noise survey detailed in SS12: Noise survey report includes measurements of noise in proximity of the existing onshore substation, but the measurements did not identify a substantial contribution of noise at the neighbouring noise sensitive properties of Table 15-6.

In addition, reference was also made to the cumulative assessment presented in chapter 16: Access, traffic and transport, which considered a wider range of developments which could lead to additional traffic generation and the associated effects. The resulting cumulative traffic assessment was referenced as the basis for the assessment of cumulative traffic noise below.

Information for each of the cumulative developments was obtained from publicly available planning information. For the relevant developments identified, which are set out in Table 15-31, the cumulative assessment was undertaken where relevant.

Table 15-31 List of developments considered for the noise and vibration cumulative impact assessment

LOCATION	DEVELOPMENT TYPE	DEVELOPMENT NAME	DISTANCE FROM ONSHORE PROJECT AREA (KM)	DISTANCE FROM ONSHORE SUBSTATION SEARCH AREA (KM)	STATUS	CONFIDENCE[3]
Spittal, Caithness	Transmission infrastructure – substation plant	ESB Asset Development Synchronous Compensator (20/05118/FUL).	0	0	Application	Low
Spittal, Caithness	Transmission infrastructure – cables	High Voltage underground Spittal Synchronous Compensator Grid Connection (22/00016/FUL).	0	0.24	Consented	Medium
Forss, Caithness	Onshore windfarm	Forss Windfarm Extension (20/04455/FUL).	0.51	18.21	Application	Low

15.7.2 Cumulative construction effects

15.7.2.1 Cumulative construction noise and vibration

Both the proposed ESB Asset Development Synchronous Compensator and associated grid connection described in Table 15-31 will generate localised noise and vibration during their construction, although these were not quantified as part of the planning application for either development, which is consistent with the scale and type of these schemes. Furthermore, most of the construction activities will occur in the area located west of the existing SHET-L Spittal substation, at a distance of more than 110 m from the nearest NSR, Achanarras Farm (NSR 14 in Table 15-6). This would also be more than 700 m from the receptors nearest to the onshore substation (such as Achomhairle Farm, NSR 10 in Table 15-6). Achanarras Farm is also more than 400 m from the construction works for the onshore Project's onshore substation assessed in section 15.6.1.5.

[3] *Confidence ratings have been applied to each cumulative development where: 'Low' = pre-application or application, 'Medium' = consented and 'High' = under construction or operational.*

It can therefore be expected that, even if the construction stages of the cumulative schemes of Table 15-31 coincided with that of the onshore substation for the onshore Project, that no additional cumulative effects would occur. This is based on the noise and vibration generated by typical construction activities required for the construction of this type of development, which would be similar to that assessed in sections 15.6.1.5 and 15.6.1.6, the level of noise expected at the distances considered above and the associated magnitudes based on the relevant criteria of Table 15-13. The EIA for the Forss Windfarm Extension (Abbey Properties, 2020), noted that the main area of the works for the two wind turbines of the extension are more than 500 m from the nearest NSRs (which would include some of the same receptors located in the proximity to the Greeny Geo landfall). Given the limited duration of the works and the restriction of construction working hours in line with THC requirements and application of best practice to minimise noise levels, it was therefore concluded that no detailed assessment of construction noise from the Forss Windfarm Extension would be necessary, which means that construction noise effects were considered effectively negligible. There is therefore considered to be no potential for additional significant cumulative noise effects.

Taking the high sensitivity of residential receptors and the low magnitude of the impact, the overall effect of cumulative construction works is considered to be minor and not significant in EIA terms.

15.7.2.2 Cumulative construction traffic noise

Based on the assumptions set out in Table 15-17, Table 15-32 sets out the predicted noise impacts for cumulative construction traffic for dwellings, when calculated in the same way as considered in section 15.6.1.7 above. The four road links assessed are those identified in chapter 16: Access, traffic and transport as the only common access routes potentially used by all the developments considered.

