Table of Contents

Tables

11. Noise and Vibration

11.1 Introduction

11.1.1 This chapter of the Environmental Statement (ES) addresses the potential noise[1] and vibration effects resulting from the Proposed Development on local Noise Sensitive Receptors (NSRs).

11.1.2 Impacts during the construction, operation (including maintenance) and decommissioning of the Proposed Development are assessed. In particular, the assessment considers:

- existing and future baseline conditions;
- the effects of construction of the Proposed Development on NSRs during the site clearance and construction works including the effects from predicted changes in road traffic noise levels on the local road network;
- the effects of noise and vibration resulting from operation of the Proposed Development; and
- the effects of noise and vibration resulting from decommissioning of the Proposed Development.

11.1.3 The cumulative effects of noise associated with the Proposed Development and other committed developments in the vicinity described in Chapter 24: Cumulative and Combined Effects (ES Volume I, Document Ref. 6.2) are assessed.

11.1.4 This chapter is supported by the Figures 11-1 to 11-5 (ES Volume II, Document Ref. 6.3), Appendix 11A: Construction Noise Assessment Methodology and Appendix 11B: Operational Noise Information (ES Volume III, Document Ref. 6.4).

11.1.5 This chapter assesses the impacts of noise on residential and other human receptors. The assessment of noise impacts on the relevant ecological receptors is presented in Chapter 12: Terrestrial Ecology, Chapter 13: Aquatic Ecology and Nature Conservation, Chapter 14: Marine Ecology and Nature Conservation, Chapter 15: Ornithology (ES Volume I, Document Ref. 6.2) and the Habitat Regulations Assessment Report (Document Ref. 5.13) submitted with the Application.

[1] In this chapter “noise” and “sound” refer to in air noise and sound rather than underwater noise and sound as is the case in Chapter 14: Marine Ecology and Nature Conservation.

11.2 Legislation and Planning Policy Context

Legislative Background

Environmental Protection Act 1990

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

11.2.2 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, they must serve a noise abatement notice. A notice is served on the person responsible for the nuisance. It requires either 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.

11.2.3 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

11.2.4 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.

11.2.5 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.

11.2.6 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) (herein referred to as 'BS 5228') as BPM.

Environmental Permitting Regulations 2016 (as amended)

11.2.7 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. The Environmental Permit applies only to the operational and decommissioning phase, not to the construction phase.

11.2.8 In terms of noise specifically, the selection of BAT has to be considered and balanced with releases to different environmental media (air, land and water), and be made with 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.

11.2.9 The definition of pollution in regulation 2 of the Environmental Permitting Regulations 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 the control of noise emissions from an installation. Consequently, the aim of BAT should be to ensure that there is no reasonable cause for annoyance to persons beyond the installation boundary.

11.2.10 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

11.2.11 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 (NSIPs) such as the Proposed Development.

11.2.12 With regard to decision making, NPS EN-1 states that “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.” (paragraph 5.11.8). Section 11.5 of this chapter describes the impact avoidance measures identified as relevant to the Proposed Development.

11.2.13 The NPS for Fossil Fuel Electricity Generating Infrastructure (EN-2) (DECC, 2011b) sets out policy specific to fossil fuel power stations. In paragraph 2.7.1, specific sources of noise are identified. Those that are relevant to the Proposed Development include ‘*the gas and steam turbines that operate continuously during normal operation*’. It then reiterates in 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.*"

11.2.14 The NPS for Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4) (DECC, 2011c) states in 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 the Proposed Development and will be located on the Power, Capture and Compressor site (PCC Site).

11.2.15 Table 11-1 provides a summary of the NPS advice regarding noise and vibration and how each has been considered in this chapter.

Table 11-1 Summary of NPS advice regarding Noise and Vibration

Summary of NPS	Consideration Within Chapter
NPS-EN1	
Paragraph 5.11.4 states: *"Where noise impacts are likely to arise from the proposed development, the applicant should include the following in the noise assessment:* • *A description of the noise generating aspects of the development proposal leading to noise impacts, including the identification of any distinctive, tonal, impulsive or low frequency characteristics of the noise;* • *Identification of noise sensitive premises and noise sensitive areas that may be affected;* • *The characteristics of the existing noise environment;* • *A prediction of how the noise environment will change with the proposed development;* – *In the shorter term such as during the construction period;* – *In the longer term during the operating life of the infrastructure;* – *At particular times of the day, evening and night as appropriate;* • *An assessment of the effect of predicted changes in the noise; and* • *Measures to be employed in mitigating noise.* *The nature and extent of the noise assessment should be proportionate to the likely noise impact."*	NSRs, including proximity of any Noise Important Areas (NIAs), are identified in Section 11.3: Assessment Methodology and Significance Criteria. Information relating to the existing noise environment is presented in Section 11.4: Baseline Conditions. Descriptions of noise generating aspects of the Proposed Development, together with assessment of construction, operational and decommissioning noise and vibration impacts, are presented in Section 11.6: Likely Impacts and Effects. The mitigation of construction and operational noise is discussed in Sections 11.5: Development Design and Impact Avoidance and 11.7: Mitigation and Enhancement Measures.
Paragraph 5.11.5 states: *"The noise impact of ancillary activities associated with the development, such as increased road and rail traffic movements, or other forms of transportation, should also be considered."*	Potential construction related traffic noise effects have been assessed in Section 11.6: Likely Impacts and Effects.

Summary of NPS	Consideration Within Chapter
NPS-EN1	
Paragraph 5.11.6 states: "Operational noise, with respect to human receptors, should be assessed using the principles of the relevant British Standards and other guidance. Further information on assessment of particular noise sources may be contained in the technology-specific NPSs. In particular, for…electricity networks (EN-5) there is assessment guidance for specific features of those technologies. For the prediction, assessment and management of construction noise, reference should be made to any relevant British Standards and other guidance which also give examples of mitigation strategies."	Potential operational noise effects on human NSRs are presented in Section 11.6: Likely Impacts and Effects.
Paragraph 5.11.7 states: *"The applicant should consult EA and Natural England (NE), as necessary and in particular with regard to assessment of noise on protected species or other wildlife. The results of any noise surveys and predictions may inform the ecological assessment. The seasonality of potentially affected species in nearby sites may also need to be taken into account."*	Potential effects of noise on ecological receptors are discussed in Chapter 14: Marine Ecology and Nature Conservation, Chapter 15: Ornithology (ES Volume I, Document Ref. 6.2) and the Habitat Regulations Assessment Report (Document Ref. 5.13) submitted with the Application.
NPS EN 2	
Paragraph 2.7.2 states: "The ES should include a noise assessment as described in Section 5.11 of EN-1."	A noise assessment is included within this chapter.

National Planning Policy Framework

11.2.16 The National Planning Policy Framework (NPPF) (MHCLG, 2019a) 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 NPPF sets out that planning policies should make sufficient provision for *"conservation and enhancement of the natural, built and historic environment"* (Paragraph 20d). Consequently, the aim is to prevent both new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of noise pollution.

11.2.19 Paragraph 170 of the NPPF 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 regard 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 times of the day.

