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11. Noise and Vibration

11.1 Introduction

11.1.1 This chapter of the Preliminary Environmental Information (PEI) Report addresses the potential noise[1] and vibration effects of the Proposed Development.

11.1.2 Impacts during the construction, operation, maintenance and decommissioning phases of the Proposed Development are assessed. In particular, the chapter considers potential impacts on identified residential and ecological receptors in terms of:

- preliminary predicted noise and vibration levels during site clearance, remediation, construction and decommissioning works associated with the Proposed Development;
- predicted changes in road traffic noise levels on the local road network during the construction phase; and
- predicted noise and vibration resulting from operation of the Proposed Development.

11.1.3 This chapter is supported by the Figure 11-1: Noise Sensitive Receptors (PEI Report, Volume II) and Appendices 11A: Construction Noise Assessment Methodology and 11B: Operational Noise Information (PEI Report, Volume III).

11.2 Legislation and Planning Policy Context

11.2.1 This section discusses the legislation, planning policy context and standards relevant to assessing the impacts of noise on residential and other human receptors. The legislation, planning policy context and standards applicable to assessment of noise impacts on the relevant ecological receptors are discussed in Chapter 13: Aquatic Ecology Chapter 14: Marine Ecology and Nature Conservation, Chapter 15: Ornithology (PEI Report, Volume I) and Appendix 15E: Habitat Regulations Assessment – Likely Significant Effects Report, (PEI Report, Volume III).

Legislative Background

Environmental Protection Act 1990

11.2.2 The Environmental Protection Act 1990 (EPA) Part 3 identifies noise (and vibration) emitted from premises (including land) at levels which can be prejudicial to health or a give rise to statutory nuisance.

11.2.3 Local Authorities are required to investigate any public complaints of noise and if they are satisfied that a statutory nuisance exists, or is likely to occur or recur,

[1] In this chapter “noise” and “sound” refer to in air noise and sound.

they must serve a noise abatement notice. A notice is served on the person responsible for the nuisance. It requires either simply the abatement of the nuisance or works to abate the nuisance to be undertaken, or it prohibits or restricts the relevant activity. Contravention of a notice without reasonable excuse is an offence. Right of appeal to the Magistrates Court exists within 21 days of the service of a noise abatement notice.

11.2.4 In determining if a noise complaint amounts to a statutory nuisance the Local Authority can take account of various guidance documents and existing case law; however, no statutory noise limits exist. Demonstrating the use of 'Best Practicable Means' (BPM) to minimise noise levels is an accepted defence against a noise abatement notice.

Control of Pollution Act 1974

11.2.5 Sections 60 and 61 of the Control of Pollution Act 1974 (CoPA) provide the main legislation regarding demolition and construction site noise and vibration. If noise complaints are received, a Section 60 notice may be issued by the local planning authority with instructions to cease work until specific conditions to reduce noise have been adopted.

11.2.6 Section 61 of the CoPA provides a means for applying for prior consent to undertake noise generating activities during construction. Once prior consent has been agreed under Section 61, a Section 60 notice cannot be served provided the agreed conditions are maintained on-site.

11.2.7 The CoPA requires that BPM (as defined in Section 72 of CoPA) be adopted for construction noise on any given site. CoPA makes reference to British Standard (BS) 5228 (British Standards Institute (BSI), 2014a and b) as BPM.

Environmental Permitting Regulations 2016 (as amended)

11.2.8 The Environmental Permitting Regulations require the application of Best Available Techniques (BAT) to activities performed within installations regulated by the legislation in order to manage the impact of these operations on the surrounding environment. This therefore just applies to the operational period, not construction.

11.2.9 In terms of noise specifically, the selection of BAT will have to be considered and balanced with releases to different environmental media (air, land and water) and to give due consideration to issues such as usage of energy and raw materials. Noise, therefore, cannot be considered in isolation from other impacts on the environment.

11.2.10 The definition of pollution includes *"emissions which may be harmful to human health or the quality of the environment, cause offence to human senses or impair or interfere with amenities and other legitimate uses of the environment"*. BAT is therefore likely to be similar, in practice, to the requirements of the Statutory Nuisance legislation which requires the use of BPM to prevent or minimise noise nuisance. In the case of noise, *"offence of any human senses"* may be judged by the likelihood of complaints. However, the lack of complaint should not necessarily imply the absence of a noise problem. In some cases it may be possible, and desirable, to reduce noise emissions still further at

reasonable costs and this may therefore be BAT for noise emissions. Consequently, the aim of BAT should be to ensure that there is no reasonable cause for annoyance to persons beyond the installation boundary.

11.2.11 Guidance regarding Environmental Permitting and noise is available in the Environment Agency's Integrated Pollution Prevention and Control (IPPC) H3 document 'Horizontal Guidance for Noise Part 2 - Noise assessment and Control' (Environment Agency, 2002a). However, 'Horizontal Guidance for Noise Part 1 – Regulation and Permitting' (Environment Agency, 2002b), which provided useful guidance relating to noise limits from industrial installations in terms of absolute rating levels and rating levels relative to background sound levels (as defined in BS 4142:1997 (now superseded)) was withdrawn in February 2016. Therefore, industry wide noise limits no longer apply.

Planning Policy Context

National Planning Policy

National Policy Statements for Energy

11.2.12 Section 5.11 of the Overarching National Policy Statement (NPS) for Energy (EN-1) (Department of Energy and Climate Change (DECC), 2011a) refers to the Government's policy on noise within the Noise Policy Statement for England (discussed further below) and sets out requirements for noise and vibration assessment for Nationally Significant Infrastructure Projects such as the Proposed Development.

11.2.13 At paragraph 5.11.8, with regards decision making, NPS EN-1 states *"The project should demonstrate good design through selection of the quietest cost-effective plant available; containment of noise within buildings wherever possible; optimisation of plant layout to minimise noise emissions; and, where possible, the use of landscaping, bunds or noise barriers to reduce noise transmission."* Section 11.5 of this chapter describes the impact avoidance measures identified as relevant to the Proposed Development.

11.2.14 The NPS for Fossil Fuel Electricity Generating Infrastructure (EN-2) (DECC, 2011b) sets out policy specific to fossil fuel power stations. At paragraph 2.7.1, specific sources of noise identified that are relevant to the Proposed Development include "*the gas and steam turbines that operate continuously during normal operation*". It reiterates at paragraph 2.7.5 the point made in NPS EN-1 that "*the primary mitigation for noise from fossil fuel generating stations is through good design, including enclosure of plant and machinery in noise-reducing buildings wherever possible and to minimise the potential for operations to create noise*" and goes on to state that "*Noise from gas turbines should be mitigated by attenuation of exhausts to reduce any risk of low-frequency noise transmission.*"

11.2.15 The NPS for Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4) (DECC, 2011c) states at paragraph 2.20.4 that *"A new gas pipeline may require an above ground installation such as a gas compression station on the route of the pipeline to boost transmission line pressure"*. This will be required for this project and will be located on the Power, Capture and Compressor site (PCC).

National Planning Policy Framework

11.2.16 The National Planning Policy Framework (NPPF) sets out the Government's planning policies for England and how these are expected to be applied. The Framework supersedes the previous guidance document Planning Policy Guidance 24 'Planning and Noise' (Office of the Deputy Prime Minister (ODPM), 1994).

11.2.17 The NPPF is a matter which the Secretary of State is likely to consider both *"relevant and important"* in determining an application for a development consent order (DCO).

11.2.18 The planning system is required to contribute to and enhance the natural and local environment. Consequently, the aim is to prevent both new and existing development from contributing to or being put at unacceptable risk from or being adversely affected by unacceptable levels of noise pollution.

11.2.19 Paragraph 170 states that:

> *"planning policies and decisions should contribute to and enhance the natural and local environment by:*
>
> - *……preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans."*

11.2.20 Paragraph 180 states that:

> *"Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:*
>
> - *mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development - and avoid noise giving rise to significant adverse impacts on health and the quality of life;… [and]*
> - *identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason".*

11.2.21 With regards to 'adverse effects' and 'significant adverse effects' the NPPF refers to the noise Policy Statement for England Explanatory Note (NPSE) (Department for Environment, Food and Rural Affairs (Defra), 2010), which is described below.

Noise Policy Statement for England

11.2.22 The NPSE (Defra, 2010) seeks to clarify the underlying principles and aims in existing policy documents, legislation and guidance that relate to noise. The NPSE applies to all forms of noise, including environmental noise, neighbour noise and neighbourhood noise.

11.2.23 The statement sets out the long-term vision of the government's noise policy, which is to:

"promote good health and a good quality of life through the effective management of noise within the context of policy on sustainable development".

11.2.24 This long-term vision is supported by three aims:

- *"avoid significant adverse impacts on health and quality of life;*
- *mitigate and minimise adverse impacts on health and quality of life; and*
- *where possible, contribute to the improvements of health and quality of life."*

11.2.25 The long-term policy vision and aims are designed to enable decisions to be made regarding what is an acceptable noise burden to place on society.

11.2.26 The 'Explanatory Note' within the NPSE provides further guidance on defining 'significant adverse effects' and 'adverse effects' using the concepts:

- No Observed Effect Level (NOEL) - the level below which no effect can be detected. Below this level no detectable effect on health and quality of life due to noise can be established;
- Lowest Observable Adverse Effect Level (LOAEL) - the level above which adverse effects on health and quality of life can be detected; and
- Significant Observed Adverse Effect Level (SOAEL) - the level above which significant adverse effects on health and quality of life occur.

11.2.27 The three aims can therefore be interpreted as follows:

- the first aim is to avoid noise levels above the SOAEL;
- the second aim considers situations where noise levels are between the LOAEL and SOAEL. In such circumstances, all reasonable steps should be taken to mitigate and minimise the effects. However, this does not mean that such adverse effects cannot occur; and
- the third aim seeks, where possible, to positively improve the health and quality of life through the pro-active management of noise whilst also taking account of the guiding principles of sustainable development. It is considered that the protection of quiet places and quiet times as well as the enhancement of the acoustic environment will assist with delivering this aim.

11.2.28 The NPSE recognises that it is not possible to have uniform objective noise-based measures that define the SOAEL, LOAEL and NOEL that are applicable

to all sources of noise in all situations. The levels are likely to be different for different noise sources, receptors and at different times of the day.

Planning Practice Guidance

11.2.29 The Planning Practice Guidance (PPG) was first published on 6th March 2014 to provide a web-based resource with more in-depth guidance to the NPPF. The PPG aims to make planning guidance more accessible, and to ensure that the guidance is kept up to date. The PPG was last updated in October 2019.

11.2.30 The guidance advises that local planning authorities should take account of the acoustic environment and consider:

- whether or not a significant adverse effect is occurring or likely to occur;
- whether or not an adverse effect is occurring or likely to occur; and
- whether or not a good standard of amenity can be achieved.

11.2.31 This guidance introduced the additional concepts of NOAEL (No Observed Adverse Effect Level), and UAEL (Unacceptable Adverse Effect Level). Full details of the PPG on effects are provided in Table 11-1.

Table 11-1: Planning Practice Guidance

Perception	Examples of outcomes	Effect level	Action
Not noticeable	No effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to	Significant Observed Adverse Effect	Avoid

Perception	Examples of outcomes	Effect level	Action
	sleep. Quality of life diminished due to change in acoustic character of the area.		
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

11.2.32 Factors to be considered in determining if noise is a concern are identified including the absolute noise level of the source, the existing ambient noise climate, time of day, frequency of occurrence, duration, character of the noise and cumulative impacts.

11.2.33 With particular regard to mitigating noise impacts on residential development, the guidance highlights that impacts may be partially off-set if residents have access to a relatively quiet façade as part of their dwelling, or a relatively quiet amenity space (private, shared or public).

Local Planning Policy

11.2.34 At this stage the local authority has not been consulted specifically regarding noise impacts other than through the scoping process however the Applicant will consult with both RCBC and STBC on the baseline noise environment and the approach to assessment.

11.2.35 As described in Chapter 7: Legislative Context and Planning Policy Framework (PEI Report, Volume I), policy is provided by a range of local documents; the Redcar and Cleveland Local Plan (RCBC, 2018) states that Development Proposals will be expected to:

“minimise pollution including light and noise and vibration levels to meet or exceed acceptable limits”

11.2.36 The Stockton-on-Tees Local Plan (STBC, 2019) contains the following guidance

“All development proposals that may cause groundwater, surface water, air (including odour), noise or light pollution either individually or cumulatively will be required to incorporate measures as appropriate to prevent or reduce their pollution so as not to cause unacceptable impacts on the living conditions of all existing and potential future occupants of land and buildings, the character and appearance of the surrounding area and the environment.”

“The Tees Lowlands National Character Area description, and the Stockton-on-Tees Landscape Character Assessment and Capacity Study (2011) provide the evidence base to consider proposals in landscape terms. The NPPF supports the protection and enhancement of valued landscapes and areas of tranquillity; countryside, limits to development and green wedge policies assist in delivering this aim. Proposals within and adjacent to these designations should be

designed to avoid impacts on areas within that have remained relatively undisturbed by noise and are prized for their recreational and amenity value."

Other Guidance

British Standard 7445-1:2003 and 7445-2:1991

11.2.37 BS 7445 'Description and measurement of environmental noise' (BSI, 1991 and 2003) defines parameters, procedures and instrumentation required for noise measurement and analysis.

British Standard 5228:2009+A1:2014

11.2.38 BS 5228-1 'Code of practice for noise and vibration control on construction and open sites. Noise' (BSI, 2014a) provides a 'best practice' guide for noise control and includes sound power level (L_w[2]) data for individual plant as well as a calculation method for noise from construction activities. BS 5228-2 'Code of practice provides a 'best practice' guide for noise and vibration control on construction and open sites. Vibration' (BSI, 2014b) provides comparable 'best practice' for vibration control, including guidance on the human response to vibration.

British Standard 6472:2008

11.2.39 BS 6472-1 'Guide to evaluation of human exposure to vibration in buildings Part 1: Vibration sources other than blasting' (BSI, 2008), presents recommended frequency weighted vibration spectra (for continuous vibration) and vibration dose values (VDV) (for intermittent vibration), above which adverse comment is likely to occur in residential properties.

British Standard 7385:1993

11.2.40 BS 7385-2 'Evaluation and measurement for vibration in buildings. Guide to damage levels from ground borne vibration' (BSI, 1993) presents guide values for transient and continuous vibration, above which there is a likelihood of cosmetic damage. The standard establishes the basic principles for carrying out vibration measurements and processing the data, with regard to evaluating vibration effects on buildings.

British Standard 4142:2014

11.2.41 BS 4142 'Methods for rating and assessing industrial and commercial sound' (BSI, 2014c) can be used for assessing the effect of noise of an industrial nature, including mechanical services plant noise. The method compares the difference between 'rating level' of the industrial noise, with the 'background sound level' at the receptor position.