Table 15-32 Predicted cumulative construction traffic noise impact (for relevant road links)

ROAD LINK	ROAD	TOTAL VEHICLE FLOW (AADF)	HGV CONSTRUCTION FLOW (DAILY)	CHANGE IN TRAFFIC NOISE LEVEL, DB(A)	PREDICTED ABSOLUTE NOISE LEVEL (L_{AEQ}, DB)
2	A836 west of Thurso	3,440	465	3.9	n/a
10	A9 between Roadside and Thurso	4,809	719	3.4	n/a
15	A9 south of C1014	2,886	921	n/a	66
16	A9 within Thurso (between A836 and Princess St)	13,885	719	1.3	n/a

For road link 16 (A9 within Thurso), the predicted noise increase relative to baseline is 1.3 dB which represents a low magnitude of change. Taking the high sensitivity of residential receptors and the low magnitude of the impact, the overall effect of cumulative construction traffic for dwellings along the A9 within Thurso is considered to be minor and not significant in EIA terms.

For the other links (2, 10 and 15), larger relative increases of 3 to 4 dB are predicted, or noise levels above 65 dB over a working day (for sustained periods of time of more than four weeks): this would correspond to a medium magnitude of change. Taking the high sensitivity of residential receptors and the medium magnitude of the impact, the overall effect of cumulative construction traffic for dwellings along A836 West of Thurso, A9 between Roadside and Thurso and A9 south of C1014 is considered to be moderate and significant in EIA terms.

The potential for cumulative levels of construction traffic would be managed and controlled through the CTMP, an outline of which is submitted along with this PPP Application (OMP2: Outline CTMP). In the outline CTMP, details are included that the Principal Contractor will liaise with other construction sites (through regular communication with their respective Principal Contractors, through THC if required), in order to schedule deliveries and traffic to site. In this way, the potential for simultaneous peak traffic periods on the same roads due to construction periods may be minimised. In addition, they should specifically control cumulative HGV traffic on the A836 west of Thurso and on the A9 such that predicted increases in traffic noise levels remain below 3 dB, or construction traffic noise levels for properties along the A9 not normally exceeding 65 dB for properties along that road. This would be expected to be achieved if total construction traffic does not increase substantially above 300 and 800 movements per day on the A836 west of Thurso and on the A9 respectively. Once the construction schedule is finalised, and if required, this additional mitigation measure and will be implemented through the final CTMP post-consent. With this additional mitigation measure in place, the cumulative effects are considered to be minor and not significant in EIA terms.

15.7.3 Cumulative operation and maintenance effects

Although the Forss Windfarm Extension would generate noise during operation which may be perceptible at some of the receptors of Table 15-5 which are located in proximity to the Crosskirk landfall, there are no operational noise impacts from the onshore Project at these receptors, as the only potential operational effects were identified from the onshore substation study area, which is more than 10 km away. Therefore, there is no potential for cumulative operational effects in this instance.

The High Voltage underground Spittal Synchronous Compensator is an application for a grid connection associated with the ESB Asset Development Synchronous Compensator development and does not include any plant which would generate operational noise. Therefore, there is no potential for cumulative operational effects in this instance.

The ESB Asset Development Synchronous Compensator development considered in Table 15-31, is in close proximity to the onshore substation, and the planning application for this included an Environmental Noise Impact Assessment which set out an analysis of operational noise levels predicted to be associated with that development. The assessment followed the methodology of BS 4142 and presented predicted noise levels from the plant assuming all equipment operated continuously and simultaneously at full capacity, therefore representing a worst case analysis.

The closest receptor to the ESB Asset Development Synchronous Compensator is Achanarras Farm (NSR 14 in Table 15-6), where predicted rated noise levels from that development is 22 dB L_{Ar}. The detailed assessment of noise from

the proposed onshore substation is detailed in SS13: Noise modelling report shows that predicted levels at Achanarras Farm, following implementation of the embedded mitigation, is 20 dB $L_{Ar.}$ This would in theory add up to a total noise level of 24 dB L_{Ar}, should both facilities operate simultaneously: this remains below the lowest criteria of 25 dB for night-time periods discussed above in section 15.5.3.2.