Planning Practice Guidance - Noise

11.2.29 The Planning Practice Guidance (PPG) (MHCLG, 2019b) 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 July 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 11-2.

Table 11-2: Planning Practice Guidance Noise Advice

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

Perception	Examples of Outcomes	Effect Level	Action
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 sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
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 As described in Chapter 7: Legislative Context and Planning Policy Framework (ES Volume I, Document Ref. 6.2), policy (including policy relevant to this noise assessment) is provided in the Redcar and Cleveland and Stockton-on-Tees Local Plans.

Redcar and Cleveland Borough Council

11.2.35 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 Details of additional consultation with RCBC regarding the scope of noise and vibration assessment are given in Table 11-16.

Stockton-on-Tees Borough Council

11.2.37 The Stockton-on-Tees Local Plan (STBC, 2019) states:

"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."

11.2.38 Details of additional consultation with STBC regarding the scope of noise and vibration assessment are given in Table 11-16.

Other Guidance

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

11.2.39 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

11.2.40 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) 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

11.2.41 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.

International Organization for Standardization (ISO) 4866:2010

11.2.42 ISO 4866:2010 'Mechanical Vibration and Shock – Vibration of Fixed Structures – Guidelines for the Measurement of Vibrations and Evaluation of Their Effects on Structures' (ISO, 2010) establishes the principles for carrying out vibration measurement and processing data with regard to evaluating vibration effects on structures.

British Standard 7385:1993

11.2.43 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+A1:2019

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

British Standard 8233:2014

11.2.45 BS 8233 'Guidance on sound insulation and noise reduction for buildings' (BSI, 2014) defines criteria for noise levels in and around buildings.

ISO 9613-2:1996: Attenuation of Sound during Propagation Outdoors

11.2.46 ISO 9613-2:1996 'Attenuation of Sound during Propagation Outdoors, Part 2: General Method of Calculation' (ISO, 1996) specifies an engineering method for calculating the attenuation of sound during propagation outdoors in order to predict the levels of environmental noise at a distance from a variety of sources.

Calculation of Road Traffic Noise

11.2.47 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.

Design Manual for Road and Bridges

11.2.48 The Highways England 'Design Manual for Road and Bridges LA 111 (Revision 2) Noise and Vibration' (DMRB) (Highways England, 2020) provides guidance on the appropriate approach to be taken 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.

World Health Organization

11.2.49 The World Health Organization's (WHO) 'Environmental Noise Guidelines for the European Region' (WHO, 2018) provides recommendations to protect

human health from noise from transportation, wind turbines and leisure. These guidelines do not cover industrial noise, however, recommend that 'Guidelines for Community Noise' (WHO, 1999) should remain valid. This recommends external daytime and evening environmental noise limits, and internal night-time limits to avoid sleep disturbance.

11.2.50 The WHO 'Night Noise Guidelines for Europe' (WHO, 2009) recommend updated guidelines on night-time noise limits to avoid sleep disturbance.

11.3 Assessment Methodology and Significance Criteria

Study Area

11.3.1 The extent of the Study Area has been defined to include the NSRs/ communities in each direction from the PCC Site, CO_2 Export Pipeline Corridor, CO_2 Gathering Network Corridor, Natural Gas Connection Corridor, Electricity Connection Corridor and Water Supply and Discharge Corridors, that may be affected by noise or vibration during construction or operation of the Proposed Development, including by changes in road traffic flows during the construction phase. The Study Area extends 2 km from the PCC Site and 800 m from the Site Boundary to include NSRs in each major direction from the Site. The extent of the Study Area, including the NSRs considered in the assessment, is shown in Figure 11-1: Noise Sensitive Receptors (ES Volume II, Document Ref. 6.3).

Determining Baseline Conditions and Noise Sensitive Receptors

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

11.3.3 Key NSR locations considered to be representative of the nearest and likely most sensitive existing receptors to the Proposed Development have been identified, as a 'worst-case scenario' approach, and are identified in Table 11-3 below. NSR 1 to NSR 6 are residential and therefore defined as being of high sensitivity in accordance with the classifications given in Table 11-14. Additionally, NSR 7 and NSR 8 have been included as potentially sensitive; these are office spaces within industrial developments and could therefore be defined as being of medium or low sensitivity. As a likely conservative approach they have been considered as medium sensitivity.

11.3.4 The NSRs are shown on Figure 11-1: Noise Sensitive Receptors (ES Volume II, Document Ref. 6.3) and their approximate distance to the Site Boundary is shown in Table 11-3. 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 NSRs in the surrounding area.

Table 11-3: Potential NSRs - Residential and Industrial

Receptor	Address / (NSR Type)	Approximate Distance to Site Boundary (m) / Direction	Approximate Distance to PCC Site (m) / Direction	Assessment Type
NSR1	58 Broadway West, Redcar / (residential- high sensitivity)	300 / SE	1300 / SE	Construction noise for: PCC Site, CO_2 Gathering Network, CO_2 Export Pipeline, Natural Gas Connection, Electrical Connection; Operational noise: PCC Site operations.
NSR2	51 York Road, Redcar / (residential- high sensitivity)	900 / E	1500 / E	Construction noise for: PCC Site, CO_2 Gathering Network, CO_2 Export Pipeline, Natural Gas Connection, Electrical Connection; Operational noise: PCC Site operations.
NSR3	131 Broadway West / (residential- high sensitivity)	300 / SE	1500 / SE	Construction noise for: CO_2 Gathering Network, Natural Gas Connection, Electrical Connection.
NSR4	Marsh House Farm / (residential- high sensitivity)	150 / NE	650 / E	Construction noise for: PCC Site, CO_2 Gathering Network, CO_2 Export Pipeline, Natural Gas Connection, Electrical Connection; Operational noise: PCC Site operations.
NSR5	Billingham / (residential- high sensitivity)	700 / NW	9600 / SW	Construction noise for: CO_2 Gathering Network.
NSR6	Haverton Hill / (residential- high sensitivity)	600 / SE	8100 / SW	Construction noise for: CO_2 Gathering Network.
NSR7	Bran Sands Waste Water Treatment Plant site offices / (office – medium sensitivity)	50 / W	800 / S	Construction noise for: CO_2 Gathering Network, Natural Gas Connection, Electrical Connection.
NSR8	Seal Sands site offices (office – medium sensitivity)	20 / E	2900 / SW	Construction noise for: CO_2 Gathering Network, Natural Gas Connection.

Note: NSR1-NSR6 are residential and therefore considered to be of high sensitivity, and NSRs 7 and 8 are offices so have been conservatively considered as medium sensitivity receptors.

11.3.5 Noise Important Areas (NIAs) are those areas identified through strategic noise mapping where the top 1% of the population are affected by the highest noise levels in England. The nearest NIA to the Site is located on a Trunk Road by the junction with the A1042. This is approximately 2 km away from the PCC Site and is further than residential NSRs included in the assessment, therefore noise

impacts from the Proposed Development at this location are unlikely and no further assessment has been undertaken.

11.3.6 A 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 (all ES Volume I, Document Ref. 6.2) and the Habitats Regulations Assessment Report (Document Ref. 5.13) submitted with the Application.