Calculation of Road Traffic Noise

11.2.42 Department for Transport (DfT)/ Welsh Office Memorandum 'Calculation of Road Traffic Noise' (CRTN) (DfT/Welsh Office, 1988) describes procedures for traffic noise calculation and measurement and is suitable for environmental assessments of schemes where road traffic noise may have an effect.

[2] L_w in dB re 1 pW

Design Manual for Road and Bridges (2019)

11.2.43 The Highways Agency 'Design Manual for Road and Bridges Volume 11 Section 3 Part 7 LA 111 (Revision 0) Noise and Vibration' (DMRB) (Highways England, 2019) provides guidance on the appropriate level of assessment to be used when assessing the noise and vibration effects arising from all road projects, including new construction, improvements and maintenance. The guidance is also useful for assessing changes in traffic noise levels as a result of non-road projects such as this.

11.3 Assessment Methodology and Significance Criteria

Study Area

11.3.1 The extent of the study area has been defined to include the receptors/ communities in each direction from the PCC, CO_2 Export Pipeline, CO_2 Gathering Network, Gas Connection, Electricity Connection and Water Connections corridors, that may be affected by changes in road traffic flows during the construction phase of the Proposed Development. The extent of the study area including the receptors is shown in Figure 11-1: Noise Sensitive Receptors (PEI Report, Volume II).

Determining Baseline Conditions and Noise Sensitive Receptors

Noise Monitoring Locations and Protocol

11.3.2 The location of potential noise sensitive receptors (NSRs) in proximity to the Site has been considered when assessing the effects associated with noise and vibration levels from the construction, operational, maintenance and decommissioning phases of the Proposed Development.

11.3.3 Adopting a 'worst case scenario' approach, key residential NSR locations considered to be representative of the nearest and likely most sensitive existing receptors to the Proposed Development have been identified and selected. As residential receptors these are all high sensitivity. These receptors are shown on Figure 11-1: Noise Sensitive Receptors (PEI Report, Volume II) and the approximate distance to the Site boundary is shown in Table 11-2. It is considered that if noise and vibration levels are suitably controlled at the key representative receptors identified, then noise and vibration levels will be suitably controlled at other sensitive receptors in the surrounding area.

Table 11-2: Residential Noise Sensitive Receptors

Receptor	Address	Approximate distance to Site boundary (m)	Assessed for
NSR1	74 Broadway West, Redcar	300	Operational noise, construction noise for PCC, construction noise of CO_2 Gathering Network, construction noise of CO_2 Export Pipeline, construction noise of Gas Connection, construction noise of Water Connections (cofferdam), construction of Electrical Connection, construction traffic noise, venting of the CO_2 pipeline
NSR2	51 York Road, Redcar	900	Operational noise, construction noise for PCC, construction noise of CO_2 Gathering Network, construction noise of CO_2 Export Pipeline, construction noise of Gas Connection, construction noise of Water Connections (cofferdam) , construction of Electrical Connection, construction traffic noise, venting of the CO_2 pipeline
NSR3	131 Broadway West	100	Construction noise of CO_2 Gathering Network, construction noise of Gas Connection, construction of Electrical Connection, venting of the CO_2 pipeline
NSR4	Turners Hospital	400	Construction noise of CO_2 Gathering Network, construction of Electrical Connection, venting of the CO_2 pipeline
NSR5	Lazenby village	250	Construction noise of CO_2 Gathering Network, construction noise of Gas Connection, construction of Electrical Connection, venting of the CO_2 pipeline
NSR6	Grangetown	0	Construction noise of CO_2 Gathering Network, construction noise of Gas Connection, construction of Electrical Connection, venting of the CO_2 pipeline
NSR7	Billingham	700	Construction noise of CO_2 Gathering Network, venting of the CO_2 pipeline
NSR8	Marsh house Farm	150	Operational noise, construction noise for PCC, construction noise of CO_2 Gathering Network, construction noise of CO_2 Export Pipeline, construction noise of Gas Connection, construction noise of Water Connections (cofferdam), construction of Electrical Connection, construction traffic noise, venting of the CO_2 pipeline

11.3.4 Additionally, the impacts of noise on ecological receptors and species has been assessed particularly for the Teesmouth and Cleveland Coast SPA / Ramsar. The location of this habitat is shown Figure 11-1: Noise Sensitive Receptors (PEI Report, Volume II).

11.3.5 Full description of the study areas for ecological receptors is available in Chapter 12: Terrestrial Ecology, Chapter 13: Aquatic Ecology, Chapter 14: Marine Ecology and Nature Conservation, Chapter 15: Ornithology (PEI Report, Volume I) and Appendix 15E: Habitats Regulations Assessment – Likely Significant Effects Report (PEI Report, Volume III).

11.3.6 In order to define existing sound conditions at NSRs, ambient sound measurements have been undertaken at five representative residential locations (M1-M5) and four locations representative of ecological receptors (E1-E4), location E1 is also representative of the residential Marsh House Farm. The baseline data collected at locations E1-E4 is used in the assessments of impacts on ecological receptors contained in this chapter, Chapter 14: Marine Ecology and Nature Conservation and Chapter 15: Ornithology (PEI Report, Volume I) and 15E: Habitats Regulations Assessment – Likely Significant Effects Report (PEI Report, Volume III). The nine monitoring locations are shown in Table 11-3 and on Figure 11-1: Noise Sensitive Receptors (PEI Report, Volume II).

Table 11-3: Monitoring Locations

Monitoring location	Address	Details	Date/Time of Measurements (all 2019)
M1	74 Broadway West, Redcar	Unattended monitoring located in trees to the rear of property, representative of NSR1	16/12 14:12 - 18/12 10:42
M2	51 York Road, Redcar	Located by the bridge where York Road becomes Tod Point Road, representative of NSR2	16/12 14:50 - 15:35 16/12 11:50 - 17/12 00:20 17/12 11:41 – 12:11
M3	26-32 Cresswell Road, Middlesbrough	Located on grass next to house closest the Broadway Road representative of NSR6	16/12 16:57 – 17:12 17/12 00:38 – 01:08 18/12 09:52 – 10:22
M4	28 Pasture Lane, Middlesbrough	Located at the end of Pasture Lane, representative of NSR5	16/12 16:15 – 16:30 17/12 01:20 – 01:50 18/12 09:09 – 09:39
M5	49-95 Roscoe Road, Stockton-on-Tees, Billingham	Located on adjacent grass, representative of NSR7	23/07 14:20 – 15:20 23/07 23:00 – 00:00 24/07 13:47 – 14:17
E1	Tod Point Road	Western end of Tod Point Road by Cleveland Golf Links	16/12 15:00 - 15:30 16/12 23:12 - 23:42 17/12 11:43 – 12:28
E2	RSPB Saltholme, A178 Seaton Carew Road, Stockton-on-Tees	South East corner of the car park	17/12 14:24 - 14:54 18/12 11:37 - 12:07
E3	12 Holly Terrace, Stockton-on-Tees	Located across the road from 12 Holly Terrace on disused land to the rear of High Clarence Primary School	17/12 15:05 - 15:35
E4	Seal Sands	At the side of the road by Fine Environmental Services	17/12 15:57 - 16:12 18/12 12:17 – 12:47

11.3.7 At M1 unattended measurements were undertaken between Monday 16th December and Wednesday 18th December 2019. At all other locations short term attended measurements were undertaken on the dates and times shown.

11.3.8 Daytime relates to the period between 07:00 and 23:00 (with evening between 19:00 and 23:00) and night-time between 23:00 and 07:00.

11.3.9 At locations E2, E3 and E4 only daytime measurements were made as these are only used in assessments of the effects of construction on ecological receptors and construction will be mostly during the daytime.

11.3.10 All measurements were made at approximately 1.2-1.5 m above ground level, and in accordance with the requirements of British Standard BS 7445 (BSI, 1991 and 2003). All monitoring locations were positioned at least 3.5 m from any reflecting surface, other than the ground (i.e. free-field). Details of ongoing activities and typical sound sources in the area were recorded during visits to the monitoring locations to set up and collect the measurement equipment.

11.3.11 Details of the instrumentation used during the surveys are presented in Table 11-4:

Table 11-4: Measurement Equipment

Equipment Used	Serial Number	Locations Used
Rion NL-52 sound level meter	386762	M1
Norsonic 118 sound level meter	31509	M2, M3, M4, M5, E1, E2, E4
Norsonic Calibrator Type 1251	27485	M1, M2, M5, E1, E2, E4
RION NA-28 sound level meter	00570400	M2, M4, E1, E2, E3, E4
RION calibrator	34973231	M2, E1, E2, E3, E4
Norsonic 140 sound level meter	1403909	M5
Norsonic Calibrator Type 1251	34393	M5

11.3.12 All sound level meters (SLMs) used were Class 1 precision instruments. Each was programmed to log a range of sound indicators including L_{Aeq}, L_{AF90} , L_{AF10} and L_{AFmax}[3], in 15-minute contiguous intervals.

[3] L_{Aeq}, L_{AF90} , L_{AF10} and L_{AFmax} are defined in the PEI Report Glossary

11.3.13 The calibration levels were checked prior to and following all measurements. No significant drift, more than 0.2 dB[4] occurred. Full calibration details are available upon request.

Meteorological Conditions

11.3.14 Observations regarding weather conditions were made during each attended measurement whilst attending the site, these are summarised in Table 11-5. Table 11-5 also includes the weather conditions assumed for the unattended measurement location M1. At the start of the first survey period (Monday 16th December 2019), weather conditions on-site were observed to be dry with patchy cloud; wind blowing from a southerly direction with an average speed of approximately 4 m/s and the road surfaces were noted to be dry. At the end of the survey on Wednesday 18th December 2019 weather conditions were noted to be dry with an average wind speed of approximately 2 m/s from a south-easterly direction.

Table 11-5: Weather Conditions for Monitoring

Monitoring location	Date/Time	Wind speed (m/s)	Wind direction	Temperature (°C)	Cloud cover (-/8)
M1	16/12 14:12 (unattended measurement start time)	4	S	5	2
	18/12 10:56 (unattended measurement end time)	2	SE	2	2
M2	16/12 14:50 - 15:35	2	S	4	2
	16/12 11:50 - 17/12 00:20	No measurable wind	No measurable wind	1	-
	17/12 11:41 - 12:11	1	SW	3	6
M3	16/12 16:57 – 17:12	2	S	3	2
	17/12 00:38 – 01:08	No measurable wind	No measurable wind	1	-
	18/12 09:52 – 10:22	2	SE	2	2
M4	16/12 16:15 – 16:30	2	S	3	2
	17/12 01:20 – 01:50	No measurable wind	No measurable wind	1	-

[4] Where decibel (dB) is used in this chapter it refers to dB re 20 μPa unless otherwise stated

Monitoring location	Date/Time	Wind speed (m/s)	Wind direction	Temperature (°C)	Cloud cover (-/8)
	18/12 09:09 – 09:39	2	SE	1	2
M5	23/07 14:20-15:20	5	S	26	1
	23/07 13:47-14:17	2	S	27	1
E1	16/12 15:00 - 15:30	2	S	4	2
	16/12 23:12 - 23:42	No measurable wind	No measurable wind	1	-
	17/12 11:43 – 12:28	1	SE	2	6
E2	17/12 14:24 - 14:54	3	SW	4	5
	18/12 11:37 - 12:07	2	SE	4	8
E3	17/12 15:05 - 15:35	3	SW	4	5
E4	17/12 15:57 - 16:12	3	SW	4	4
	18/12 12:17 – 12:47	2	SE	2	8

11.3.15 During all measurement periods the weather was suitable for environmental sound measurements (wind speeds below 5 m/s and no precipitation).

11.3.16 The results of the sound monitoring are presented in Section 11.4 (Baseline Conditions).

Impact Assessment and Significance Criteria

Assessment of Construction and Decommissioning Noise Effects

11.3.17 As no construction contractor has yet been appointed, site specific details on the construction activities, programme and numbers and types of construction plant are not yet available. Therefore, detailed construction noise predictions cannot be based on site specific construction information. Nevertheless, indicative construction noise predictions have been undertaken using the calculation methods set out in BS 5228:2009+A1:2014 ‘Code of practice for noise and vibration control on construction and open sites' (BSI, 2014a), based upon construction information from other power and pipeline construction projects. In addition, indicative calculations have been made for works associated with the CO_2 Gathering Network, Gas Connection, CO_2 Export Pipeline, Electrical Connection and possible cofferdam installation as part of refurbishment of the Abstraction Corridor, as well as decommissioning.

11.3.18 The calculation method provided in BS 5228 (2014a) takes account of factors including the number and types of equipment operating, their associated sound power levels (L_w), their modes of operation (% on-times within the working period), the distance to NSRs, and the effects of any intervening ground cover or barrier/ topographical screening. This allows prediction of the magnitude of impact. Construction away from the PCC (including construction of the CO_2 Gathering Network) is assessed separately to the construction assessment for the PCC because the types of plant and activities are different and it will be constructed over a greater area. Construction away from the PCC will be assessed based on the same Significance criteria described in this section as construction within the PCC.

11.3.19 The subsequent assessment of construction noise effects at residential NSRs considers the guidance in 'example method 1 – the ABC method' as defined in BS 5228-1:2009+A1:2014 (BSI, 2014a). Table 11-6 (reproduced from BS 5228) provides guidance in terms of appropriate threshold values for residential NSRs, based upon existing ambient noise levels.

Table 11-6: Construction Noise Threshold Values at Residential Dwellings

Assessment category and threshold value period	Threshold Value $L_{Aeq,T}$ dB – free-field		
	Category A (a)	**Category B (b)**	**Category C (c)**
Night-time (23:00 – 07:00)	45	50	55
Evenings and weekends (d)	55	60	65
Daytime (07:00 – 19:00) and Saturdays (07:00 – 13:00)	65	70	75

NOTE 1: A potential significant effect is indicated if the $L_{Aeq,T}$ noise level arising from the site exceeds the threshold level for the category appropriate to the ambient noise level.

NOTE 2 If the ambient noise level exceeds the Category C threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a potential significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3 dB due to site noise.

NOTE 3: Applies to residential receptors only.

(a) Category A: Threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.

(b) Category B: Threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as Category A values.

(c) Category C: Threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than Category A values.

(d) 19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays, 07:00 – 23:00 Sundays.

11.3.20 For the appropriate period (day, evening, night, weekend etc.), the ambient noise level is determined and rounded to the nearest 5 dB and the appropriate Threshold Value is then derived. The predicted construction noise level is then compared with this Threshold Value.

11.3.21 Based upon the BS 5228 ABC method (BSI, 2014a), the criterion adopted in this assessment for the determination of potentially significant effects is the exceedance of the $L_{Aeq,T}$ threshold level for the category appropriate to the

ambient noise level at each NSR. This is considered to be potentially equivalent to the SOAEL, although as stated in BS 5228, other project-specific factors, such as the number of NSRs affected and the duration and character of the impact, should also be considered by the assessor when determining if there is a potentially significant effect.