For Achomhairle Farm (NSR 10 in Table 15-6), the predicted levels from the ESB Asset Development Synchronous Compensator (which is located more than 700 m away) set out in the noise impact assessment is 18 dB $L_{Ar.}$ Similar or lower noise levels would be predicted at the other properties situated closest to the onshore Projects onshore substation. However, this prediction did not take into account the earth bunding which is proposed as part of the onshore Project and which would in practice screen some of the noise from the ESB Asset Development Synchronous Compensator. It can therefore be expected that noise levels from the ESB Asset Development Synchronous Compensator at these properties would be lower than 15 dB L_{Ar}, which is 10 dB or more below the predicted levels and therefore represents a negligible contribution[4] to noise levels from the onshore Project at these properties.

Taking the high sensitivity of residential receptors and the low magnitude of the impact, the overall effect of cumulative operational noise is considered to be minor and not significant in EIA terms.

15.7.4 Cumulative decommissioning effects

As there is limited information on the decommissioning of the onshore Project and that of other developments, at present, a thorough assessment of decommissioning cumulative effects has not been undertaken. Nonetheless, it is expected that the cumulative effects are likely to be less than or equal to the construction stage, given the decommissioning will be a largely a reverse process to that of construction. Furthermore, decommissioning of multiple other developments are not expected to occur at the same time as the decommissioning stage of the onshore Project.

A Decommissioning, Restoration and Aftercare Plan will be developed and approved pre-construction to address the principal decommissioning measures for the onshore Project and will be written in accordance with applicable guidance. The Decommissioning, Restoration and Aftercare Plan will detail the environmental management, and schedule for decommissioning and will be reviewed and updated throughout the lifetime of the onshore Project to account for changing best practices.

15.7.5 Summary of cumulative effects

A summary of the outcomes of the assessment of cumulative effects for the construction, operation and maintenance and decommissioning stages of the onshore Project is provided in Table 15-33.

[4] If one of a pair of sources is at least 10 dB quieter than the other, then it will contribute negligibly to the combined noise level. So, for example, 40 dB + 50 dB = 50 dB.

Table 15-33 Summary of assessment of cumulative effects for noise and vibration

POTENTIAL IMPACT	RECEPTOR	SENSITIVITY OF RECEPTOR	MAGNITUDE OF IMPACT	CONSEQUENCE (SIGNIFICANCE OF EFFECT)	SECONDARY MITIGATION REQUIREMENTS	RESIDUAL CONSEQUENCE (SIGNIFICANT OF EFFECT)
Construction and decommissioning*						
Cumulative construction works – noise and vibration	Residential receptors	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)
Cumulative construction traffic – noise	Residential receptors	High	Medium	Moderate (significant)	Management of cumulative traffic controlled through the final CTMP.	Minor (not significant)
Operation and maintenance						
Cumulative operational noise	Residential receptors	High	Low	Minor (not significant)	None required above embedded mitigation measures.	Minor (not significant)

In the absence of detailed information regarding decommissioning works, and unless otherwise stated, the impacts during the decommissioning of the onshore Project are considered comparable with, or likely less than, those of the construction stage.

15.8 Inter-related effects

Inter-related effects are the potential effects of multiple impacts, affecting one receptor or a group of receptors. Inter-related effects include interactions between the impacts of the different stages of the onshore Project (i.e. interaction of impacts across construction, operation and maintenance and decommissioning), as well as the interaction between impacts on a receptor within an onshore Project stage. The potential inter-related effects for noise and vibration receptors are described below.

15.8.1 Inter-related effects between onshore Project stages

The assessment of operational noise effects considers the impact of the operation of the onshore substation, which could only come into effect when the large majority of all construction activities would be completed (including the potentially noisiest activities). As such there is no potential for inter-related effects between the onshore Project stages assessed.

15.8.2 Inter-related effects within an onshore Project stage

The assessment of construction noise has determined that effects of construction noise and vibration are relatively localised spatially, and therefore if different stages and activities should be undertaken simultaneously, this would have limited additional effects in practice. Furthermore, the potential for this interaction would be limited in practice due to the need to sequence activities, for example ancillary access work required prior to landfall works, or construction compound works largely completed before the remainder of the construction work.

For the onshore substation works, the noise from the construction activities assessed in section 15.6.1.6 could be experienced in addition to the effects of traffic on the A9 (section 15.6.1.7), however the properties closest to that road would experience this noise on a different side of the properties to that exposed to the other construction activities. Furthermore, the predictions were made on a worst case basis with the activities occurring at the closest possible point. Overall, it is not considered that significant inter-related effects would arise.