Noise Monitoring Locations and Protocol

11.3.7 In order to define baseline sound conditions at NSRs, sound measurements surveys have been undertaken at six representative residential locations (M1-M6) and four locations representative of ecological receptors (E1 - E4). The baseline data collected at locations E1 - E4 is used in the assessments of impacts on ecological receptors contained in Chapter 14: Marine Ecology and Nature Conservation and Chapter 15: Ornithology (ES Volume I, Document Ref. 6.2) and the Habitats Regulations Assessment Report (Document Ref. 5.13) submitted with the Application. The ten monitoring locations are shown in Table 11-4 and on Figure 11-1: Noise Sensitive Receptors (ES Volume II, Document Ref. 6.3).

Table 11-4: Monitoring Locations

Monitoring Location	Address	Details	Date/Times of Measurements
M1	58 Broadway West, Redcar	Unattended monitoring, located to the rear of property. Representative of NSR1.	16/12/2019 14:12 - 18/12/2019 10:42
M2	51 York Road, Redcar	Attended monitoring, located by the bridge where York Road becomes Tod Point Road. Representative of NSR2.	16/12/2019 14:50 - 15:35 16/12/2019 11:50 - 17/12/2019 00:20 17/12/2019 11:41 – 12:11
M3	Tod Point Road	Attended monitoring, located at western end of Tod Point Road by Cleveland Golf Links. Representative of NSR 4.	16/12/2019 15:00 - 15:30 16/12/2019 23:12 - 23:42 17/12/2019 11:43 – 12:28
M4	Seal Sands	Attended monitoring, located at the side of the road by Fine Environmental Services. Representative of NSR 8.	17/12/2019 15:57 - 16:12 18/12/2019 12:17 – 12:47
M5	Marsh House Farm	Unattended monitoring on land to rear of property.	21/01/2021 13:45 - 28/01/2021 11:30
M6	58 Broadway West, Redcar	Unattended monitoring on land to rear of property. Representative of NSR1.	21/01/2021 12:30 - 28/01/2021 12:00
E1	RSPB Saltholme, A178 Seaton Carew Road, Stockton-on-Tees	Attended monitoring, located in southeast corner of the car park.	17/12/2019 14:24 - 14:54 18/12/2019 11:37 - 12:07
E2	12 Holly Terrace, Stockton-on-Tees	Attended monitoring, located across the road from 12 Holly Terrace on disused land to the rear of High Clarence Primary School.	17/12/2019 15:05 - 15:35

Monitoring Location	Address	Details	Date/Times of Measurements
E3	Coatham Sands	Attended monitoring, within the Coatham Dunes.	27/11/2020 15:23 – 02/12/2020 14:19
E4	Bran Sands	Attended monitoring, located approximately 100 m from the coast at Bran Sands, adjacent to Redcar Bulk Terminal.	27/11/2020 13:16 – 09/12/2020 12:00

11.3.8 At M1 unattended measurements were undertaken between Monday 16th December and Wednesday 18th December 2019 and at M5 and M6 unattended measurements were undertaken between Thursday 21st January and Thursday 28th January 2021. Additionally, at E3 and E4 unattended measurements were undertaken between Friday 27th November and Wednesday 9th December 2020. At all other locations short-term attended measurements were undertaken in December 2019 on the dates and times shown.

11.3.9 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.

11.3.10 At locations E1 and E2 only daytime measurements were made as the data are used in assessments of the effects of construction on ecological receptors and construction activities will be mostly undertaken during the daytime. Similarly, at M4 only daytime measurements were undertaken as the data have been used in the assessment of daytime construction noise effects only.

11.3.11 All measurements were undertaken 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 unattended monitoring locations for set up and collection of the measurement equipment. Observations were made throughout the attended measurements.

11.3.12 Details of the instrumentation used during the surveys are presented in Table 11-5.

Table 11-5: 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, E1
Norsonic Calibrator Type 1251	27485	M2, M3, M4 E1, E3
RION NA-28 sound level meter	00570400	M2, M3, E1, E2
RION NC-74 calibrator	34973231	M1, M2, M3, M5, M6, E2, E4
Norsonic 140 sound level meter	1403909	E3

Equipment Used	Serial Number	Locations Used
Norsonic Calibrator Type 1251	34393	E3
Rion NL-32 sound level meter	00840885	E4
Rion NL-52 sound level meter	610211	M5
Rion NL-52 sound level meter	410085	M6

11.3.13 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}[2], in 15-minute contiguous intervals.

11.3.14 The calibration levels were checked prior to and following all measurements. No significant drift occurred (maximum drift being 0.2 dB[3]). Full calibration details are available upon request.

Meteorological Conditions

11.3.15 Observations regarding weather conditions were made during each attended measurement. In addition, weather data has been obtained for the nearest weather station, located in Redcar, approximately 4 km from the PCC Site.

11.3.16 Observations regarding weather conditions are summarised in Table 11-6 including weather conditions recorded at the start and finish for the unattended measurement locations.

Table 11-6: Weather Conditions

Monitoring Location	Date/Time	Wind Speed (m/s)	Wind Direction	Temperature (°C)	Cloud Cover (-/8)
M1	16/12/2019 14:12 (unattended measurement start time)	4	S	5	2
	18/12/2019 10:56 (unattended measurement end time)	2	SE	2	2
M2	16/12/2019 14:50 - 15:35	2	S	4	2
	16/12/2019 11:50 - 17/12/2019 00:20	No measurable wind	No measurable wind	1	-
	17/12/2019 11:41 - 12:11	1	SW	3	6
M3	16/12/2019 15:00 - 15:30	2	S	4	2
	16/12/2019 23:12 - 23:42	No measurable wind	No measurable wind	1	-
	17/12/2019 11:43 – 12:28	1	SE	2	6
M4	17/12/2019 15:57 - 16:12	3	SW	4	4

[2] L_{Aeq}, L_{AF90} , L_{AF10} and L_{AFmax} are defined in the ES Report Glossary
[3] 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)
	18/12/2019 12:17 – 12:47	2	SE	2	8
M5	21/01/2021 13:45 (unattended measurement start time)	5	NE	5	4
	28/01/2021 11:30 (unattended measurement end time)	2	NW	3	8
M6	21/01/2021 12:30 (unattended measurement start time)	5	NE	5	5
	28/01/2021 12:00 (unattended measurement end time)	2	NW	3	8
E1	17/12/2019 14:24 - 14:54	3	SW	4	5
	18/12/2019 11:37 - 12:07	2	SE	4	8
E2	17/12/2019 15:05 - 15:35	3	SW	4	5
E3	27/11/2020 15:22 (unattended measurement start time)	2	N	11	7
	02/12/2020 14:18 (unattended measurement end time)	5	SW	5	4
E4	27/11/2020 13:16 (unattended measurement start time)	2	N	11	7
	09/12/2020 12:01 (unattended measurement end time)	2	NE	10	2

11.3.17 Measurement periods during which the weather was not suitable for environmental sound measurements (i.e. when wind speeds >5 m/s and during precipitation or wet conditions) were removed during analysis of the measured data.