11.3.22 For residential receptors and other high sensitivity receptors the criterion for the LOAEL is a predicted construction noise level equal to the existing ambient noise level at each NSR i.e. resulting in a 3 dB increase in noise level when combined with the existing ambient noise level. Currently insufficient data is available on ambient noise level at some NSRs. Therefore, to inform this indicative assessment the LOAEL has been assumed. The threshold is determined by rounding to the nearest 5 dB and comparing to the ABC values. The LOAEL has been assumed to be to be 5 dB below the ABC method threshold value, this will usually be approximately the ambient level.

11.3.23 Note that the criteria for the LOAEL and SOAEL relate to residential NSRs only, in line with the ABC method.

11.3.24 In accordance with the NPPF (MHCLG, 2019) and NPSE (Defra, 2010), it is important to identify NSRs that exceed the LOAEL and ensure significant adverse effects are mitigated and minimised. The assessment focuses on the impact at existing residential NSRs.

11.3.25 Based upon the above, the magnitude of the impact of construction noise is classified in accordance with the descriptors in Table 11-7.

Table 11-7: Magnitude of Construction Noise Impacts

Magnitude of Impact	$L_{Aeq,T}$ dB (façade)
High	Exceedance of ABC Threshold Value by ≥+5 dB
Medium	Exceedance of ABC Threshold Value by up to +5 dB
Low	Equal to or below the ABC Threshold Value by up to 5 dB
Very low	Below the ABC Threshold Value by ≥-5 dB

Assessment of CO_2 Venting Noise Effects

11.3.26 The CO_2 gathering network pipeline will require occasional venting during commissioning and for planned maintenance. This will be infrequent but is a potentially high noise activity which will be managed and assessed in the same way as construction using the threshold values given in Table 11-6 for the BS 5228 ABC method.

Assessment of Daytime Construction Works Traffic on the Public Highway

11.3.27 The Proposed Development will affect traffic flows on existing roads in the area within and surrounding the proposed Site boundary during construction. The assessment focuses on the impact at receptors located alongside the local road network, either residential or ecological.

11.3.28 Construction traffic noise has been assessed by considering the increase in traffic flows during the construction works, following the guidance of CRTN (DfT/Welsh Office, 1988) and DMRB (Highways Agency, 2019).

11.3.29 18-hour (06:00 – 24:00) Annual Average Weekday Traffic (AAWT) data have been obtained for the year 2024 'with' and 'without' construction traffic during the peak construction period, in order to determine if any existing roads are predicted to be subject to a potentially significant change in 18-hour traffic flows. Basic Noise Level (BNL) calculations have been undertaken to predict the change in noise level between the 'with' and 'without' scenarios.

11.3.30 The criteria for the assessment of traffic noise changes arising from construction works have been taken from Table 3.17 of DMRB (Highways Agency, 2019) and are provided in Table 11-8 below.

Table 11-8: Construction Traffic Noise Criteria

Magnitude of impact	Change in traffic noise level $L_{A10,18hr}$ dB
High	≥ 5
Medium	≥3 to <5
Low	≥1 to <3
Very low	<1

11.3.31 An increase in road traffic flows of 25% (where the traffic speed and composition remain consistent) equates to an approximate increase in road traffic noise of 1 dB L_A. A doubling of in traffic flow would be required for an approximate increase in 3 dB L_A.

11.3.32 It is generally accepted that changes in noise levels of 1 dB L_A or less are imperceptible, and changes of 1 to 3 dB L_A are not widely perceptible. Consequently, at the selected road traffic noise receptors the magnitude of the predicted change in noise levels uses the scale shown in Table 11-8 above with respect to construction traffic. The criteria are based on the current guidance on short-term changes in traffic noise levels in DMRB. The SOAEL is set at a change in traffic noise of +3 dB and the LOAEL at +1 dB.

Assessment of Construction Vibration Effects

Effects on Humans – Annoyance

11.3.33 Vibration due to construction activities has the potential to result in adverse impacts at nearby residential NSRs. The transmission of ground-borne vibration is highly dependent on the nature of the intervening ground between the source and receptor and the activities being undertaken. BS 5228-2: 2009+A1: 2014 'Code of Practice for Noise and Vibration Control on Construction and Open Sites - Vibration' (BSI, 2014b) provides data on measured levels of vibration for various construction works, with particular emphasis on piling. Impacts are considered for both damage to buildings and annoyance to occupiers.

11.3.34

11.3.35 Table 11-9 sets out Peak Particle Velocity (PPV) vibration levels and provides a semantic scale for the description of demolition and construction vibration effects on human receptors, based on guidance contained in BS 5228-2 (BSI, 2014b).

Table 11-9: Construction Vibration Threshold at Residential Dwellings

Peak Particle Velocity (PPV) level	Description	Magnitude of impact
>= 10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level.	High
1.0 to < 10 mm/s	It is likely that vibration of this level in residential environments will cause complaint but can be tolerated if prior warning and explanation has been given to residents.	Medium
0.3 to < 1.0 mm/s	Vibration might be just perceptible in residential environments.	Low
0.14 to < 0.3 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.	Very low

11.3.36 For residential receptors and other high sensitivity receptors, the LOAEL is defined as a PPV of 0.3 mm/s (millimetres per second), this being the point at which construction vibration is likely to become perceptible. The SOAEL is defined as a PPV of 1.0 mm/s, this being the level at which construction vibration can be tolerated with prior warning.

11.3.37 At receptors above the SOAEL, further consideration of whether an effect is significant is undertaken using professional judgement, taking account of the duration and frequency of the effect, as well as the time of evening/ night that the effect would be experienced.

11.3.38 In the absence of specific information on likely construction activities and plant, a qualitative assessment based upon professional judgement has been undertaken at this stage.

Effects on Buildings

11.3.39 In addition to human annoyance, building structures may be damaged by high levels of vibration. The levels of vibration that may cause building damage are far in excess of those that may cause annoyance. Consequently, if vibration levels are controlled to those relating to annoyance (i.e. 1.0 mm/s), then it is highly unlikely that buildings will be damaged by demolition and construction vibration levels.

11.3.40 The criteria used in this assessment relate to the potential for cosmetic damage, not structural damage. The principal concern is generally transient vibration, for example due to piling.

11.3.41 BS 7385-2: 1993 ‘Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from groundborne vibration’ (BSI, 1993) provides

guidance on vibration levels likely to result in cosmetic damage and is referenced in BS 5228-2: 2009+A1:2014 (BSI, 2014b). Guide values for transient vibration, above which cosmetic damage could occur, are given in Table 11-10.

Table 11-10: Transient Vibration Guide Values for Cosmetic Damage

Type of building	Peak component particle velocity in frequency range of predominant pulse	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
Unreinforced or light framed structures Residential or light commercial buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

NOTE 1: Values referred to are at the base of the building.

NOTE 2: For un-reinforced or light framed structures and residential or light commercial buildings, a maximum displacement of 0.6 mm (zero to peak) is not to be exceeded

11.3.42 BS 7385-2:1993 (BSI, 1993) states that the probability of building damage tends to zero for transient vibration levels less than 12.5 mm/s PPV. For continuous vibration, such as from vibratory rollers, the threshold is around half this value.

11.3.43 It is also noted that these values refer to the likelihood of cosmetic damage. ISO 4866:2010 (ISO, 2010) defines three different categories of building damage:

- cosmetic – formation of hairline cracks in plaster or drywall surfaces and in mortar joints of brick/concrete block constructions;
- minor – formation of large cracks or loosening and falling of plaster or drywall surfaces or cracks through brick/block; and
- major – damage to structural elements, cracks in support columns, loosening of joints, splaying of masonry cracks.

11.3.44 BS 7385-2:1993 (BSI, 1993) defines that minor damage occurs at a vibration level twice that of cosmetic damage and major damage occurs at a vibration twice that of minor damage. Therefore, this guidance can be used to define the magnitude of impact identified in Table 11-11.

Table 11-11: Magnitude of Impact – Construction Vibration Building Damage

Magnitude of impact	Damage risk	Continuous vibration level ppv mm/s
High	Major	30
Medium	Minor	15
Low	Cosmetic	6
Very low	Negligible	<6

11.3.45 In the absence of specific information on likely construction activities and plant, a qualitative assessment based upon professional judgement has been undertaken. Again, given the significant distance to residential receptors, no significant vibration is expected to result from the proposed construction of the PCC or within the CO_2 Export Pipeline .

11.3.46 However, pipeline construction within the CO_2 Gathering Network and Gas Connection Corridor may be closer to residential receptors, and there is potential for higher impacts. This will depend on the nature of pipeline construction with buried pipes having a greater potential for impact than above ground pipes. This possibility will be considered within the CEMP and suitable techniques and buffer distances developed and implemented.

Vibration Effects on Ecological Receptors

11.3.47 Vibration impacts on ecological receptors, including the SPA / Ramsar site, resulting from construction on the main site are not expected to be significant due to the distances involved. Where construction of the CO_2 Gathering Network, CO_2 Export Pipeline or Natural Gas Connection is close to ecological receptors there is potential for vibration impacts, this will be considered within the CEMP.

Assessment of Operational Noise

11.3.48 A noise propagation model has been developed using the noise modelling software CadnaA 2019 to assess the current layout options for the Proposed Development. CadnaA implements the noise prediction method ISO 9613-2: 1996 ‘Attenuation of sound during propagation outdoors’ (ISO, 1996), which has been employed to calculate noise levels at surrounding NSRs due to noise breakout from the proposed buildings and plant at the PCC.

11.3.49 The noise model consists of a three-dimensional representation of an indicative layout of the PCC and its surroundings. Indicative sound level data for the key sound emitting plant/ buildings within the Proposed Development (turbine halls, Heat Recovery Steam Generator (HRSG), peaking plant) have been sourced from similar CCGT projects based on the indicative concept designs for the PCC. This has been corrected by adding 7 dB to the sound power levels of each source to conservatively reflect the specific conditions and layout of the PCC . The HP Compressor has been assumed to produce a sound pressure level (A-weighted) of 85 dB at 1 m. This is likely to overestimate the sound power level of the Compressor Station.

11.3.50 Significant topographical details and buildings that may influence the transmission of noise to NSRs are included in the noise model. A digital terrain model created using ground elevation spot height data has been used to position buildings and other noise sources at the correct height. The model assumes that the prevailing wind direction is always from source to receiver, which is likely to overestimate the noise effect associated with the Proposed Development.

11.3.51 Based upon the predicted noise levels from the noise model, an assessment of potential noise impact at nearby NSRs has been undertaken using the guidance

in BS 4142: 2014 'Methods for rating and assessing industrial and commercial sound' (BSI, 2014c).

11.3.52 A key aspect of the BS 4142 assessment procedure is a comparison between the background sound level in the vicinity of residential locations and the rating level of the sound source under consideration. The relevant parameters in this instance are as follows:

- Background sound level – $L_{A90,T}$ – defined in the Standard as the *"A-weighted sound pressure level that is exceeded by the residual sound for 90% of a given time interval, T, measured using time weighting F and quoted to the nearest whole number of decibels"*;
- Specific sound level – L_s *($L_{Aeq,Tr}$) – the "equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, Tr"*; and
- Rating level – $L_{Ar,Tr}$ – the *"specific sound level plus any adjustment made for the characteristic features of the sound"*.

11.3.53 Whereas the previous version of BS 4142:1997 allowed for a single correction of 5 dB to be added to the *specific sound level* if one or more of the distinguishable, impulsive or irregular features were considered to be present, BS 4142: 2014 allows for corrections to be applied based upon the presence or expected presence of the following:

- tonality: up to 6 dB penalty;
- impulsivity: up to 9 dB penalty (this can be summed with tonality penalty); and
- other sound characteristics (neither tonal or impulsive but still distinctive): 3 dB penalty.

11.3.54 Once any adjustments have been made, the background sound level and the rating level are compared. The standard states that:

- *"Typically, the greater the difference, the greater the magnitude of impact.*
- *A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending upon the context.*
- *A difference of around +5 dB is likely to be an indication of an adverse impact, depending upon the context.*
- *The lower the rating level is to the measured background sound level, the less likely it is that the specific sound will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending upon the context."*

11.3.55 Importantly, as suggested above, BS 4142:2014 (BSI, 2014c) requires that the rating level of the noise source under assessment be considered in the context of the environment when defining the overall significance of the impact.

11.3.56 BS 4142:2014 (BSI, 2014c) suggests that a one-hour assessment period is considered during the day and a 15-minute assessment period at night.

11.3.57 Table 11-12 illustrates the adopted magnitude of impact scale used in this assessment based upon the numerical level difference. For BS 4142 assessment purposes the SOAEL is set at a rating level above the background sound level of +10 dB, and the LOAEL at +5 dB, although it should be remembered that the context assessment (including the absolute level of the sound under consideration) can vary the overall classification of effects.

Table 11-12: Magnitude of Impact for Industrial Noise

Magnitude of impact	BS 4142 descriptor	Rating level – background sound level (dB)
High	No BS 4142 descriptor for this magnitude level	>15
Medium	Indication of a significant adverse effect, depending upon context	+10 approx.
Low	Indication of an adverse effect, depending upon context	+5 approx.
Very low	Indication of low impact, depending upon context	≤ 0

Assessment of Operational Vibration

11.3.58 The operational equipment at the PCC will comprise precision rotating machinery, which will be monitored and maintained in a high state of balance. This type of equipment therefore does not pass significant levels of vibration into the ground. That, and the distances between the expected location of the equipment and the residential and ecological receptors means that vibration levels will be negligible and further assessment of operational vibration is unnecessary.

11.3.59 No significant sources of vibration are present for operations in the CO_2 Gathering Network, CO_2 Export Pipeline, Water Connections Corridors, Natural Gas Corridor and Electrical Connection Corridor, so vibration levels will be negligible and further assessment of operational vibration for these sources is unnecessary.

Assessment of Noise Effects on Ecological receptors

11.3.60 Worst-case construction noise predictions at ecological receptors have been undertaken. This includes prediction of noise levels due to piling; this is the potential method of construction that is expected to result in the highest noise levels so this will likely result in the worst effects on habitats during the construction period.

11.3.61 The effects of the operational sound and CO_2 venting noise levels predicted on ecological receptors are also assessed.

Noise Effects on Aquatic Ecology

11.3.62 Construction may result in noise and vibration next to waterbodies causing disturbance to fish. The likely impacts and effects of the construction of the Proposed Development on fish will be assessed following field surveys in Spring/Summer 2020 and included in the Environmental Statement which will form part of the DCO Application. Therefore, no further assessment of impacts on aquatic ecological is made in this chapter. Further details of assessment of effects of noise on Aquatic Ecology are available in Chapter 13: Aquatic Ecology (PEI Report, Volume I).

Noise Effects on Marine Ecology

11.3.63 Marine and land-based construction activities associated with the Proposed Development will create airborne noise which has the potential to disturb pinnipeds (i.e. seals) that have surfaced or have hauled out.