The assessment of operational noise has considered all potential sources operating simultaneously so there are no additional relevant inter-related effects.

15.9 Whole Project assessment

The offshore Project is summarised in chapter 5: Project description and a summary of the effects of the offshore Project is provided in chapter 18: Offshore EIA summary. These offshore aspects of the Project have been considered in relation to the impacts assessed in section 15.6. The findings are presented below.

Most activities associated with the construction and operation of the offshore Project would occur at a substantial distance of several kilometres from the onshore study areas and would therefore be unlikely to create additional effects to the onshore NSRs considered in the present chapter.

There is however potential for a cable laying sea vessel to be close to shore for a period of time which would coincide with the construction period at landfall for the onshore Project. Therefore, the cumulative impact of these construction activities can be considered. Source noise from the cable laying sea vessel has been estimated by assuming that it is similar to a dredging vessel for which BS 5228-1 provides example source noise information, equivalent to a sound power of L_{wA} 110 dB (which is considered precautionary). The position of the cable laying sea vessel may vary and for the purpose of assessment it has been taken as being up to 400 m seaward of the Mean High Water Spring (MHWS)), and therefore more than 500 m from the nearest NSRs for the landfall area considered in Table 15-5. This would represent noise levels of clearly less than 50 dB L_{Aeq} at these receptors, which would represent a negligible contribution relative to the worst case noise levels considered in section 15.6.1.1, and therefore there would be no additional whole project impacts in addition to those identified above.

15.10 Transboundary effects

There is no potential for transboundary impacts upon noise and vibration receptors due to construction, operation and maintenance and decommissioning of the onshore Project. The potential noise impacts are localised and will not affect other European Economic Area (EEA) states. Therefore, transboundary effects for noise and vibration receptors do not need to be considered further.

15.11 Summary of mitigation and monitoring

Secondary mitigation has been identified to reduce potentially significant effects on noise and vibration to acceptable levels. This mitigation has been identified within sections 15.6 and 15.7 and is summarised in Table 15-34.

Table 15-34 Secondary mitigation requirements

SECONDARY MITIGATION	SECURED BY
For HDD works at landfall and trenchless works along the onshore export cable corridor, following site investigations: • Minimise extent and effects of trenchless work particularly for night-time HDD; • Maximise distance from nearby residential properties where possible; • Liaise with closest affected residents; and • Interrupt drilling at night if possible, or investigate alternative techniques or equipment, use of solid screening. As a result, noise levels from HDD drilling at the nearest occupied NSR should not exceed the following levels for night-time periods: 45 dB $L_{Aeq, T}$ for more than 10 days in a 15 day period, or above 50 dB $L_{Aeq, T}$ for less than 10 days in a 15 day period. If these noise levels cannot be achieved, then consider offering temporary re-housing of residents affected.	Established within the design principles (secured through the CMSs) and within the NVMP. The NVMP will be secured through a condition attached to the PPP.

SECONDARY MITIGATION	SECURED BY
Site construction compound areas along the onshore export cable corridor should be determined to maximise distance from nearby residential properties as far as practical, with a minimum separation distance of at least 20 m from the nearest dwellings. If rock-breaking activities are required as part of cable trenching, and likely to last more than one week within 30 m of a dwelling, then use, where possible, temporary solid screening to reduce noise levels below 75 dB(A).	Established within the design principles (secured through the CMSs) and within the NVMP. The NVMP will be secured through a condition attached to the PPP.
Onshore substation construction: installation of a temporary solid site barrier between the site compound area and NSR 11 (The Cottage, Achalone), to reduce expected construction noise levels below 65 dB(A) at NSR 11.	Established within the design principles (secured through the CMSs) and within the NVMP. The NVMP will be secured through a condition attached to the PPP.

A detailed NVMP will be developed through consultation with relevant stakeholders and will be subject to approval as part of the discharge of planning conditions. This may include some monitoring of construction noise from some activities: although details have not yet been confirmed, but potential monitoring could include monitoring at the nearest NSR during night-time HDD work.