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

11.3.19 The COVID-19 outbreak has presented challenges in obtaining representative baseline sound levels because typical road, air and rail transport usage has been reduced by travel restrictions and social distancing measures. Other sound sources may also have been affected – for example, due to changes in operating patterns at industrial and commercial premises. Nevertheless, collection of baseline sound levels during this period was discussed and agreed with RCBC and STBC on the basis that it would be likely to result in collection of lower baseline sound levels, which would provide a conservative basis for this assessment.

Impact Assessment and Significance Criteria

Assessment of Construction and Decommissioning Noise

11.3.20 At this stage in the project design development, before the appointment of a construction contractor, site specific details regarding the construction activities, programme and numbers and types of construction plant are unavailable. Therefore, detailed construction noise predictions cannot be undertaken. Nevertheless, indicative construction noise predictions have been undertaken using the calculation methods set out in BS 5228, based upon construction information from other power and pipeline construction projects. In addition, indicative calculations have been undertaken for works associated with the CO_2 Gathering Network, Gas Connection, CO_2 Export Pipeline and Electrical Connection, as well as for the decommissioning phase.

11.3.21 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 activities away from the PCC Site (including construction of the CO_2 Gathering Network) are assessed separately to the construction assessment for the PCC Site because the types of plant and activities are likely to be different, and construction will extend over a greater area. Construction noise from activities away from the PCC Site will be assessed based on the same significance criteria described in this section as for construction noise from activities within the PCC Site.

11.3.22 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. Table 11-7 (reproduced from BS 5228-1) provides guidance in terms of appropriate threshold values for residential NSRs, based upon existing ambient noise levels.

11.3.23 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 noise threshold value is then derived. The predicted construction noise level is then compared with this noise threshold value.

11.3.24 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 value 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.

Table 11-7: 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)
Daytime (07:00 – 19:00) and Saturdays (07:00 – 13:00)	65	70	75
Evenings and weekends (d)	55	60	65
Night-time (23:00 – 07:00)	45	50	55

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.

11.3.25 For residential receptors and other high sensitivity human 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.

11.3.26 It is noted that the criteria for the LOAEL and SOAEL relate to residential NSRs only, in line with the ABC method. While the BS 5228 ABC method applies only to residential NSRs, the daytime noise threshold values have been applied to NSR 7 and NSR 8 (office spaces) in this chapter. This is considered to represent a conservative assessment of effects.

11.3.27 In accordance with the NPPF (MHCLG, 2019) and NPSE (Defra, 2010), it is important to avoid significant adverse effects (at or above the SOAEL) and also mitigate and minimise other adverse effects (above the LOAEL), where possible. This assessment focuses on the impact at existing residential NSRs.

11.3.28 Based upon the above, the magnitude of the impact of construction noise is classified in accordance with the descriptors in Table 11-8.

Table 11-8: Magnitude of Construction Noise Impacts

Magnitude of Impact	Comparison with Threshold Value $L_{Aeq,T}$ dB (Free-field)
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

Construction Works Traffic on the Public Highway

11.3.29 The Proposed Development will affect traffic flows on existing roads in the area within and surrounding the Site Boundary during construction. The assessment focuses on the impact at residential NSRs located alongside the local road network.

11.3.30 Construction traffic noise has been assessed by considering the increase in traffic flows during the construction works, following the guidance of CRTN and DMRB.

11.3.31 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 phase. This is 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.

11.3.32 The criteria for the assessment of traffic noise changes arising from construction works have been taken from Table 3.17 of DMRB and are provided in Table 11-9 below.

Table 11-9: 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

11.3.33 DMRB advises that 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 in traffic flow would be required for an approximate increase of 3 dB L_A.

11.3.34 The criteria are based on the current guidance on short-term changes in traffic noise levels in DMRB. 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. Therefore, at the selected road traffic NSRs, the SOAEL is set at a change in traffic noise level of +3 dB and the LOAEL at +1 dB.

Assessment of Construction Vibration

Impacts on Humans – Annoyance

11.3.35 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.

11.3.36 Table 11-10 sets out Peak Particle Velocity (PPV) vibration levels and provides a semantic scale for the description of demolition and construction vibration impacts on human receptors, based on guidance contained in BS 5228-2 (BSI, 2014b).

Table 11-10: 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

11.3.37 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.

11.3.38 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.

11.3.39 In the absence of specific information regarding likely construction activities and plant, a qualitative assessment of vibration impacts based upon professional judgement has been undertaken at this stage. Given the significant distance from the PCC Site to residential and industrial NSRs (a minimum distance of 650m), no significant vibration (medium or high magnitude impacts) is expected to result from the proposed construction (or demolition) activities at the PCC Site and therefore further assessment is scoped out.

Impacts on Buildings

11.3.40 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.

11.3.41 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.

11.3.42 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 11-11.

Table 11-11: 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

11.3.43 BS 7385-2 (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.

11.3.44 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.

11.3.45 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 11-12 below.

Table 11-12: 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

11.3.46 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.

11.3.47 These values for construction vibration building damage will apply to relevant structures including those on the Teesworks site.

11.3.48 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 (a minimum distance of 650 m), no significant vibration is expected to result from the proposed construction of the PCC Site or within the CO_2 Export Pipeline at nearby residential buildings and therefore further assessment of the effects of vibration on such buildings is scoped out.

11.3.49 However, pipeline construction within the CO_2 Gathering Network and Gas Connection Corridor may be closer to the industrial receptors NSR 7 and NSR 8. The potential location of the gas pipeline is shown on Indicative Gas Connection and Above Ground Installation Plans (Sheet 7) (Document Ref. 4.7), however, as a worst case, pipeline construction is assumed to be at the closest part of its corridor to NSRs as shown on Figure 4-1 (ES Volume II, Document Ref. 6.3). As such, there is the potential for higher impacts and therefore vibration impacts have been assessed.

Assessment of Operational Noise

11.3.50 The assessment of operational noise levels has been based upon calculations taking account of proposed plant equipment (see Appendix 11B: Operational Noise Information, ES Volume III, Document Ref. 6.4), sound power levels (L_w) and sound pressure levels (SPLs) relating to the proposed plant, distance between the proposed plant and NSRs and the acoustic screening and absorption offered by the existing topography and existing buildings.

11.3.51 A noise propagation model has been developed using the noise modelling software CadnaA 2021 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 sound levels at surrounding NSRs due to operations at the PCC Site (from both proposed external plant and breakout of sound from plant within the proposed buildings).The noise model consists of a three-dimensional representation of an indicative layout of the PCC Site and its surroundings.

11.3.52 Indicative sound level data for the key sound emitting plant/ buildings within the Proposed Development (Gas Turbine, Heat Recovery Steam Generator (HRSG)) have been sourced from similar CCGT projects based on the indicative concept designs for the PCC Site. However, a level of embedded sound mitigation was already included within the available data, therefore it has been necessary to adjust the data to represent an unmitigated scenario for this assessment. Through comparison and correlation with data from other current CCGT projects, the CCGT plant sound power levels have therefore been increased for this project by 7 dB $L_{A,}$ to allow modelling of the specific conditions and layout of an unmitigated scenario of the Proposed Development Site. This is considered to be a conservative but reasonable approach to assessment.