11.3.64 The sound exposure level (L_E) thresholds for the onset of temporary threshold shift (TTS) and permanent threshold shift (PTS) in phocids (such as harbour and grey seals) are 134 and 154 dB (re 20 µPa) in air (Southall *et al*., 2019). These sound exposure level thresholds use a weighting specific to the phocid seal group (Southall *et al*., 2019) which differs slightly from the A-weighting that has been applied within the model and is typically used for human receptors. These weightings reflect variations in peak sensitivity of the two receptor groups, which occurs around 10 kHz for marine species and around 1 – 4 kHz for humans (i.e. marine species are more sensitive to high frequency sound than humans).

11.3.65 Construction activities would be expected to be dominated by low- or mid-frequency sound. Furthermore, there is also likely to be less propagation of high frequency sound (compared to mid- or lower-frequency sound) due to ground absorption and air absorption. Thus, it is considered reasonable to assume for the purpose of this PEI Report that the predicted human A-weighted sound pressure levels are equivalent (and a likely worst-case) to phocid-weighted sound pressure levels. However, to permit a comparison between the predicted levels expressed as an L_{Aeq}, and the TTS and PTS thresholds which are expressed as sound exposure levels, the former have been reported as 12 hour unweighted sound pressure levels then converted to a sound exposure level and as a worst case, are compared to the thresholds for phocid seals.

11.3.66 Further details of assessment of effects of noise on Aquatic Ecology are available in Chapter 14: Marine Ecology and Nature Conservation (PEI Report, Volume I).

Noise Effects on Bird Habitats

11.3.67 The degree of impact that varying levels of noise will have on different species of bird is relatively poorly understood. Research published by the Institute of Estuarine & Coastal Studies in 2013, summarises the key evidence base relating to this impact pathway. Based on the observed responses of waterbirds to noise stimuli, an acceptable receptor dose (i.e. maximum noise level at the bird) of 69 dB $L_{Aeq,T}$ has been identified in discussion with Natural England on schemes in other parts of England.

11.3.68 On other projects, Natural England have stated that it is the change in the noise levels experienced by birds, rather than an absolute threshold, that is more appropriate for impact assessment. Birds are considered to have similar hearing to humans. The smallest change in the level of a sound source detectable as a change to the human ear is approximately 3 dB. Such a small change is very unlikely to be disturbing to birds for the same reason it is not disturbing to people. However, a change of 10 dB at a receptor would effectively represent a doubling in the perceived loudness and could result in disturbance. These relationships primarily refer to sounds of a similar nature. A significant change in the nature of the sound will increase the perception of change and hence the potential disturbance. As such, it is important to gain an understanding of the baseline noise levels near ecological receptors and to put the noise levels as a result of construction of the Proposed Development into context. Measurements at E1 are considered representative of the closest point of the Teesmouth and Cleveland Coast SPA / Ramsar to the site.

11.3.69 Further details of assessment of effects of noise on habitats are available in Chapter 15: Ornithology (PEI Report, Volume I) and Appendix 15E: Habitat Regulations Assessment – Likely Significant Effects Report (PEI Report, Volume III).

Receptor Sensitivity

11.3.70 Effects are classified based on the magnitude of the impact and the sensitivity or value of the affected receptor. The criteria for assigning the magnitude of impacts are outlined below for the various potential impacts during construction and operation, and these are followed by a scale of receptor sensitivity in Table 11-13 and overall classification of effects matrix in.

11.3.71 Table 11-14.

Significance of Effects

11.3.72 Impacts are defined as changes arising from the Proposed Development, and consideration of the result of these impacts on environmental receptors enables the identification of associated effects, and their classification (major, moderate, minor and negligible, and adverse, neutral or beneficial). Each effect has been classified both before and after mitigation measures have been applied.

11.3.73 The following terminology has been used in the assessment to define effects:

- adverse – detrimental or negative effects to an environmental resource or receptor;
- neutral – effects to an environmental resource or receptor that are neither adverse nor beneficial; or
- beneficial – advantageous or positive effect to an environmental resource or receptor.

Table 11-13: Sensitivity/Value of Receptors

Sensitivity/ value of resource/ receptor	Description	Examples of receptor usage
Very high	Receptors where noise or vibration will significantly affect the function of a receptor	Auditoria/studios Specialist medical/teaching centres, or laboratories with highly sensitive equipment
High	Receptors where people or operations are particularly susceptible to noise or vibration. Sensitive ecological receptors known to be vulnerable to the effects of noise or vibration.	Residential Quiet outdoor areas used for recreation Conference facilities Schools/educational facilities in the daytime Hospitals/residential care homes Libraries Ecologically sensitive areas for example Special Protection Areas (SPAs)
Medium	Receptors moderately sensitive to noise or vibration where it may cause some distraction or disturbance	Offices Restaurants/retail Sports grounds when spectator or noise is not a normal part of the event and where quiet conditions are necessary (e.g. tennis, golf)
Low	Receptors where distraction or disturbance of people from noise or vibration is minimal	Residences and other buildings not occupied during working hours Factories and working environments with existing high noise levels Sports grounds when spectator or noise is a normal part of the event

11.3.74 The effect resulting from each individual potential impact type above is classified according to the magnitude of the impact and the sensitivity or value of the affected receptor using the matrix presented in .

11.3.75 Table 11-14 below, but where necessary also considering the context of the acoustic environment.

Table 11-14: Classification of Effects

Sensitivity/ value of resource/ receptor	Classification of effect			
	High	**Medium**	**Low**	**Very low**
Very high	Major	Major	Moderate	Minor
High	Major	Moderate	Minor	Negligible
Medium	Moderate	Minor	Negligible	Negligible
Low	Minor	Negligible	Negligible	Negligible

11.3.76 Where adverse or beneficial effects have been identified, these have been assessed against the following significance scale, derived using the matrix presented in .

11.3.77 Table 11-14:

- negligible – imperceptible effect of no significant consequence;
- minor – slight, very short or highly localised effect of no significant consequence;
- moderate – limited effect (by extent, duration or magnitude), which may be considered significant; or
- major – considerable effect (by extent, duration or magnitude) of more than local significance or in breach of recognised acceptability, legislation, policy or standards.

11.3.78 For the purposes of this assessment, negligible and minor effects are considered to be not significant, whereas moderate and major effects are considered to be significant.

Sources of Information/ Data

11.3.79 The following sources of information that define the Proposed Development have been reviewed and form the basis of the assessment of likely significant effects of noise and vibration:

- PEI Report Chapter 4: Proposed Development;
- PEI Report Chapter 5: Construction Programme and Management;
- construction plant and equipment from similar power and pipeline construction projects;
- construction noise data referenced from BS 5228 (BSI, 2014a);
- sound power level (L_w) data from similar power projects (with embedded mitigation);
- AAWT traffic data from the Transport Assessment (TA) for the Proposed Development (see Appendix 16A: Transport Assessment, PEI Report, Volume III); and
- Ordnance Survey (OS) mapping of the Proposed Development and surrounding area; Topographical data (LIDAR data) and aerial photography.

Use of the Rochdale Envelope

11.3.80 In line with PINS Guidance Note Nine (PINS, 2018), the Rochdale Envelope approach has been used. The Rochdale envelope is applicable where some of the details of a Proposed Development have not been confirmed when an application is submitted and flexibility is needed to address uncertainty. The three key principles an assessment should adopt:

- use a cautious worst-case approach;

- the level of information assessed should be sufficient to enable the Likely Significant Effects of a Proposed Development to be assessed; and
- the allowance for flexibility should not be abused to provide inadequate descriptions of projects.

11.3.81 In line with these principles the following assumptions have been made for the construction stage:

- pipeline construction and electrical connection has been assumed to take place at the nearest part of the pipeline corridor to NSRs. Where the pipeline or electrical connection corridor is adjacent to a property it has been assumed that the distance to the edge of the construction area will be 20 m;
- construction activities and plant have mostly been assumed to be in constant operation through the 07:00 to 19:00 working day, see Appendix 11A: Construction Noise Assessment Methodology (PEI Report, Volume III);
- initial predictions made for construction noise in the evening and night-time period assume the same intensity of operation as daytime.

11.3.82 The following assumptions have been made for the operational stage

- assumed that the noise sources will be in the closest part of the PPC site to NSRs;
- the Compressor Station has been assumed to produce a sound pressure level (A-weighted) of 85 dB at 1 m;
- sound emission data assumptions have been taken from a comparable site with embedded mitigation included and corrected to a lower level of mitigation.

11.3.83 There are opportunities for flexibility during the design process to refine these requirements but still deliver an assessment with appropriate impacts and effects.

Consultation

11.3.84 Consultation undertaken during the preparation of this PEI Report Chapter is presented in

11.3.85 Table 11-15 below.

Table 11-15: Consultation Summary Table

Consultee	Date (method of consultation)	Summary of consultee comments	Summary of response/ how comments have been addressed
The Planning Inspectorate	April 2019 (Scoping Opinion)	Comments received on the scoping report The inspectorate agrees with the proposed scope items including that traffic noise due to the workforce of the operational plant should be scoped out.	Traffic noise due to the workforce of the operational plant has been scoped out.
The Planning Inspectorate	April 2019 (Scoping Opinion)	The Inspectorate welcomes the intention to identify NSRs with RCBC, Natural England (NE) and other key stakeholders. The Inspectorate advises that STBC is included as another key stakeholder.	NSRs will be confirmed with RCBC, NE and STBC for the ES chapter
The Planning Inspectorate	April 2019 (Scoping Opinion)	The ES should contain a comprehensive list and figure(s) illustrating the locations of receptors sensitive to noise and vibration impacts, relative to the entirety of the Proposed Development including elements beyond the PCC. It should be clear how other aspects (for example, construction traffic routes to the different parts of the application site) relate to the choice of sensitive receptors	Figure 11-1: Noise Sensitive Receptors (PEI Report, Volume II) shows sensitive receptors.
The Planning Inspectorate	April 2019 (Scoping Opinion)	The assessment of noise and vibration impacts on sensitive ecological receptors e.g. birds and fish should take into account the seasonality of potentially affected species. Cross reference should be made to the ecological impact assessment in the ES.	Impacts on sensitive ecological receptors have been considered in this chapter, Chapter 13: Aquatic Ecology Chapter 14: Marine Ecology and Nature Conservation, Chapter 15: Ornithology (PEI Report, Volume I) and Appendix 15E: Habitat Regulations Assessment – Likely Significant Effects Report, (PEI Report, Volume III). Impacts on fish will be assessed following field surveys in Spring/Summer 2020 and included in the Environmental Statement.
The Planning Inspectorate	April 2019 (Scoping Opinion)	The Scoping Report identifies the potential for noise impacts from road traffic on public roads. The Inspectorate considers the assessment of impacts should not be limited to noise on public roads as NSRs may be present around private roads.	The possibility of impacts from private roads has been considered however access to PCC is understood to be by public roads as discussed in section 11.6.

Consultee	Date (method of consultation)	Summary of consultee comments	Summary of response/ how comments have been addressed
The Planning Inspectorate	April 2019 (Scoping Opinion)	Paragraph 6.67 does not provide assurance that vibration from traffic would be assessed. The ES should assess impacts from ground-borne vibration from HGV traffic during construction and decommissioning where significant effects are likely. Any such assessment should be based on the traffic modelling and likely HGV movements. The vibration sensitive receptors should be identified and shown on a supporting plan within the ES.	Significant effects are not considered likely at any receptors, further information is available in section 11.6.
The Planning Inspectorate	April 2019 (Scoping Opinion)	The Scoping Report states that the assessment of traffic noise levels will be based on '*a range of relevant guidance including the DMRB*'. In the absence of any specific commitment to a methodological approach, the Inspectorate is unable to comment on the applicability of the criteria. In undertaking the assessment, effort should be made to agree the final criteria with the relevant Environmental Health Officer. The ES should clearly explain the approach to determining significance for the assessment of impacts from changes to road traffic noise levels.	This will be agreed for the ES chapter.
The Planning Inspectorate	April 2019 (Scoping Opinion)	Significant Observed Adverse Effect Level (SOAEL) and Lowest Observed Adverse Effect Level (LOAEL) should be defined for all the noise and vibration matters assessed.	These have been defined in section 11.3.
The Planning Inspectorate	April 2019 (Scoping Opinion)	The Inspectorate welcomes the intention to agree baseline noise monitoring requirements with RCBC, however advises that effort is also made to agree the requirements with STBC as the connections are located within their borough.	Monitoring requirements will be agreed for the ES chapter.

Consultee	Date (method of consultation)	Summary of consultee comments	Summary of response/ how comments have been addressed
The Planning Inspectorate	April 2019 (Scoping Opinion)	The Scoping Report confirms that the assessment of construction works will include the electrical, water and gas connections. For the avoidance of doubt, the Inspectorate also expects the ES to assess noise impacts from construction of the CO_2 Gathering Network and any other elements to the Proposed Development that have not yet been identified but have the potential to result in significant effects.	All have been assessed in this chapter.
The Planning Inspectorate	April 2019 (Scoping Opinion)	The ES should identify all sources of noise and vibration which may result from the Proposed Development, including those which extend into the marine area.	Indicative sources have been identified. Full details are shown in Appendix 11A: Construction Noise Assessment Methodology and Appendix 11B: Operational Noise Information (PEI Report, Volume III). The marine area is assessed in Chapter 14: Marine Ecology (PEI Report, Volume I).
The Planning Inspectorate	April 2019 (Scoping Opinion)	It should be clear what assumptions have been made to develop and inform noise modelling. This would include the placement of construction activities/ plant within the application site; and how the likely noise levels generated by the construction activities/ plant have been estimated. If uncertainty exists and flexibility is sought, the noise impact assessment should be undertaken based on a worst case scenario.	Assumptions are discussed in this chapter.
The Planning Inspectorate	April 2019 (Scoping Opinion)	The Scoping Report does not provide any details of anticipated construction methodologies or of the anticipated working hours (including any nighttime working required). This detail should be provided within the ES and incorporated into the noise level predictions and assessment of likely significant effects. Construction working hours should be consistent with those specified in the DCO.	Indicative details provided in section 11.6 and Appendix 11A: Construction Noise Assessment Methodology (PEI Report, Volume III).

Consultee	Date (method of consultation)	Summary of consultee comments	Summary of response/ how comments have been addressed
The Planning Inspectorate	April 2019 (Scoping Opinion)	The ES should define noise limit values and explain how they were determined. The ES should explain the need for monitoring of noise to ensure adherence to the specified noise limits and the appropriateness of mitigation. Effort should be made to agree the need for and scope of monitoring and remedial measures during construction, operation and decommissioning with relevant consultation bodies. This information should be presented in the ES, along with an explanation of how these measures are secured.	Noise limits are considered to be the LOAEL values at NSRs defined in section 11.3.

11.4 Baseline Conditions

Existing Baseline

Sound Survey Results

11.4.1 The processed results from each sound survey position are provided in Table 11-16. The L_{Aeq} are over all measurements taken in each time period (day/night) and the L_{AF90} values presented are the representative BS4142 background sound levels determined from analysis of the measured values. Observations regarding the general baseline sound environment at each monitoring location are detailed after the table.