In addition, monitoring and addressing of noise complaints will be undertaken by setting up and publicising a contact point with the contractor to log, monitor and address any complaints associated with noise during the construction period. Local residents will be provided with information, if appropriate, to advise of any potential noisy works. The complaints procedures will be detailed within the final CEMP (as indicated in OMP1: Outline CEMP) and within the NVMP, with respect to noise.

15.12 References

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15.13 Abbreviations

ACRONYM	DEFINITION
AADF	Average Annual Daily Flow
AIS	Air Insulated Substation
BPM	Best Practicable Means
BS	British Standard
BSI	British Standards Institution
CaSPlan	Caithness and Sutherland Local Development Plan
CEMP	Construction Environmental Management Plan
CJB	Cable Joint Bay
CLO	Community Liaison Officer
CoPA	Control of Pollution Act 1974
CMS	Construction Method Statement
CRTN	Calculation of Road Traffic Noise
CTMP	Construction Traffic Management Plan
DfT	Department for Transport
dB	Decibel
DMRB	Design Manual for Roads and Bridges
EEA	European Economic Area
EIA	Environmental Impact Assessment
ESB	Electricity Supply Board
HDD	Horizontal Directional Drilling
HGV	Heavy Goods Vehicle
HwLDP	Highland-wide Local Development Plan
Hz	Hertz
ISO	International Organization for Standardization
km	Kilometres

ACRONYM	DEFINITION
m	Metres
m^2	Metres squared
mm/s	Millimetres per Second
M&E	Mechanical and Electrical
MD-LOT	Marine Directorate - Licensing Operations Team
MHWS	Mean High Water Springs
MS-LOT	Marine Scotland - Licensing Operations Team
NPF4	National Planning Framework 4
NRTE	Naval Reactor Test Establishment
NSR	Noise Sensitive Receptor
NVMP	Noise and Vibration Management Plan
OIC	Orkney Islands Council
OMP	Outline Management Plan
OS	Ordnance Survey
PAN	Planning Advice Note
PDE	Project Design Envelope
PPP	Planning Permission in Principle
PPV	Peak Particle Velocity
SHET-L	Scottish Hydro Electric Transmission plc
SS	Supporting Study
TAN	Technical Advice Note
THC	The Highland Council
TJB	Transition Joint Bay
USB	Universal Serial Bus
ZoI	Zones of Influence

15.14 Glossary

TERM	DEFINITION
'A' weighting	The A-weighting is a correction term applied to the frequency range in order to mimic the sensitivity of the human ear to noise.
Decibel or dB	The decibel is the unit used to quantify sound pressure levels as well as sound intensity and power levels. In accordance with the logarithmic scale, an increase of 10 dB in sound pressure level is equivalent to an increase by a factor of 10 in the sound pressure level (measured in Pa). Subjectively, this increase would correspond to a doubling of the perceived loudness of the sound.
Rating Level or rating level (LAr)	A sound pressure level measured in decibels inclusive of character, tonality and impulsivity / intermittency corrections.
Frequency	The rate at which the pressure fluctuations occur determines the pitch or frequency of the sound. The frequency is expressed in Hertz (Hz) or cycles per second.
Noise	Noise is often defined as a sound or sounds, especially when it is unwanted, unpleasant or loud.
L_{A90}	'A' weighted statistical sound pressure level exceeded for 90% of a time period. Used to represent the background sound level.
L_{Aeq}	'A' weighted average sound pressure level.
Octave band frequency analysis	A frequency analysis using a filter that is an octave wide (the upper limit of the filter's frequency band is exactly twice that of its lower frequency limit).
1/3 Octave band frequency analysis	Similar to Octave Band analysis but with each octave further split into three providing a more detailed analysis of frequency content.
Peak Particle Velocity	Measurement of vibration in mm/s.
Sound	The sound energy emitted by an object measured in Watts (W) (decibel referenced to 10-12 W).
Sound Power Level	The sound energy emitted by an object measured in Watts (W) (decibel referenced to 10-12 W).
$L_W(A)$	A-weighted sound power level.
Sound Pressure Level	The human ear has an approximately logarithmic response to sound pressure over a very large dynamic range. The lowest audible sound pressure approximately 2 x 10-5 Pa (2 ten billionths of an atmosphere) and the highest is approximately 100 Pa. It is therefore convenient to express the sound pressure as a logarithmic decibel scale related to this lowest human audible sound.