11.3.53 The carbon capture plant noise sources, including the CO_2 Absorber stack exhaust (at the point of emission to atmosphere) and the HP Compressor will be designed so that they do not individually exceed a maximum sound pressure level of 85 dB $L_{Aeq,T}$ at 1 m external to the building/ plant. This will potentially overestimate the sound power level, but is intended to represent a reasonable worst-case assessment. The sound power level for the CO_2 Absorber tower has been modelled based upon the Absorber being an open structure producing a sound pressure level of 77 dB $L_{Aeq,T}$ at 1 m. The Absorber stack exterior (adjacent to the stack casing rather than at the point of emission to atmosphere) has also been modelled as radiating a sound pressure level of 77 dB $L_{Aeq,T}$ at 1 m. The Direct Contact Cooler has been included with sound power level data from a similar Carbon Capture Usage and Storage (CCUS) project, however, this is not anticipated to be a significant source of noise.

11.3.54 Significant topographical details and buildings that may influence the transmission of sound from the Proposed Development 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 their heights relative to the ground. Areas of acoustically soft and hard ground have been identified from the Ordnance Survey MasterMap Topographic Layer and modelled accordingly.

11.3.55 The model assumes that the prevailing wind direction is always from source to receiver, which again is likely to overestimate the noise effects associated with the Proposed Development for much of the time given the predominant wind direction in the UK is from the southwest.

11.3.56 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 (BSI, 2014c).

11.3.57 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 – LA90,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 – Ls (LAeq,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 – LAr,Tr – the "specific sound level plus any adjustment made for the characteristic features of the sound".

11.3.58 BS 4142 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 nor impulsive but still distinctive): +3 dB penalty.

11.3.59 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 on the context.*
- *A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.*
- *The lower the rating level is relative 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 on the context."*

11.3.60 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.

11.3.61 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.

11.3.62 Table 11-13 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 11-13: Magnitude of Impact for Industrial Noise

Magnitude of Impact	BS 4142 Descriptor	*Rating Level* minus *Background Sound Level* (dB)
High	No BS 4142 descriptor for this magnitude level	>15
Medium	Indication of a significant adverse impact, depending upon context	+10 approx.
Low	Indication of an adverse impact, depending upon context	+5 approx.
Very low	Indication of low impact, depending upon context	≤ 0

Assessment of Operational Vibration Impacts

11.3.63 The operational equipment at the PCC Site 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. Taking this into account, together with the distances between the proposed indicative location of the equipment and residential NSRs, it is not anticipated that vibration levels will be significant. Therefore, further assessment of operational vibration is scoped out of this assessment.

11.3.64 No significant sources of vibration are associated with operation of the CO_2 Gathering Network, CO_2 Export Pipeline, Water Supply and Discharge Corridors, Gas Connection and Electrical Connection Corridor, therefore further assessment of operational vibration for these sources has been scoped out.

Receptor Sensitivity

11.3.65 Effects are classified based on the magnitude of the impact (as outlined above) for the various potential impacts during construction and operation, and the sensitivity or value of the affected receptor. A scale of receptor sensitivity is presented in Table 11-14.

Classification of Effects

11.3.66 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.

11.3.67 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 11-14: 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

11.3.68 The effect resulting from each individual potential impact type is classified according to the magnitude of the impact and the sensitivity or value of the affected receptor using the matrix presented in Table 11-15 below, but where necessary also considering the context of the acoustic environment.

Table 11-15: Classification of Effects

Sensitivity/ Value of Resource/ Receptor	Magnitude of Impact			
	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

11.3.69 Where adverse or beneficial effects have been identified, these have been assessed against the following significance scale, derived using the matrix presented in The effect resulting from each individual potential impact type is classified according to the magnitude of the impact and the sensitivity or value of the affected receptor using the matrix presented in Table 11-15 below, but where necessary also considering the context of the acoustic environment.

11.3.70 Table 11-15:

- 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.

11.3.71 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

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

- ES Chapter 4: Proposed Development (ES Volume I, Document Ref. 6.2);
- ES Chapter 5: Construction Programme and Management (ES Volume I, Document Ref. 6.2);
- Indicative Power Capture and Compression Facility Plans (Document Ref. 4.6) and Figure 4-1: PCC Site Layout (ES Volume II, Document Ref. 6.3);
- construction plant and equipment from similar power and linear infrastructure projects;
- construction plant and equipment from similar power and linear infrastructure projects;
- construction noise data referenced from BS 5228 (BSI, 2014a);
- sound power level (L_w) data used for similar power or carbon capture projects (with embedded mitigation) and sound pressure level (SPL) plant design criterion;
- AAWT traffic data from the Transport Assessment (TA) for the construction phase of the Proposed Development (see Appendix 16A: Transport Assessment, ES Volume III, Document Ref. 6.4); and

- Ordnance Survey (OS) mapping of the Proposed Development and surrounding area; Topographical data (LIDAR data) and aerial photography.

Use of the Rochdale Envelope

11.3.73 The assessment of operational noise and vibration has been undertaken using the Rochdale Envelope approach, having regard to the Planning Inspectorate (PINS) Advice Note 9 (PINS, 2018). 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 are as follows:

- use a reasonable 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.

11.3.74 In line with these principles, the following approach has been taken for the construction stage:

- pipeline construction and electrical connection has been assumed to take place at the nearest part of the corridor to NSRs;
- construction activities and plant have been assumed to be in constant operation through the 07:00 to 19:00 working day, see Appendix 11A: Construction Noise Assessment Methodology (ES Volume III, Document Ref. 6.4);
- initial predictions made for construction noise in the evening and night-time period assume the same intensity of operation as daytime.

11.3.75 The following approach has been taken for the operational stage:

- sensitivity testing of the positioning of key sound source locations has been undertaken to represent a reasonable worst-case scenario. This has included moving the highest contributing sound sources to various locations within their respective plant areas, and reporting the resulting highest predicted sound levels at each NSR;
- the High-Pressure Compressors have each been conservatively modelled as producing a design criterion sound pressure level of 85 dB $L_{Aeq,T}$ at 1m;
- the CO_2 Absorber stack exhaust (at the point of emission to atmosphere) has been conservatively modelled as producing a design criterion sound pressure level of 85 dB $L_{Aeq,T}$ at 1m;
- the CO_2 Absorber and stack exhaust casing (adjacent to the stack casing rather than at the point of emission to atmosphere) sound power level has been calculated based upon being an open structure which produces 77 dB $L_{Aeq,T}$ at 1 m. This is considered to be a reasonable worst case based on other CCUS projects;

- pumps for carbon capture plant have each been conservatively modelled as producing a design criterion sound pressure level of 85 dB $L_{Aeq,T}$ at 1m; and
- sound emission data assumptions for some items of plant have been taken from a comparable site with embedded mitigation included and corrected to a lower level of mitigation as a conservative approach.

11.3.76 There are opportunities for flexibility during the detailed design process to refine these requirements. However, it is assumed that final design chosen and the application of appropriate mitigation as outlined within this chapter will result in equivalent impacts and effects to those presented in this assessment.