Table 11-16: Sound Survey Results

Location	Time period	$L_{Aeq,T}$ dB	Highest $L_{AFmax,15min}$ dB	$L_{AF90,15min}$ dB
74 Broadway West, Redcar (M1)	Daytime	54	85	49
	Night-time	50	69	47
51 York Road (M2)	Daytime	66	87	50
	Night-time	52	75	40
26-32 Cresswell Road (M3)	Daytime	57	84	52
	Night-time	45	64	37
28 Pasture Lane (M4)	Daytime	51	67	50
	Night-time	39	60	37
49-95 Roscoe Road (M5)	Daytime	53	80	46
	Night-time	44	64	42
Tod Point Road (E1)	Daytime	56	81	46
	Night-time	47	73	41

Location	Time period	$L_{Aeq,T}$ dB	Highest $L_{AFmax,15min}$ dB	$L_{AF90,15min}$ dB
RSPB Saltholme (E2)	Daytime	56	81	46
	Night-time	47	73	41
12 Holly Terrace (E3)	Daytime	56	74	53
Seal Sands (E4)	Daytime	68	83	56

74 Broadway West, Redcar (M1)

11.4.2 The major sound sources at this location during the daytime were noted to be road traffic on Broadway West and other nearby roads and the industrial estate approximately 40 m north including the building supplies yard.

51 York Road (M2)

11.4.3 During the day road traffic on York Road was observed to be the major sound source with some contribution from unidentified industrial sources to the west or south-west. During the night this industrial sound was more significant with only a minor contribution from occasional cars along York Road.

26-32 Cresswell Road (M3)

11.4.4 During the day road traffic on Broadway was noted to be the major sound source. There was also a contribution from an intermittent industrial source though it was not clear which of the nearby industrial premises was heard. There was another contribution from a distant alarm/siren that was heard three times during the daytime measurements for a period of a few minutes. During the night road traffic sound and industrial sound had similar contributions.

28 Pasture Lane (M4)

11.4.5 At this site there were contributions from road traffic on local roads around the village and the A174. There were also contributions from industrial sources on the Wilton chemical site.

49-95 Roscoe Road (M5)

11.4.6 Sound at this location was dominated by sound from the CF fertilisers site and other industrial sites. However, during the day there were additional contributions from children playing in the park, road traffic and trees rustling.

Tod Point Road (E1)

11.4.7 During the day industrial sound from operations to the south and east along Tod Point road made the largest contribution. There were also contributions from some small-scale construction approximately 100 m away, golfers on the Cleveland Golf Links and occasional traffic along the unnamed road through the area. During the night the only contribution was from the industrial/commercial sources.

RSPB Saltholme (E2)

11.4.8 Sound at this location was dominated by road traffic from both the A1185 to the north and Seaton Carew Road to the east.

12 Holly Terrace (E3)

11.4.9 At this location the dominant source was observed to be traffic on the A1046. There was also intermittent small aircraft sound.

Seal Sands (E4)

11.4.10 The major source at this location was industrial mainly from the Fine Environmental Services site. There was also a significant contribution from the unnamed road through the Seal Sands industrial estate.

Additional surveys required

11.4.11 In advance of the ES chapter additional baseline data will be required both to cover any gaps in the baseline data collected (including evening data at NSR2-NSR7 if required and data at NSR3 and NSR4) and to give confidence the data collected is representative across the year.

Future Baseline

11.4.12 In the absence of the Proposed Development, future baseline sound levels at NSRs will depend largely on traffic flows on surrounding road networks, and the future operations at other industrial and commercial premises.

11.5 Development Design and Impact Avoidance

Construction Noise

11.5.1 Construction activities will typically be undertaken during weekday daytimes (07:00 to 19:00) and Saturday mornings (07:00 to 13:00). As detailed in Chapter 5: Construction Programme and Management (PEI Report, Volume I), some works may need to take place outside of normal working hours, provided that they do not give rise to unacceptable noise impacts. Measures to mitigate noise will be implemented during the construction phase of the Proposed Development in order to minimise impacts at local residential receptors and ecological receptors, particularly with respect to activities required outside of normal working hours. Mitigation (to be included in a Construction Environmental Management Plan (CEMP)) shall include, but not be limited to:

- abiding by agreed construction noise limits at nearby NSRs;
- avoidance of working in the more sensitive evening and night times where possible;
- ensuring that processes are in place to minimise noise before works begin and ensuring that BPM are being achieved throughout the construction programme;
- ensuring that modern plant is used, complying with the latest European noise emission requirements. Selection of inherently quiet plant where possible;
- hydraulic techniques for breaking to be used in preference to percussive techniques where practical;

- use of rotary bored rather the driven piling techniques (if required), where possible;
- off-site pre-fabrication, where practical;
- all plant and equipment being used for the works to be properly maintained, silenced where appropriate, operated to prevent excessive noise and switched off when not in use;
- all contractors to be made familiar with current legislation and the guidance in BS 5228 (Parts 1 and 2) (BSI, 2014a and b), which should form a prerequisite of their appointment;
- loading and unloading of vehicles, dismantling of site equipment such as scaffolding or moving equipment or materials within the proposed Site boundary to be conducted in such a manner as to minimise noise generation;
- appropriate routing of construction traffic on public roads and along access tracks, to reduce as far as reasonably practicable noise level increase (see Chapter 16: Traffic and Transportation, PEI Report, Volume I);
- consultation with the local authorities (RCBC and STBC) and local residents to advise of potential noisy works that are due to take place; and
- noise complaints should be monitored, reported to the contractor and immediately investigated.

11.5.2 Method statements regarding construction management, traffic management, and overall site management will be prepared in accordance with best practice and relevant British Standards, to help to reduce as far as reasonably practicable impacts of construction works. One of the key aims of such method statements will be to minimise noise disruption to local residents during the construction phase.

11.5.3 Regular communication with the local community throughout the construction period will also serve to publicise the works schedule, giving notification to residents regarding periods when higher levels of noise may occur during specific operations, and providing lines of communication where complaints can be addressed.

11.5.4 As mentioned above, a CEMP will be prepared, including setting out provisions to ensure that the noise and vibration impacts relating to construction activities are reduce as far as reasonably practicable based on the measures outlined above. A framework CEMP will be included with the final ES to support the DCO application. To assist in the preparation of the final CEMP, a detailed noise and vibration assessment will be undertaken once the contractor is appointed in order to identify specific mitigation measures for the Proposed Development (including construction traffic).

11.5.5 The timing details of decommissioning are uncertain however the mitigation measures set out in this section for construction noise will also be appropriate mitigation during the decommissioning stage.

CO_2 Venting

11.5.6 Measures to mitigate CO_2 venting during commissioning will include those listed for construction including consultation with local communities and local authorities as well as avoidance of venting during the more sensitive times of the day. Where appropriate and possible mitigation of the CO_2 venting may also include silencers, earthworks or absorptive attenuators.

Operational Noise

11.5.7 During the detailed design stage, potential significant residual noise effects will be mitigated by location and design (see Section 11.7). The PCC will be operated in accordance with an Environmental Permit, issued and regulated by the Environment Agency. This will require operational noise from the generating station to be controlled through the use of BAT, which will be determined through the Environmental Permit application.

11.6 Likely Impacts and Effects

Construction Noise and Vibration

Construction Noise Emission Criteria

11.6.1 Based upon the analysis and summary of the results of the existing free-field baseline ambient noise surveys undertaken for the project, Table 11-17 sets out the BS 5228 ‘ABC’ noise threshold categories (BSI, 2014) at each monitoring location in the vicinity of each NSR for the time periods as set out in Table 11-3. Where baseline data is not available for an NSR a category has been assigned using conservative assumptions, these are

- If evening data is unavailable it has been categorised the same as the lowest category of day and night;
- As NSR3 is close to NSR1 it has been assigned the same categories as sound level data at this location; and
- Otherwise NSRs have been categorised as ‘BS 5228 ABC Category A’, this is a conservative assumption.

Table 11-17: Measured Free-Field $L_{Aeq,T}$ Noise Levels and Associated ‘ABC’ Assessment Category

Receptor	Weekday daytime 07:00 – 19:00		Weekday evening 19:00 – 23:00		Night 23:00 – 07:00	
	$L_{Aeq,T}$ dB	ABC	$L_{Aeq,T}$ dB	ABC	$L_{Aeq,T}$ dB	ABC
NSR1 – 74 Broadway West, Redcar	54	A	51	A	50	C
NSR2 – 51 York Road Redcar	66	B	-	B	52	C

Receptor	Weekday daytime 07:00 – 19:00		Weekday evening 19:00 – 23:00		Night 23:00 – 07:00	
	$L_{Aeq,T}$ dB	ABC	$L_{Aeq,T}$ dB	ABC	$L_{Aeq,T}$ dB	ABC
NSR3 - 131 Broadway West	-	A	-	A	-	C
NSR4 - Turners Hospital	-	A	-	A	-	A
NSR5 - Lazenby village	51	A	-	A	39	A
NSR6 - Grangetown	57	A	-	A	45	B
NSR7 - Billingham	53	A	-	A	44	B
NSR8 – Marsh House Farm	56	A	-	A	47	B

11.6.2 Construction noise limits have been derived for each NSR in Table 11-18 below using the BS5228 ABC methodology (described in Table 11-6). Where baseline data is not available for an NSR limits have been assigned using conservative assumptions.

Table 11-18: Indicative Construction Noise Limits

Receptor	Construction noise limit $L_{Aeq,T}$ dB (Free-field)					
	Weekday daytime 07:00 – 19:00	Weekday evening 19:00 – 23:00	Night 23:00 – 07:00	Saturday 07:00 – 13:00	Saturday 13:00 – 23:00	Sunday 07:00 – 23:00
NSR1 – 74 Broadway West, Redcar	65	55	55	65*	55*	55*
NSR2 – 51 York Road Redcar	70	55*	55	65*	55*	55*
NSR3 - 131 Broadway West	65*	55*	55*	65*	55*	55*
NSR4 - Turners Hospital	65*	55*	45*	65*	55*	55*
NSR5 - Lazenby village	65	55*	45	65*	55*	55*
NSR6 - Grangetown	65	55*	50	65*	55*	55*
NSR7 - Billingham	65	55*	50	65*	55*	55*
NSR8 – Marsh House Farm	65	55*	50	65*	55*	55*

* Assigned based upon a conservative approach in the absence of representative baseline data.

Construction Noise Predictions

11.6.3 Demolition and remediation of the site is expected to be completed in advance however as a worst-case indicative predictions for demolition have been included based on similar power projects.

11.6.4 During the clearance of the Site there is the possibility unexploded ordnance (UXO) will be discovered. If any UXO is discovered its disposal will be carefully managed so that any use of explosives would be managed to occur with warning, at appropriate times of day and taking into account the proximity and sensitivity of nearby receptors. It is not possible to predict the impact of the unlikely event that UXO is detonated unexpectedly.

11.6.5 This following section discusses the potential noise and vibration effects on sensitive receptors arising during the construction phase of the Proposed Development. Construction noise effects are assessed for:

- The PCC;
- CO_2 Gathering Network;
- CO_2 Export Pipeline;
- Natural Gas Connection;
- Electrical Connection; and
- Water Connections.

11.6.6 Noise levels experienced by local receptors during such works depend upon several variables, the most significant of which are:

- the noise generated by plant or equipment used on site, generally expressed as sound power levels (L_w) or the vibration generated by the plant;
- the periods of use of the plant on site, known as its on-time;
- the distance between the noise/ vibration source and the receptor;
- the noise attenuation due to ground absorption, air absorption and barrier effects;
- in some instances, the reflection of noise due to the presence of hard surfaces such as the sides of buildings; and
- the time of day or night the works are undertaken.

11.6.7 Residential NSRs are located in different directions around the PCC. The closest residential NSRs to the PCC (which includes the Power and Capture site and HP Compressor Station) include those located approximately 1 km to the south in the borough of Dormanstown (NSR1) and those located in the town of Redcar (NSR2) approximately 1.6 km to the east.

11.6.8 The site boundary covers the full area in which construction may take place including the PCC, CO_2 Export Pipeline, Water Connections, the CO_2 Gathering Network and Natural Gas and Electrical Connection Corridors (see Figure 4.1

(PEI Report, Volume II)). NSRs located near to this site boundary are assessed for the impact of construction. This includes residences at the western end of Dormanstown (NSR3) which is 100 m from the Electrical Connection Corridor. Sir William Turner's Hospital (NSR4), an assisted living centre, is a residential receptor located in Kirkleatham 450 m east of the site boundary. Lazenby village (NSR5) is located 250 m south of the southern part of the site boundary and Grangetown (NSR6) is located adjacent to the southern part of the site boundary. Additionally, the town of Billingham (NSR7) is approximately 700 m west of the site boundary. Where receptors are adjacent to the Site boundary it has been assumed construction will be at least 20 m away from receptors as this is considered to be a realistic assumption regarding where construction works will actually take place. The minimum distance of each NSR to the construction areas being assessed is shown in Table 11-19.

11.6.9 There are two worst cast possibilities for the indicative construction programme for the Proposed Development. One is that all three trains (each comprising a single CCGT unit with associated carbon capture constructed) are constructed sequentially from 2022 and are operational by 2026. An alternative programme is that the first train operational by 2026, with trains 2 and 3 constructed sequentially commencing in 2028 and both operational by 2031. The construction phases for the CO_2 Gathering Network, CO_2 Export Pipeline, Natural Gas Connection, Electrical connections and water connections may overlap the main construction works or be separate. The majority of construction works will be undertaken during the period Monday to Friday 07:00-19:00 and Saturday 07:00-13:00, although it is likely that some construction activities will be required to be 24 hours during the peak periods or for works that cannot be stopped once commenced.

11.6.10 As exact construction activities are unknown at this stage this assessment, indicative predicted noise levels for construction of the Proposed Development have been based on construction methods used for similar power and pipeline projects. This gives an indication of where, at what stage and during which construction activities construction noise is at risk of leading to potentially significant effects. These levels will be reassessed in the ES which will accompany the DCO application as the scheme design is refined and as information becomes available in order to predict the noise impacts more accurately.

Table 11-19: Distances Between NSRs and Construction

Receptor	Minimum Distance to Construction (m)					
	PCC	CO_2 Gathering Network	CO_2 Export Pipeline	Natural Gas Connection corridor	Water Connections (distances to Cofferdam)	Electrical connections
NSR1 - 74 Broadway West, Redcar	1100	550	1500	450	3400	300
NSR2 - 51 York Road Redcar	1600	1200	1400	1200	4200	1200
NSR3 - 131 Broadway West	N/A	550	N/A	550	N/A	100
NSR4 - Turners Hospital	N/A	2800	N/A	N/A	N/A	400
NSR5 - Lazenby village	N/A	2900	N/A	N/A	N/A	250
NSR6 - Grangetown	N/A	1200	N/A	N/A	N/A	0*
NSR7 - Billingham	N/A	700	N/A	N/A	N/A	N/A
NSR8 – Marsh House Farm	650	250	600	250	3200	250

*Where the site boundary is adjacent to receptors it is assumed for calculations that the construction area will be 20 m away

11.6.11 The construction noise predictions have been undertaken using noise data for plant and calculation methodologies from BS 5228 (2014a). As a conservative approach, it is assumed that all plant and activities area take place at the closest approach to each NSR (except where the site boundary is adjacent to receptors when it is assumed that the construction area will be 20 m away). This is a conservative assumption and as construction corridors and programme are refined this may not occur for any significant duration if at all.