11.3.77 In relation to both construction and operational effects, mitigation, if considered necessary, would be integrated into the detailed design, in order to meet noise limits to be agreed at the nearest NSRs, in accordance with Requirements in the draft DCO.

Consultation

11.3.78 Consultation for the Proposed Development has been ongoing and commenced at the EIA Scoping Stage with the preparation of the EIA Scoping Opinion Report which was submitted to the Planning Inspectorate in February 2019. The Scoping Opinion was received from the Planning Inspectorate in April 2019, see Appendix 1A (ES Volume III, Document Ref. 6.4).

11.3.79 The Applicant also undertook a formal Section 42 and Section 47 consultation as required under the Planning Act 2008, which commenced at the same time as the publication of the Preliminary Environmental Information (PEI) Report in early July 2020 and ended in September 2020. The issues that have been raised by consultees through consultation, and how these have been considered and addressed within the design evolution of the Proposed Development and the EIA is set out, where relevant, within each of the topic chapters in the ES and where relevant in Chapter 6: Alternatives and Design Evolution (ES Volume I, Document Ref. 6.2).

11.3.80 Table 11-16 provides a summary of how comments raised to date in relation to noise and vibration have been considered and actioned where appropriate.

Table 11-16: 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)	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.	Residential NSRs discussed with RCBC on 11/01/2021 and STBC on 13/01/2021.

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 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 Site. 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 (ES Volume II, Document Ref. 6.3) 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.	This chapter cross references the assessment of impacts on sensitive ecological receptors, which have been considered in Chapter 14: Marine Ecology and Nature Conservation, Chapter 15: Ornithology (ES Volume I, Document Ref. 6.2) and the Habitat Regulations Assessment Report (Document Ref. 5.13) submitted with the Application.
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 the PCC Site is to be by public roads, as discussed in section 11.6: Likely Impacts and Effects.
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.	This has been assessed and significant effects are not considered likely at the NSRs. Further information is available in section 11.6: Likely Impacts and Effects.

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 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.	Details of the assessment of traffic noise levels are provided in Section 11.6: Likely Impacts and Effects.
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: Assessment Methodology and Significance Criteria.
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 discussed and agreed with RCBC on 11/01/2021 and STBC on 13/01/2021.
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.

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 identify all sources of noise and vibration which may result from the Proposed Development, including those which extend into the marine area.	Sound sources have been identified based upon current design information. Full details are shown in Appendix 11A: Construction Noise Assessment Methodology and Appendix 11B: Operational Noise Information (all ES Volume III, Document Ref. 6.4). The marine area is assessed in Chapter 14: Marine Ecology and Nature Conservation (ES Volume I, Document Ref. 6.2).
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 with respect to setting out a reasonable worst-case assessment scenario as summarised within Paragraphs 11.3.53 – 11.3.56 and 11.3.75 – 11.3.76.
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 night-time 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 are provided in section 11.6: Likely Impacts and Effects and Appendix 11A: Construction Noise Assessment Methodology (ES Volume III, Document Ref. 6.4).
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.	Reference to the control and monitoring of noise during construction, operation and decommissioning is defined in Section 11.3.

Consultee	Date (Method of Consultation)	Summary of Consultee Comments	Summary of Response/ How Comments have been Addressed
Redcar and Cleveland Borough Council	January 2021 (technical engagement)	A complaint investigation procedure should be put in place during construction of the proposed development.	This is to be included in the Final CEMP as discussed in Section 11.5: Development Design and Impact Avoidance.
Redcar and Cleveland Borough Council	January 2021 (technical engagement)	AECOM confirmed the intention to set the operational noise LOAEL at a BS 4142 excess of *background sound level* above *rating level* of +5 dB, as has been applied by AECOM on other Power project DCOs. RCBC did not object to this and confirmed that they do not have a specific BS 4142 criterion to be applied. RCBC raised the point that there are several other simultaneous developments consented or under construction and the Council want to avoid a "creeping background".	Cumulative effects are assessed in Section 11.6: Likely Impacts and Effects.
Redcar and Cleveland Borough Council	January 2021 (technical engagement)	AECOM confirmed that baseline sound monitoring had been undertaken in December 2019 and additional monitoring is proposed to comprise approximately a week of measurement at the key residential receptors of Broadway West in Dormanstown and Marsh House Farm. This would provide a similar duration of baseline data to that collected on other Power project DCOs undertaken by AECOM. RCBC confirmed it is usually left to consultants to decide the scope and duration of monitoring appropriate to a project; there is no fixed guidance from the Council.	As has been considered appropriate on other power DCO's seven days of measurement has been undertaken at key residential receptors in January 2021 as described in Table 11-4.
Redcar and Cleveland Borough Council	January 2021 (technical engagement)	Discussion was held with RCBC regarding the potential for Background Sound Levels to be lower than usual due to coronavirus restrictions reducing road traffic and other activities, albeit it was acknowledged that lower Background Sound Levels would lead to a conservative operational sound assessment undertaken in accordance with BS 4142.	This has been considered in Section 11.4: Baseline Conditions and Section 11.6: Likely Impacts and Effects.
Redcar and Cleveland Borough Council	January 2021 (technical engagement)	AECOM confirmed that construction noise effects will be assessed using the BS 5228 ABC method. RCBC confirmed that the they usually leave consultants to decide on the appropriate assessment methods, but thought this method seemed appropriate for the Proposed Development.	Construction noise effects are assessed using BS 5228 in Section 11.6: Likely Impacts and Effects as this is the standard methodology for assessing effects of construction noise.

Consultee	Date (Method of Consultation)	Summary of Consultee Comments	Summary of Response/ How Comments have been Addressed
Redcar and Cleveland Borough Council	January 2021 (technical engagement)	Impacts on office developments on the STDC should be considered.	Where offices (and other medium sensitivity receptors) are closer to the site than residential receptors impacts on these have been assessed in Section 11.6: Likely Impacts and Effects
Redcar and Cleveland Borough Council	January 2021 (technical engagement)	AECOM discussed that due to distances between residential receptors and construction activities (i.e. 650 m to the PCC Site, and 100 m to the red line boundary where pipeline works are at their closest approach to receptors) vibration effects would be negligible. RCBC asked about the procedure that would be in place if there were complaints. AECOM suggested this would be likely be set out within the Final CEMP for the Proposed Development.	Vibration effects during construction have not been considered further as no significant effects are likely due to distance.
Stockton-on-Tees Borough Council	January 2021 (technical engagement)	STBC agree that the noise from construction work at all times should fall within the Category A limits of table E.1 of BS 5228 at the nearest residential properties.	This method has been applied where ambient sound levels data have not been available to inform the assessment including at the receptors in Stockton-on-Tees; otherwise the ABC category relevant to the baseline ambient noise level at the NSR has been applied as discussed in Section 11.6: Likely Impacts and Effects.

Consultee	Date (Method of Consultation)	Summary of Consultee Comments	Summary of Response/ How Comments have been Addressed
Stockton-on-Tees Borough Council	January 2021 (technical engagement)	I am concerned about the short-term environmental impact on the surrounding dwellings during construction/demolition, should the development be approved. My main concerns are potential noise, vibration and dust emissions from site operations and vehicles accessing the site. I would recommend that working hours of all construction/demolition operations including delivery/removal of materials on/off site shall be restricted to 08:00 – 18:00 hrs on weekdays, 09.00 – 13:00 hrs on a Saturday and no Sunday or Bank Holiday working. Should works need to be undertaken outside of these hours the developer should apply for consent under Section 61 Control of Pollution Act 1974. This would involve limiting operations on site that cause noise nuisance.	Assessment of construction noise is presented in Section 11.6: Likely Impacts and Effects and in the Framework CEMP as discussed in Section 11.5: Development Design and Impact Avoidance which will address STBCs recommendations regarding working hours.
Stockton-on-Tees Borough Council	January 2021 (technical engagement)	We are satisfied that the noise assessment of the proposal during operation is based upon the nearest residential properties in Redcar.	NSRs in the Borough of Stockton-on-Tees have not been considered for operational noise.
Hartlepool Borough Council	September 2020 (Section 43 Consultation response on the PEI Report)	The noise assessment has not considered the possible impacts on Greatham Village or Seaton Carew. These are both located directly across the Tees Bay from the site and as water does not absorb noise there is a potential impact, particularly from any piling operations. I am aware that when Able UK piled the Seaton Port/TERCC site at Graythorp, Redcar and Cleveland Council received noise complaints about the piling from Lazenby Village although it did not affect anyone in Hartlepool.	The noise assessment has been based upon the nearest residential properties in Redcar as these are as close as 650 m from the PCC Site at NSR 4 and 20 m from the Site Boundary at NSR 8. This is much closer than receptors in Seaton Carew situated 5.4 km form the PCC Site and 3.7 km form the Site Boundary. 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 NSRs in Seaton Carew which are significantly further away.

11.4 Baseline Conditions

Existing Baseline

Impacts of COVID-19

11.4.1 Initial sound surveys were carried out in December 2019 and additional surveys were planned for 2020, in order to define baseline sound level conditions. However, the COVID-19 outbreak presented challenges in obtaining representative baseline sound levels because typical road, air and rail transport usage has been reduced by travel restrictions and social distancing measures. Other sound sources may also have been affected – for example, due to changes in operating patterns at industrial and commercial premises and reduced school attendance or closures. The planned surveys were therefore delayed.

11.4.2 However, additional baseline sound surveys took place in November/ December 2020 and January 2021 during which COVID-19 lockdown measures were in force, while sound levels are likely to have been lower than typical for the area. The baseline data are therefore considered conservative and will potentially result in greater impacts being predicted than when using baseline data from pre- or post-COVID-19 lockdowns.

Sound Survey Results

11.4.3 The processed results from each sound survey position are provided in Table 11-17. The L_{Aeq} values presented combine all measurements taken in each time period (day/night). The L_{AF90} values presented are the those deemed to be 'representative' of Background Sound Levels, for use in the BS 4142 assessment. Representative Background Sound Levels have been selected through consideration of the outcome of different methods of analysing the measured 15-minute measurement data. Observations regarding the general baseline sound environment at each monitoring location are detailed below the table.

Table 11-17: Sound Survey Results

Monitoring Location	Time Period	$L_{Aeq,T}$ dB	Highest L_{AFmax} dB	$L_{AF90,T}$ dB
58 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
Tod Point Road (M3)	Daytime	56	81	46
	Night-time	47	73	41
Seal Sands (M4)	Daytime	68	83	56
Marsh House Farm (M5)	Daytime	46	82	39
	Night-time	41	76	39

Monitoring Location	Time Period	$L_{Aeq,T}$ dB	Highest L_{AFmax} dB	$L_{AF90,T}$ dB
58 Broadway West, Redcar (M6)	Daytime	47	88	45
	Night-time	43	79	43
RSPB Saltholme (E1)	Daytime	56	81	46
	Night-time	47	73	41
12 Holly Terrace (E2)	Daytime	56	74	53
Coatham sands (E3)	Daytime	46	59	41
	Night-time	43	54	40
Bran sands (E4)	Daytime	48	67	42
	Night-time	44	57	40

Note: Where a receptor is represented by two measurement locations (for example M1 and M6 for 58 Broadway West), data for both locations have been used in the assessment.

M1 - 58 Broadway West, Redcar (December 2019)

11.4.4 The dominant 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.

M2 - 51 York Road (December 2019)

11.4.5 During the daytime, road traffic on York Road was observed to be the dominant 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 using York Road.

M3 - Tod Point Road (December 2019)

11.4.6 During the daytime, 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 works approximately 100 m away, golfers on the Cleveland Golf Links and occasional traffic along Tod Point Road. During the night, the only contribution was from industrial/commercial sources.

M4 - Seal Sands (December 2019)

11.4.7 The major sound 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.

M5 - Marsh House Farm (January 2021)

11.4.8 Similar sound source observations were made at this NSR as at M3. During the daytime, industrial sound came from operations to the east along Tod Point Road, and additionally from more distant industrial sources to the west made the largest contribution. There were also contributions from road traffic along Tod Point Road.

M6 - 58 Broadway West (January 2021)

11.4.9 Sound at this location was observed from road traffic using both the Trunk Road to the north and Broadway West to the south. Additionally some sound was observed from commercial properties to the north, together with birdsong and dogs in neighbouring gardens.

E1 - RSPB Saltholme (December 2019)

11.4.10 The largest contribution to sound at this location was from road traffic on both the A1185 to the north and Seaton Carew Road to the east.

E2 - 12 Holly Terrace (December 2019)

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

E3 - Coatham Sands (November/December 2020)

11.4.12 Sound sources observed at this location included waves, road traffic (both distant and on South Gare Road), distant industry and birds.

E4 - Bran Sands (November/December 2020)

11.4.13 The dominant sound sources at this location were activities at the port including moving plant, reverse alarms and loading/unloading of ships. Additionally, sound from waves and birds was noted.

Future Baseline

11.4.14 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 in the area. However, it is considered that sound levels would increase over time compared with those collected in November/December 2020 and January 2021, due to the increase in road traffic and other activities in the area once COVID restrictions are lifted.

11.5 Development Design and Impact Avoidance

Construction Noise

11.5.1 Construction activities will typically be undertaken during weekday daytime periods (07:00 to 19:00) and Saturday mornings (07:00 to 13:00). As detailed in Chapter 5: Construction Programme and Management (ES Volume I, Document Ref. 6.2), some works may need to take place outside of normal working hours, provided that they do not give rise to unacceptable noise impacts at NSRs.

11.5.2 Measures to control and mitigate noise will be implemented during the construction phase of the Proposed Development in order to minimise impacts at local residential and ecological NSRs, particularly with respect to activities required outside of normal working hours. Embedded 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, including the use of localised screening around significant noise producing plant and activities;
- ensuring that modern plant is used, complying with the latest UK noise emission requirements and selecting inherently quiet plant where possible;
- hydraulic techniques for breaking to be used where practical in preference to percussive techniques;
- use of lower noise piling (e.g. rotary bored) rather than driven piling techniques;
- off-site pre-fabrication for components of the Proposed Development, where reasonably practicable;
- 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 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, ES Volume I, Document Ref. 6.2);
- consultation with the local authorities (RCBC and STBC) and local residents to advise of potential noisy works that are due to take place; and
- monitoring of noise complaints and reporting to the contractor and Applicants for immediate investigation.