11.6.12 The predicted levels apply to normal weekday daytime (07:00 – 19:00) working, although they could approximate to other time periods where working at the same rate and intensity is proposed. These assume constant operation of equipment throughout the 07:00 – 19:00 working day; this is a conservative worst-case assumption. Details on the noise prediction methodology, including a full list of construction plant and associated sound power levels (L_w) for each

construction phase, are presented in Appendix 11A: Construction Noise Assessment Methodology (PEI Report, Volume III).

11.6.13 A summary of indicative noise predictions at the NSR locations for the PCC are presented in Table 11-20. Only NSR 1 and NSR 2 are included as these are the closest to the PCC. Noise predictions for the other construction works are presented in Table 11-21. Free-field noise levels have been predicted to allow subsequent comparison with the ABC categories derived from free-field baseline ambient noise levels at NSRs.

11.6.14 As advised by BS 5228 noise levels predicted at distances over 300 m (of which both NSRs for the PCC are significantly greater than) should be treated with caution due to the increasing importance of meteorological effects. Where predicted noise levels at NSRs greater than 300 m from the Proposed Development are significantly below the LOAEL the margin of uncertainty is considered insignificant.

11.6.15 With respect to prediction of construction noise of the CO_2 Gathering Network and Natural Gas Connection the presented values are for 'pipe stringing, pipe bending and pipeline welding'. This represents the highest noise levels predicted from multiple potential sub-activities considered for pipeline construction for both above ground pipeline (as is the case for the CO_2 Gathering Network) and below ground (as is the case for the Gas Connection) (see Appendix 11A: Construction Noise Assessment Methodology, PEI Report, Volume III). These predictions also assume that where the corridor boundary is adjacent to a property pipeline construction activity will take place at least 20 m from the property. In reality works are not expected to occur as close as that to NSRs.

11.6.16 Predictions of construction noise levels for the CO_2 Export Pipeline show values for trenchless technologies as this represents the highest noise levels predicted from multiple potential sub-activities for this pipeline (see Appendix 11A: Construction Noise Assessment Methodology, PEI Report, Volume III).

11.6.17 Laydown areas/construction compounds for construction materials for the CO_2 collection network and gas connections will be required. At this stage the locations of these are not defined however assessment of noise from construction compounds will be undertaken for the ES chapter as significant effects cannot be excluded.

11.6.18 Possible routes for the Electrical Connection are either the corridor to the west or east of the Wilton International site. The Electrical Connection may require above ground connections utilising pylons if the route taken is to the west of the Wilton International site or be routed below ground (if the route taken is to the east of the Wilton International site.

11.6.19 To provide a worst-case prediction of construction noise, levels due to installation of foundations for new 400 kV pylons have been included in Table 11-21 for receptors on the western side. The exception is at NSR6 where the nearest construction is the upgrading of existing pylons so predictions of pylon reconductoring have been made. Indicative predictions of construction of an

underground connection have been made for the corridor to the east of the Wilton International site. Predictions for construction of an underground connection are for the topsoil stripping stage of construction as this is predicted to produce the highest levels of the construction activities for an underground connection. As with CO_2 Gathering Network predictions the electrical connection construction predictions also assume that where the corridor boundary is adjacent to a property construction activity will take place at least 20 m from the property. In reality works are not expected to occur as close as that to NSRs.

11.6.20 Within the water connection corridors trenchless technologies, open cut trenches and construction of a cofferdam may be required. The installation of a cofferdam will produce the highest levels of any of the works in the Water Abstraction and Discharge Corridors. Noise levels at NSRs due to installation of the cofferdam (Abstraction Corridor) have been calculated; these are based on sheet piling only as this will result in the highest noise levels during cofferdam installation and removal. Effects of trenchless technologies and open cut trenches have been assessed as a construction activity for the CO_2 Export Pipeline and CO_2 Gathering Network respectively. The location of the cofferdam is shown on Figure 11-1 Noise Sensitive Receptors (PEI Report, Volume II).

Construction Noise Effects of Construction of the PCC

11.6.21 The effects of the predicted daytime construction noise levels (as presented in Table 11-20) have been classified by considering the daytime ABC noise limit value given in Table 11-18, and using the semantic scales in Table 11-6,

11.6.22 Table 11-11and Table 11-13. These effects are summarised in Table 11-22.

Table 11-20: Indicative Construction Noise Predictions for the Proposed Development Within the Proposed Development Boundary

Receptor	Predicted free-field noise level for daytime construction activity dB $L_{Aeq,12h}$					
	Demolition	Site clearance	Piling and foundation	Building	Fit out	Landscaping
NSR1 – 74 Broadway West, Redcar	53	49	53	50	49	29
NSR2 – 51 York Road Redcar	47	43	47	47	43	26
NSR8 – Marsh House Farm	60	54	58	56	54	35

Values above daytime thresholds are shown in bold

Table 11-21: Indicative Construction Noise Predictions for the Proposed Development away from the PCC

Receptor	Predicted free-field noise level for daytime construction activity dB $L_{Aeq,12h}$				
	CO_2 Gathering Network	CO_2 Export Pipeline	Natural Gas Connection	Water Connections (Cofferdam)	Electrical connections
NSR1 - 74 Broadway West, Redcar	54	44	56	37	52
NSR2 - 51 York Road Redcar	51	45	51	36	38
NSR3 - 131 Broadway West	54	N/A	51	N/A	62
NSR4 - Turners Hospital	44	N/A	N/A	N/A	55
NSR5 - Lazenby village	43	N/A	N/A	N/A	54
NSR6 - Grangetown	51	N/A	N/A	N/A	**73**
NSR7 - Billingham	53	N/A	N/A	N/A	N/A
NSR8 – Marsh House Farm	59	52	59	38	54

Values above daytime thresholds are shown in bold

11.6.23 Construction noise effects at all residential receptors during construction of the PCC are predicted to be negligible (not significant) during the daytime period due largely to the distances between the works and NSRs.

11.6.24 It may be necessary for some construction activities to take place continuously over day, evening and night periods during peak construction times of the Proposed Development, although the exact nature of the works is unknown. Noise limits during non-weekday daytime periods have been defined in Table 11-18. The effects of the predicted construction noise levels during the evening and night are shown in Table 11-22 if the same intensity of working as for the daytime is assumed.

11.6.25 Comparison of the predicted daytime noise levels for construction on the PCC against the lower limit values for evening, weekend and night-time working indicate negligible or minor adverse effects. Though only minor effects are predicted, construction activities taking place outside normal working hours will need to be planned, managed and controlled appropriately so they do not exceed the limits for construction noise that have been defined in Table 11-18. Provided noise limits are not exceeded, construction activities outside normal working hours can be considered as having a minor adverse effect or less (not significant). Potential measures to ensure that appropriate embedded mitigation is in place during the works have already been discussed in Section 11.5.

Table 11-22: Indicative Construction Effects for Construction of the PCC

Receptor	Time period	Construction of the Proposed Development					
		Demolition	Site clearance	Piling and foundations	Building	Fit out	Landscaping
NSR1 – 74 Broadway West, Redcar	Daytime	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse
	Evening	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse
	Night-time	Minor adverse	Negligible adverse	Minor adverse	Minor adverse	Negligible adverse	Negligible adverse
NSR2 – 51 York Road Redcar	Daytime	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse
	Evening	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse
	Night-time	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse
NSR8 – Marsh House Farm	Daytime	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse
	Evening	**Major adverse**	Minor adverse	**Moderate adverse**	**Moderate adverse**	Minor adverse	Negligible adverse
	Night-time	**Major adverse**	**Moderate adverse**	**Major adverse**	**Major adverse**	**Moderate adverse**	Negligible adverse

Daytime is 07:00 – 19:00 weekdays and Saturday morning (07:00 – 13:00)
Evening is 19:00 – 23:00 weekdays, Saturday afternoon (13:00 – 23:00) and Sunday 07:00 – 23:00
Night-time is 23:00 – 07:00 all days

Construction Noise Effects of Construction away from the PCC

11.6.26 The effects of the predicted construction noise levels for the construction of the CO_2 Gathering Network, CO_2 Export Pipeline, Electrical Connection, Natural Gas Connection and Water Connections (cofferdam) are shown in Table 11-23.

11.6.27 For construction within the Electrical Connection Corridor unmitigated daytime construction noise effects at NSR6 are predicted to be up to major adverse (significant) when working at the closest approach. This is largely due to the short distance from these properties to the Electrical Connection Corridor. It is unlikely the noisiest construction activities associated with the Electrical Connection Corridor will take place as close to properties as has been used in calculations for a significant period. The Electrical Connection Corridor will only make use of one of two possible routes considered. So when the corridor has been finalised the predicted effects will be reduced at some NSRs. Further work is ongoing to better define the construction corridors. One of the factors being considered is the desire to increase the separation distance to identified sensitive receptors. This should therefore reduce the possible disruption. Also, as the works progress and move further away, adverse effects will reduce.

Table 11-23: Indicative Worst-Case Construction Effects for Construction away from the PCC

Receptor	Time period	Classification of effect				
		CO_2 Gathering Network	**CO_2 Export Pipeline**	**Gas Connection**	**Water Connections (Cofferdam)**	**Electrical Connection**
NSR1 – 74 Broadway West, Redcar	Daytime	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse
	Evening	Minor adverse	Negligible adverse	**Moderate adverse**	Negligible adverse	Minor adverse
	Night-time	Minor adverse	Negligible adverse	**Moderate adverse**	Negligible adverse	Minor adverse
NSR2 – 51 York Road Redcar	Daytime	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse
	Evening	Minor adverse	Negligible adverse	Minor adverse	Negligible adverse	Negligible adverse
	Night-time	Minor adverse	Negligible adverse	Minor adverse	Negligible adverse	Negligible adverse
NSR3 - 131 Broadway West	Daytime	Negligible adverse	N/A	Negligible adverse	N/A	Minor adverse
	Evening	Minor adverse	N/A	Minor adverse	N/A	**Major adverse**
	Night-time	Minor adverse	N/A	Minor adverse	N/A	**Major adverse**
NSR4 - Turners Hospital	Daytime	Negligible adverse	N/A	N/A	N/A	Negligible adverse
	Evening	Negligible adverse	N/A	N/A	N/A	Minor adverse
	Night-time	Minor adverse	N/A	N/A	N/A	**Major adverse**
NSR5 - Lazenby village	Daytime	Negligible adverse	N/A	N/A	N/A	Negligible adverse
	Evening	Negligible adverse	N/A	N/A	N/A	Minor adverse
	Night-time	Minor adverse	N/A	N/A	N/A	**Major adverse**
NSR6 - Grangetown	Daytime	Negligible adverse	N/A	N/A	N/A	**Major adverse**
	Evening	Minor adverse	N/A	N/A	N/A	**Major adverse**
	Night-time	**Moderate adverse**	N/A	N/A	N/A	**Major adverse**
NSR7 - Billingham	Daytime	Negligible adverse	N/A	N/A	N/A	N/A

Receptor	Time period	Classification of effect				
		CO_2 Gathering Network	**CO_2 Export Pipeline**	**Gas Connection**	**Water Connections (Cofferdam)**	**Electrical Connection**
	Evening	Minor adverse	N/A	N/A	N/A	N/A
	Night-time	**Moderate adverse**	N/A	N/A	N/A	N/A
NSR8 – Marsh House Farm	Daytime	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse
	Evening	**Moderate adverse**	Minor adverse	**Moderate adverse**	Negligible adverse	Minor adverse
	Night-time	**Moderate adverse**	**Moderate adverse**	**Major adverse**	Negligible adverse	Minor adverse

Daytime is 07:00 – 19:00 weekdays and Saturday morning (07:00 – 13:00)
Evening is 19:00 – 23:00 weekdays, Saturday afternoon (13:00 – 23:00) and Sunday 07:00 – 23:00
Night-time is 23:00 – 07:00 all days
Potentially significant effects are in bold

11.6.28 The preliminary calculations presented above indicate that the highest noise levels during pipeline construction are likely to result from pipe stringing, pipe bending and pipeline welding operations. If these activities are to take place within 90 m of a residential receptor then specific consideration will be given to control and mitigation within the CEMP.

11.6.29 For all other residential receptors no significant effects are predicted during the daytime. Significant effects are predicted during the evening or night-time. However, most construction activities will take place during the daytime and therefore effects on these residential receptors are unlikely to be significant provided evening and night work is planned, managed and controlled appropriately. Potential measures to ensure that appropriate mitigation is in place during the works have already been discussed in Section 11.5.

11.6.30 The noise effects at the nearest residential receptors during construction of the CO_2 Gathering Network Pipeline are predicted to be negligible adverse (not significant) during the daytime. However up to moderate effects are predicted during the evening or night-time at NSR6, NSR7 and NSR8.

11.6.31 The noise effects at the nearest residential receptors during construction of the CO_2 Export Pipeline are predicted to be negligible adverse (not significant), this is largely because of the distances from residential receptors to the CO_2 Export Pipeline.

11.6.32 The noise effects at the nearest residential receptors during construction of the cofferdam (Water Connections Corridors) are predicted to be negligible adverse (not significant), this is largely because of the distances from residential receptors to the location of the cofferdam.

Construction Traffic Noise

11.6.33 For the purposes of assessment, it is assumed that construction traffic access to the proposed construction area (including for both the construction on the PCC and pipeline construction) will be via the A1085, A1042, A1380, A66, A1046, A178, A1053, unnamed Seal Sands road and A174. Data has been provided from the Transport Assessment (see Appendix 16A: Transport Assessment, PEI Report, Volume III) for the traffic scenario 'without' and 'with' Proposed Development construction traffic in 2024 for the roads within the scope of the transport assessment, as follows:

- scenario 1 - 'without' Proposed Development construction - 2024 Base + Committed development; and
- scenario 2 - 'with' Proposed Development construction - 2024 Base + Committed development + Proposed Development construction traffic.

11.6.34 It has been assumed traffic speeds will remain the same for both scenarios.

11.6.35 The potential changes in road traffic noise from these roads as a result of the Proposed Development have been considered by calculating the basic noise level and percentage heavy vehicles and traffic speed correction at 10 m from the road and comparing the change. Table 11-24 presents the results of the assessment.

11.6.36 Table 11-24 shows either no change or very low change in road traffic noise due to traffic flows along the construction traffic routes of the Proposed Development. This will result in negligible adverse effects (not significant) at local residential NSRs. Based upon the above, no further specific mitigation measures are proposed in addition to those listed in Section 11.5.

11.6.37 In addition to the road traffic related to the Proposed Development construction, occasional rail transport may be used to import material or workers to Site (subject to feasibility), using the existing railway line to the Redcar British Steel station. Details regarding the number of trips will not be known until the contractor is appointed, but it is considered that any noise from this source in addition to noise from works already on-going will be negligible (not significant).

11.6.38 The construction noise management measures listed within the Section 11.5, which should be further developed as the project progresses, will assist in minimising adverse effects at nearby NSRs.

Table 11-24: Changes in Road Traffic as a Result of the Proposed Development

Link	Scenario 1 Without Proposed Development construction			Scenario 2 With Proposed Development construction			Change in BNL, dB (Scenario 2 minus Scenario 1)	Classification of effect
	AAWT	% HGV	Speed (kph)	AAWT	% HGV	Speed (kph)		
A1085 Trunk Road, 100m east of Ennis Road	14437	9.1%	70	14699	8.9%	70	+0.1	Negligible adverse
A1085 Trunk Road, 1345m south of West Coatham Lane	17289	10.3%	82	18137	10.3%	82	+0.3	Negligible adverse
A1042 Kirkleatham Lane, 85m south of Staintondale Avenue	13180	7.2%	52	13308	7.1%	52	0.0	Negligible adverse
A1085 Trunk Road, 500m north of A1053 Tees Dock Road	18411	14.2%	83	19259	13.9%	83	+0.3	Negligible adverse
A1085 Broadway, 235m east of Birchington Avenue	9323	6.9%	53	9529	6.8%	53	+0.1	Negligible adverse
A1380 High Street, 50m east of Lackenby Lane	10996	9.1%	50	11010	9.0%	50	0.0	Negligible adverse
A66, 140m east of Whitworth Road	23125	20.3%	66	23674	20.0%	66	+0.1	Negligible adverse
A1046 Port Clarence Road, 20m north of Beech Terrace	9212	12.1%	47	9312	12.1%	47	0.0	Negligible adverse

Link	Scenario 1 Without Proposed Development construction			Scenario 2 With Proposed Development construction			Change in BNL, dB (Scenario 2 minus Scenario 1)	Classification of effect
	AAWT	% HGV	Speed (kph)	AAWT	% HGV	Speed (kph)		
A178 Seaton Carew Road, 535m north of Huntsman Drive	9744	13.2%	72	9844	13.2%	72	0.0	Negligible adverse
Unnamed Road, 725m east of A178 Seaton Carew Road	5219	19.0%	59	5319	18.8%	59	+0.1	Negligible adverse
A1053 Greystone Road	17470	10.0%	97	17563	10.2%	97	+0.1	Negligible adverse
A174 (west of Greystone Roundabout);	38347	6.3%	97	38412	6.4%	97	0.0	Negligible adverse

Construction Traffic Vibration

11.6.39 Given that the changes in road traffic noise shown in Table 11-24 are very low it is not considered that there would be any significant change in construction traffic vibration. It is therefore considered that no significant effects are likely and so no further assessment is required.

Construction Vibration from the PCC

11.6.40 The level of impact at different receptors will be dependent upon a number of factors including distance between the works and receptors, ground conditions, the nature and method of works required close to receptors and the specific activities being undertaken at any given time.

11.6.41 There are no residential receptors within close proximity to the PCC to be significantly affected by construction vibration. Due to distances of at least 550 m to residential receptors vibration effects are likely to be negligible.

Construction Vibration Pipelines

11.6.42 Both the CO_2 Gathering Network and Natural Gas Connection Corridor are in close proximity to residential receptors in some locations. There is the potential for some vibration impacts upon residential buildings during construction of both systems. Whilst it is considered unlikely that most typical construction working routines would generate levels of vibration above which building damage would be expected to be sustained (subject to final plant and working requirements), there is the potential that vibration impacts could cause annoyance to occupants and exceed the LOAEL and SOAEL set out in Section 11.3 unless appropriate control measures are applied.

11.6.43 If heavy earthworks, vibratory rollers or other significant vibration producing operations are proposed in close proximity to any sensitive buildings, during pipeline construction, further consideration will be given to potential impacts as the construction corridors are refined and the assessment will be updated as part of the ES which will accompany the DCO application. Potential measures to ensure that appropriate mitigation is in place during the works are discussed in Section 11.5.

Construction Effects on Marine Ecology

11.6.44 During the construction phase, the activity which is predicted to generate the highest noise impacts for seals hauled out at Seal Sands is the potential for vibro-piling for installation of the temporary cofferdam if this is required. This will occur at the abstraction point within the River Tees. In practice, installation or removal of the cofferdam at the intake shall be undertaken outside of the breeding and moulting season for harbour seal, which extends from June through to early September and so, this activity will not disturb seals either surfaced or hauled out during this period. Nonetheless, this activity has been considered as a worst-case for the construction phase assessment as it may potentially impact seals either surfaced or hauled out during the remainder of the year.

11.6.45 The predicted noise levels at Seal Sands due to vibro-piling are shown in Table 11-25. These predictions were converted to sound exposure levels for

comparison with the TTS and PTS thresholds pinnipeds (i.e. seals) from Southall *et al*. (2019).

Table 11-25. Predicted Airborne Noise Levels at Seal Sands for Sheet Piling at the Abstraction Point

Location	Distance to cofferdam (m)	Predicted free-field noise level for sheet piling for cofferdam installation (unweighted) $L_{eq,12h}$	sound exposure level (unweighted)
Nearest part of the mudflat	750	53	99
Site most commonly used by harbour seals	1600	46	92

11.6.46 The predicted unweighted sound exposure level at the nearest part of the Seal Sands mudflat to the abstraction point is 99 dB which is considerably less than the 134 dB and 154 dB onset weighted thresholds for TTS and PTS given by Southall *et al*. (2019). The unweighted sound exposure level of 92 dB at the site most commonly used by harbour seals is even lower.

11.6.47 Thus, it is considered unlikely that seals hauled out at Seal Sands would be vulnerable to auditory damage due to changes in the airborne soundscape during construction as a result of sheet piling at the abstraction point. Using the TTS threshold as a proxy behavioural threshold, the risk of behavioural disturbance is also considered to be negligible.

11.6.48 Full assessment of the effects of noise on Marine Ecology, using the prediction methodologies outlined in this chapter, has been undertaken in Chapter 14: Marine Ecology and Nature Conservation (PEI Report, Volume I).

Construction Effects on Habitats

11.6.49 AECOM has predicted noise levels for sheet piling in terms of both L_{AFmax} and L_{Aeq}. This is the potential construction activity that would be expected to result in the highest noise levels. A comparison of the predicted levels with the measured baseline levels is shown in Table 11-26.

Table 11-26 Modelled Noise Levels due to Sheet Piling in the Pools of the SPA / Ramsar and Measured Levels at E1

Predicted L_{Amax} dB	Predicted $L_{Aeq,T}$ dB	Highest measured $L_{AFmax,15min}$ dB at E2	Ambient daytime Noise level at E2 $L_{Aeq,T}$ dB
80	65	81	56

11.6.50 Chapter 5: Construction Programme and Management (PEI Report, Volume I) indicates that earthworks are to be carried out over a period of 6 months. As a worst case, in line with the Rochdale Envelope, it is therefore considered that sheet piling might be carried out for that entire period as a worst case.

11.6.51 The Predicted $L_{Aeq,T}$ due to sheet piling will be less than the 69 dB $L_{Aeq,T}$ identified in discussion with Natural England. The sheet piling for construction of the CCGTs will not produce L_{AFmax} levels above the highest $L_{AFmax,15min}$ level that was measured at E1. However the L_{AFmax} produced by the piling will occur repeatedly and it will produce an L_{Aeq} 9 dB higher than the current ambient level in the pools of the Teesmouth and Cleveland Coast SPA / Ramsar. Therefore, Likely Significant Effects of PCC construction on the SPA / Ramsar birds cannot be excluded.

11.6.52 The CO_2 Export Pipeline will run directly through the dunes of the Teesmouth and Cleveland Coast SPA / Ramsar. It is likely that the pipeline will be put in place by combining trenchless technologies and open cut techniques (possibly up to a 36 m wide open trench). Both methods are currently being reviewed to determine the technique with the lowest impacts on the Teesmouth and Cleveland Coast SPA/Ramsar. However, at this point, open cut trenching is assumed in line with Rochdale Envelope requirements.

11.6.53 It is predicted that pipeline construction would result in an L_{Aeq} of 78 dB and 70 dB at distances of 20 m and 50 m from the source respectively. This is considerably higher than the daytime L_{Aeq} of 56 dB measured at location E2. Given that above-ground pipelines might be constructed to the west of the River Tees in Saltholme Reserve (within the SPA/Ramsar), this could result in increased noise levels experienced by breeding common tern. Therefore, Likely Significant Effects of the CO_2 Export Pipeline construction noise cannot be excluded as construction activity will be taking place within the SPA / Ramsar. This will apply regardless of which construction method will be used. Mitigation measures such as seasonal restrictions on works may be used. The excavation and drilling activities associated with the construction of the pipeline will be less noisy than other construction activities (e.g. sheet piling). However, given that these techniques will be carried out within the SPA / Ramsar, they are screened in for Appropriate Assessment.

11.6.54 Full assessment of the effects of noise on habitats, using the baseline data and prediction methodologies outlined in this chapter, has been undertaken in Chapter 14: Marine Ecology and Nature Conservation and Chapter 15: Ornithology (PEI Report, Volume I) and Appendix 15E: Habitats Regulations Assessment – Likely Significant Effects Report (PEI Report, Volume III).

CO_2 Venting Noise Effects

11.6.55 Venting of the CO_2 pipeline will be occasionally required for commissioning and planned maintenance. The locations of these vents are shown on the Figure 11-1: Noise Sensitive Receptors (PEI Report, Volume II). Sound data from similar pipeline projects has been used to calculate noise levels at receptors. For the purpose of calculating noise levels due to venting it has been assumed that 5 minutes of venting will be required. The noise levels have been averaged over 1 hour and the effects have been classified by considering the daytime ABC noise limit value given in Table 11-18, and using the semantic scales in Table 11-6,

11.6.56 Table 11-11 and Table 11-13.

Table 11-27: CO_2 Venting Noise Predictions

Receptor	Distance to nearest vent (m)	Predicted free-field noise level for venting dB $L_{Aeq,5\ min}$	Predicted free-field noise level for five-minute venting averaged over 1 hour dB $L_{Aeq,1\ hour}$	Classification of effect
NSR1 – 74 Broadway West, Redcar	1200	78	68	**Moderate adverse**
NSR2 – 51 York Road Redcar	1600	76	65	Minor adverse
NSR3 - 131 Broadway West	1200	78	68	**Moderate adverse**
NSR4 - Turners Hospital	3300	70	59	Negligible adverse
NSR5 - Lazenby village	3600	69	58	Negligible adverse
NSR6 - Grangetown	2900	71	60	Negligible adverse
NSR7 - Billingham	1000	80	69	**Moderate adverse**
NSR8 – Marsh House Farm	1000	80	69	**Moderate adverse**

11.6.57 Unmitigated CO_2 venting effects are predicted to be up to moderate adverse. While the exact frequency of venting is yet to be determined this will however be an occasional occurrence of short duration. This will reduce the impacts on affected residences. Potential measures to ensure that appropriate noise management is in place during the works have already been discussed in Section 11.5.

CO_2 Venting Noise Effects on Marine Ecology

11.6.58 Predictions of CO_2 venting noise levels at Seal Sands are shown in Table 11-28.

Table 11-28. Predicted Airborne Noise Levels at Seal Sands for CO_2 Venting

Location	Distance to the nearest CO_2 vent (m)	Predicted free-field noise level for CO2 Venting (A-weighted) $L_{Aeq,5\ min}$	sound exposure level (A-weighted)
Nearest part of the mudflat	1100	79	104
Site most commonly used by harbour seals (i.e. Site A)	1500	77	102

11.6.59 The A-weighted sound exposure level at the nearest part of the mud flats to the sound source is predicted to be 104 dB which is considerably less than the

134 dB and 154 dB onset threshold for TTS and PTS respectively which use phocid-specific weightings (Southall *et al*., 2019). As the predicted A-weighted level is 30 dB less than the onset threshold for TTS, and given that the two weightings are relatively similar it is considered with a high level of confidence that the sound pressure levels produced by CO_2 venting will not exceed the onset threshold for TTS and PTS given in Southall *et al*. (2019).

11.6.60 Thus, it is considered very unlikely that seals hauled out at Seal Sands would be vulnerable to auditory damage due to changes in the airborne soundscape during commissioning and operation as a result of CO_2 venting. Using the TTS threshold as a proxy behavioural threshold, the risk of behavioural disturbance is also considered to be negligible.

CO_2 Venting Noise Effects on Habitats

11.6.61 At 3.6 km from the venting an $L_{Aeq,5\ min}$ of 69 dB is predicted (assuming there are no significant barriers), therefore sensitive ecological receptors within 3.6 km of CO_2 venting will exceed the acceptable receptor level limit of 69 dB $L_{Aeq,T}$ identified in discussion with Natural England. Venting will be an occasional occurrence and short-term effect; this will reduce the impacts on affected receptors. However significant effects on habitats and ecological receptors cannot be excluded.

Operational Noise

11.6.62 Operational noise modelling has been based on nominal plant sound emission data taken from similar power projects, as actual sound data is currently unavailable for the exact plant to be constructed since detailed design works have not yet been undertaken.

11.6.63 The following assumptions have been made when undertaking the operational noise modelling:

- the Proposed Development will operate continually at full load, 24 hours a day
- sound power levels (L_w) used in modelling of previous similar projects have been inputted for all principal noise emitting buildings/ elements (air inlet filters, electrical buildings, transformers, workshops etc.), these sound power levels are taken from a comparable site adjusted for the known differences between the sites. As some level of embedded sound mitigation is already included within this data a 7dB increase in sound power levels has been made to conservatively reflect the specific conditions and layout of the Proposed Development Site.
- The CO_2 Compressor Station produces a worst-case unmitigated sound pressure level (A-weighted) of 85 dB at 1 m from the building.
- proposed hybrid cooling cells have been modelled as area sources, located 0.1 m above the top of each cell;
- stacks have been modelled as individual point sources, located 0.1 m above the top of each stack; and

11.6.64 At all three residential NSRs assessed for operational noise there are other industrial noise sources closer than the Proposed Development. The levels produced by the Proposed development are below background sound levels during the day as shown in Table 11-30. Noise from operation of the Proposed Development will not be distinctive against the residual acoustic environment at the NSRs and is unlikely to attract attention in the context of this site. Therefore, no correction has been applied for other sound characteristics. The plant will have start up and shut down conditions however for the reasons outlined here these are unlikely to attract attention, so no correction has been applied for intermittency.

11.6.65 A +4 dB character correction has been applied to the BS 4142 rating level for NSR 8. This is a conservative assumption based on the potential for audible tonality. It is, however, likely that this can be designed out of the Proposed Development during the detailed design phase by the selection of appropriate design and mitigation. No tonality correction has been applied at NSR 1 or NSR 2 as the levels produced by the Proposed development are significantly below background sound levels, as shown in Table 11-30, so a tone is unlikely to be perceptible.

11.6.66 Details of the sound source sound power level (L_w) data, the settings used in the noise modelling software and the list of assumptions used are presented in Appendix 11B: Operational Noise Information (PEI Report, Volume III).

11.6.67 The predicted free-field operational specific sound levels at the NSRs around the PCC are presented in Table 11-29. The NSRs assessed have the highest predicted levels of any NSR within the Study Area. The results presented are for the storey of the residence with the highest predicted level. Assuming continual 24-hr operation, the predicted noise levels could apply to 1-hour daytime or 15-minute night-time BS 4142 assessment periods.

Table 11-29: Indicative Predicted Operational Noise Levels

Receptor	Predicted operational specific sound level $L_{Aeq,1h}$ dB
NSR1 – 74 Broadway West, Redcar	33
NSR2 – 51 York Road Redcar	33
NSR8 –Marsh House farm	42

11.6.68 The daytime and night-time BS 4142 assessments are presented in Table 11-30. In addition, the magnitude of impact and effect classification has been included based upon the BS4142 assessment outcomes, with reference to the semantic scales in Table 11-12, Table 11-13 and .

11.6.69 Table 11-14.

11.6.70 The representative background sound levels used are those presented in Table 11-16, to present an assessment against existing baseline conditions.

Table 11-30: Indicative BS4142 Assessment

Receptor	NSR1		NSR2		NSR8	
Time period	**Daytime**	**Night-time**	**Daytime**	**Night-time**	**Daytime**	**Night-time**
Specific sound level L_S ($L_{Aeq,Tr}$), dB	33	33	33	33	42	42
Acoustic feature correction, dB	+0	+0	+0	+0	+4	+4
Rating level ($L_{Ar,Tr}$), dB	33	33	33	33	46	46
Representative background sound level ($L_{A90,T}$), dB	49	47	50	40	46	41
Excess of rating level over background sound level ($L_{Ar,Tr}$ - $L_{A90,T}$), dB	-16	-14	-17	-7	0	+5
BS 4142:2014 assessment outcome	Low impact	Low impact	Low impact	Low impact	Low impact	adverse impact
Magnitude of impact (assigned from Table 11-12)	Very low	Very low	Very low	Very low	Very low	Low
Classification of effect (assigned from Table 11-14)	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse	Minor adverse

Uncertainty: Given the variability of sound levels data obtained during the surveys is representative 'snapshot' of these levels and different 'representative' background sound level values may be obtained with more monitoring.

11.6.71 At NSR 1 and NSR 2 during both the daytime and night-time the indicative BS4142 rating level is significantly below the background sound levels. At NSR 8 during the day the indicative BS4142 rating level is equal to the background sound levels. Predicted effects are therefore categorised as negligible (not significant) with no specifically designed mitigation in place.

11.6.72 At NSR 8 during the night-time the BS4142 rating level is 5 dB above the background sound level, in the context of this site this is likely to be a minor adverse effect.

11.6.73 The predicted noise levels are equal to or below the LOAEL (+5 dB) at all NSRs assessed during the day and night for the BS 4142 assessment comparison of rating levels and background sound levels.

11.6.74 The design and layout of the PCC will be refined (particularly details of noise source sound power levels) and will enable uncertainties in this assessment to be addressed in the ES which will accompany the DCO application.

Operational Noise Effects on Ecological Receptors

11.6.75 An assessment of the potential for noise disturbance to habitats during the operational period has been undertaken.

11.6.76 Noise modelling predicts that the operation of the Proposed Development will result in a noise level of 50 dB $L_{Aeq,T}$ or less in the dune systems of the SPA / Ramsar. This is below the existing day-time level of 56 dB $L_{Aeq,T}$ but is 3 dB above the night-time level of 47 dB $L_{Aeq,T}$ measured at location E1. The predicted level is significantly below the acceptable receptor level limit of 69 dB $L_{Aeq,T}$ identified in discussion with Natural England. It is therefore concluded that the operational phase of the Proposed Development would not result in Likely Significant Effects on the Teesmouth and Cleveland Coast SPA/Ramsar site.

11.6.77 Full assessment of the effects of noise on ecological receptors, using the baseline data and prediction methodologies outlined in this chapter, has been undertaken in Chapter 14: Marine Ecology and Nature Conservation, Chapter 15: Ornithology (PEI Report, Volume I) and Appendix 15E: Habitat Regulations Assessment – Likely Significant Effects Report (PEI Report, Volume III).

Decommissioning

11.6.78 Indicative predictions for noise during the decommissioning phase of the proposed development on the main site have been prepared. These are shown in Table 11-31. In addition, the effect classification has been included with reference to the semantic scales in Table 11-6,

11.6.79 Table 11-11 and Table 11-13.

Table 11-31: Indicative Noise Levels for Decommissioning of the PCC

Receptor	Predicted free-field noise level dB $L_{Aeq,12h}$	Classification of daytime effect
NSR1 – 74 Broadway West, Redcar	47	Negligible adverse
NSR2 – 51 York Road Redcar	51	Negligible adverse
NSR8 –Marsh House farm	60	Negligible adverse

11.6.80 Noise effects due to decommissioning of the PCC will result in negligible adverse effects during the daytime.

11.6.81 Decommissioning of the Proposed Development off the PCC will result in similar impacts and effects to those presented for construction. Therefore, for construction of within the Electrical Connection unmitigated daytime construction noise effects NSR6 are predicted to be up to major adverse (significant) when working at the closest approach. This is largely due to the short distances to this NSRs though works are only likely to take place at this distance for a short period of time. At all other NSRs no significant effects are predicted from decommissioning off the PCC during the daytime. Potential

measures to ensure that appropriate mitigation is in place during the works have already been discussed in Section 11.5.

Project Combined Effects

11.6.82 As the construction phases of CO_2 Gathering Network, CO_2 Export Pipeline, Natural Gas Connection, Electrical Connection and PCC overlap there is possibility of cumulative ('in combination') effects. Up to major adverse effects have been identified when working at the closest approach to residences. While this is unlikely to happen for long there is the possibility of significant effects at greater distances from properties if these are constructed simultaneously. As construction corridors and construction programme are refined, this will need to be assessed in detail in the ES chapter.

11.6.83 There are two worst case possibilities for the indicative construction programme for the Proposed Development. One is that all three trains (each comprising a single CCGT unit with associated carbon capture constructed) are constructed sequentially from 2022 and are operational by 2026. An alternative programme is that the first train operational by 2026, with trains 2 and 3 constructed sequentially commencing in 2028 and both operational by 2031. This introduces the possibility of cumulative effects from construction and operation of the site. With only one of the trains completed operational noise levels will be lower than when all three are completed. As effects from both construction on the PCC and operation of the PCC on residences are negligible or minor this is likely to remain a negligible or minor effect.

11.7 Mitigation and Enhancement Measures

Construction

11.7.1 This preliminary assessment has identified the potential for major adverse effects at a single NSR during the daytime Electrical Connection construction works and at seven out of the eight NSRs during night-time construction away from the PCC. However, the design of the pipeline corridors and Electrical Connection is ongoing and working methods and corridors are being refined which is likely to increase the distance from activities to residential receptors. Night-time working will also be limited so far as reasonably practicable. In addition, during construction there is the potential for some vibration effects at NSRs adjacent to the Site boundary.

11.7.2 The preferred approach for controlling construction noise and vibration is to reduce levels at source where possible, but with due regard to practicality. Sometimes a greater noise or vibration level may be acceptable if the overall construction time, and therefore length of disruption, is reduced.

11.7.3 The list of noise control measures presented within Section 11.5 of this chapter provides a detailed but not exhaustive list of construction noise management measures. The measures listed will be implemented and supplemented as necessary with further bespoke measures identified through further detailed assessment as part of the ES which will accompany the DCO application. This

will likely include temporary or local screening of NSRs where significant effects have been identified while construction activities are in close proximity. The need for monitoring of noise and vibration levels during construction will also be determined through the detailed assessment undertaken.

11.7.4 Residual effects after mitigation are described in Section 11.9.

Operational Noise

11.7.5 Assessment has indicated that predicted operational noise levels at all NSRs meet the LOAEL based upon the relative BS 4142 assessment comparison of rating levels and background sound levels including mitigation. There are opportunities during the design process to refine the mitigation requirements but still deliver an assessment with appropriate impacts and effects.

11.7.6 Residual effects after mitigation are described in Section 11.9 below and are not considered to be significant.

11.8 Limitations or Difficulties

Construction

11.8.1 Detailed construction information is not yet available and therefore this assessment draws upon the experience and assessments undertaken for other similar projects. The assessment is therefore indicative. However, construction noise thresholds (limit values) are based upon existing ambient sound levels at NSRs. Further assessment has been identified to ensure that appropriate mitigation is developed to achieve the limit values once the contractor is appointed. Mitigation measures will be included in the CEMP to minimise construction noise and vibration effects.

11.8.2 At present, construction effects for the CO_2 Gathering Network are predicted on the assumption that construction activities may occur at the closest point on the corridor to each NSR (as a worst case), but the refinement of the corridor has the potential to increase the distance from the pipeline to some NSRs which would reduce predicted impacts.

Operation

11.8.3 Lists of assumptions made during the noise modelling and assessment of the Proposed Development are as presented in paragraph 11.6.30 and in Appendix 11B: Operational Noise Information (PEI Report, Volume III). Further uncertainties are detailed in Table 11-30 with respect to defining the representative background sound levels. Further assessment will be undertaken at the detailed design stage to ensure that appropriate noise limit values are achieved. Boundary noise levels will be proposed based on the noise limits required at the sensitive receptors.

11.8.4 Sound emission data for key sound emitting plant/ buildings within the Proposed Development has been taken from a site with significant embedded mitigation

and corrected by adding 7 dB to the sound power levels of each source to adjust for a conservative level of mitigation at this site.

11.9 Residual Effects or Conclusions

11.9.1 A summary of the residual effects, assuming the implementation of all appropriate mitigation to reduce noise and vibration during construction and operational phases, is presented in Table 11-32. With mitigation, no significant residual effects are predicted for either construction or operation.

Table 11-32: Summary of Effects

Development stage	Environmental effect (following development design and impact avoidance measures)	Classification of effect prior to mitigation	Mitigation/ enhancement (if identified)	Classification of residual effect after mitigation	Nature of effect(s) (Lt/ Mt/ St and P/ T and D/ In)
Construction	Noise effects on residential receptors during construction on the PCC	Negligible adverse at nearest residential NSRs during daytime.	Further detailed assessment and CEMP once contractor appointed, particularly regarding working outside of daytime working hours.	Negligible adverse or less, on the basis that similar construction techniques to those used in indicative calculations are used.	St, T, D
Construction	Noise effects on residential receptors during construction of the CO_2 Gathering Network	Negligible adverse at nearest residential NSRs during daytime.	Further detailed assessment to inform the ES and CEMP once contractor appointed, particularly regarding working outside of daytime working hours.	Negligible adverse or less, on the basis that similar construction techniques to those used in indicative calculations are used.	St, T, D
Construction	Noise effects on residential receptors during construction of the CO_2 Export Pipeline	Negligible adverse at nearest residential NSRs during daytime.	Further detailed assessment and CEMP once contractor appointed, particularly regarding working outside of daytime working hours.	Negligible adverse or less, on the basis that similar construction techniques to those used in indicative calculations are used.	St, T, D
Construction	Noise effects on residential receptors during construction of the Natural Gas Connection	Negligible adverse at nearest residential NSRs during daytime.	Further detailed assessment for the ES and CEMP once contractor appointed, particularly regarding working outside of daytime working hours.	Negligible adverse or less, on the basis that similar construction techniques to those used in indicative calculations are used.	St, T, D

Development stage	Environmental effect (following development design and impact avoidance measures)	Classification of effect prior to mitigation	Mitigation/ enhancement (if identified)	Classification of residual effect after mitigation	Nature of effect(s) (Lt/ Mt/ St and P/ T and D/ In)
Construction	Noise effects on residential receptors during construction of within the Electrical Connection corridors	Up to major adverse at nearest residential NSR during daytime (significant).	Further detailed assessment for the ES and CEMP once contractor appointed, particularly regarding working outside of daytime working hours.	Minor adverse or less, on the basis that BS 5228 ABC noise limits are met (not significant).	St, T, D
Construction	Noise effects on residential receptors during installation of the cofferdam (Abstraction Connection Corridor)	Negligible adverse at nearest residential NSRs during all time periods.	Further detailed assessment and CEMP once contractor appointed, particularly regarding working outside of daytime working hours.	Negligible adverse or less, on the basis that BS 5228 ABC noise limits are met (not significant).	St, T, D
Construction	Noise effects due to construction traffic	Negligible adverse	Further detailed assessment and CEMP once contractor appointed.	Negligible adverse	St, T, D
Construction	Noise effects on Marine Ecology during installation of the cofferdam (Abstraction Connection Corridor)	Negligible adverse	Further detailed assessment and CEMP once contractor appointed, particularly regarding working outside of daytime working hours.	Negligible adverse	St, T, D
Construction	Noise effects on habitats during construction on the PCC	Moderate adverse	Further detailed assessment and CEMP once contractor appointed, particularly regarding working outside of daytime working hours.	Negligible adverse or less, on the basis that BS 5228 and section 11.5 mitigation guidance is followed.	St, T, D

Development stage	Environmental effect (following development design and impact avoidance measures)	Classification of effect prior to mitigation	Mitigation/ enhancement (if identified)	Classification of residual effect after mitigation	Nature of effect(s) (Lt/ Mt/ St and P/ T and D/ In)
Operation	Operation of the PCC effects on residential receptors	Negligible adverse during the daytime and minor adverse during the night-time.	Noise data from already mitigated power station with correction (+7 dB source sound power level) for lower level of mitigation.	Negligible adverse during the daytime and minor adverse during the night-time.	Lt, P, D
Operation	Operation of the PCC effects on habitats	Minor adverse	Noise data from already mitigated power station with correction (+7 dB source sound power level) for lower level of mitigation.	Minor adverse	Lt, P, D
Operation	CO_2 venting effects on residential receptors	Up to Moderate adverse at nearest residential NSR during daytime (significant).	Further detailed assessment for the ES	Minor adverse or less	Lt, T, D
Operation	CO_2 venting effects on Marine Ecology	Negligible adverse	Further detailed assessment for the ES	Negligible adverse	Lt, T, D
Decommissioning	Noise effects during decommissioning of the PCC	Negligible adverse	Further detailed assessment at this stage	Negligible adverse	St, T, D
Decommissioning	Noise effects during decommissioning off the PCC	Up to major adverse at nearest residential NSR during daytime (significant).	Further detailed assessment at this stage	Minor adverse or less, on the basis that BS 5228 ABC noise limits are met (not significant).	

Note: Lt = long term, Mt = medium term, St = short term, P = permanent, T = temporary, D = direct and In = indirect.

11.10 References

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