11.5.3 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 as far as reasonably practicable.

11.5.4 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.

11.5.5 As mentioned above, the Final CEMP will be prepared by the contractors, which will include setting out provisions to ensure that the noise and vibration impacts relating to construction activities are reduced as far as reasonably practicable based on the measures outlined above. A framework CEMP is presented in Appendix 5A: Framework CEMP (ES Volume III, Document Ref. 6.4).

11.5.6 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 noise and vibration mitigation measures for the Proposed Development (including construction traffic).

11.5.7 The timing details of decommissioning are uncertain at this time. However, the mitigation measures set out in this section for construction noise will also be appropriate mitigation during the decommissioning stage.

11.5.8 The control and monitoring of noise during construction and decommissioning will be secured by a Requirement in the draft DCO.

Construction Vibration

11.5.9 Pipeline construction within the CO_2 Export Pipeline, CO_2 Gathering Network and Gas Connection Corridor is closer to NSRs than construction at the PCC Site, therefore there is the potential for higher impacts at those locations. The noise impact is dependent on the nature of pipeline construction, with construction of buried pipes having a greater potential for impact than construction of above ground pipes. The CO_2 Gathering Network will be constructed on existing above ground racking and using existing special crossings where possible. The CO_2 Export Pipeline is being constructed using HDD techniques and is not close to human NSRs. Whilst the gas connection will be constructed below ground, the bulk of the route is through an industrial area and has been sited some distance from the existing industrial operations. Therefore, it is considered unlikely levels of vibration above which building damage would be expected to be sustained will be generated by pipeline construction. However, there is the potential that vibration impacts could cause annoyance to occupants of the office spaces within the industrial developments and exceed the LOAEL and SOAEL set out in Section 11.3 unless appropriate control measures are applied. Therefore, this possibility will be considered within the Final CEMP and suitable techniques and buffer distances developed and implemented.

Operational Noise

11.5.10 During the detailed design stage, embedded mitigation will be included through choice of plant location and design. This may include appropriate stack design, use of cladding and shielding where appropriate and where practical siting of equipment away from site boundaries and receptors. The PCC Site 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 and carbon capture plant to be controlled through the use of BAT, which will be determined through the Environmental Permit application.

11.5.11 The control and monitoring of noise during operation will be secured by a Requirement in the draft DCO.

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 free-field baseline ambient sound surveys undertaken for the Proposed Development, Table 11-18 sets out the BS 5228 'ABC' noise threshold categories (BSI, 2014) at each monitoring location in the vicinity of each residential NSR for the time periods as set out in Table 11-4. Where baseline data are not available for an NSR, the following have been applied:

- If evening data are unavailable, the NSR has been categorised the same as the lowest category of day and night (if the ambient noise is high at an NSR during both day and night this is likely to be the case during the evening);
- As NSR3 is close to NSR1, NSR3 has been assigned the same ABC categories as NSR1;
- As NSR7 is expected to have similar sound levels to NSR4, NSR7 has been assigned the same ABC categories as NSR4; and
- Otherwise, NSRs have been categorised as BS 5228 ABC 'Category A', a conservative assumption.

Table 11-18: 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	$L_{Aeq,T}$ dB	ABC	$L_{Aeq,T}$ dB	ABC	$L_{Aeq,T}$ dB	ABC
NSR1 – 58 Broadway West, Redcar	47	A	44	A	43	B
NSR2 – 51 York Road Redcar	66	B	-	B	52	C
NSR3 - 131 Broadway West	47*	A	44*	A	43*	B
NSR4 – Marsh House Farm	56	A	-	A	41	A
NSR5 - Billingham (Charlton Close)	-	A	-	A	-	A
NSR6 - Haverton Hill	-	A	-	A	-	A
NSR7 - Northumbrian Water site offices	-	A	N/A**	N/A**	N/A**	N/A**
NSR8 - Seal Sands offices	68	C	N/A**	N/A**	N/A**	N/A**

*NSR 3 uses NSR 1 data collected to assign ABC categories as these two receptors are close to each other

**Office spaces at Seal Sands and at Northumbrian Water's Bran Sands water treatment plan are assumed to be attended 24-hours a day but are assigned the daytime limit in all time periods as unlike residential spaces office use is unchanged during different times of the day/evening/night.

11.6.2 Construction noise limits have been derived for each NSR in Table 11-19 below using the BS 5228 ABC methodology (described in Table 11-7).

Table 11-19: 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 – 58 Broadway West, Redcar	65	55	50	65*	55*	55*
NSR2 – 51 York Road Redcar	70	60*	55	65*	60*	60*
NSR3 - 131 Broadway West	65*	55*	50*	65*	55*	55*
NSR4 – Marsh House Farm	65	55	45	65	55	55
NSR5 - Billingham (Charlton Close)	65*	55*	45*	65*	55*	55*
NSR6 -Haverton Hill	65*	55*	45*	65*	55*	55*
NSR7 - Northumbrian Water site offices	65*	65**	65**	65**	65**	65**
NSR8 - Seal Sands offices	75	75**	75**	75**	75**	75**

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

**The office spaces identified as receptors are assumed to be attended 24-hours a day and are assigned with the daytime limit in all time periods as, unlike residential spaces, office use is unchanged during different times of the day/evening/night.

Construction Noise Predictions

11.6.3 The following section discusses the potential noise and vibration effects on NSRs arising during the construction phase of the Proposed Development. Noise effects are assessed for the construction of:

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

11.6.4 Noise levels experienced by local NSRs 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.

11.6.5 Demolition and remediation of the site is expected to be completed in advance of commencement of the Proposed Development. As a worst-case, indicative predictions for demolition have been included based upon noise data for similar demolition operations.

11.6.6 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. Any use of controlled explosives would only be undertaken with prior warning of the nearby community and businesses, as well as relevant stakeholders such as the local authority, with any such activity only undertaken at appropriate times of day, and taking into account the proximity and sensitivity of nearby NSRs.

11.6.7 Residential NSRs are located in different directions around the PCC Site. The closest residential NSRs to the PCC Site (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), those located in the town of Redcar (NSR2) approximately 1.6 km to the east, and the closest which is Marsh House Farm (NSR8) situated on Tod Point Road 650 m east of the PCC Site.

11.6.8 The Site Boundary covers the full area in which construction may take place including the PCC Site, CO_2 Export Pipeline, Water Supply and Discharge Corridors, the CO_2 Gathering Network and Natural Gas and Electrical Connection Corridors on Figure 4-1 (ES Volume II, Document Ref. 6.3). NSRs located near to the Site Boundary, identified in Table 11-3, are assessed for the impact of construction noise. Where human NSRs are adjacent to the Site Boundary, as at Northumbrian Water's offices at Bran Sands, it has been assumed construction will be at least 20 m away from receptors; this is considered a reasonable assumption regarding the location of construction works within the Site Boundary and the contractors will maintain this separation distance, which will be controlled through the CEMP. The minimum distance of each NSR to the construction areas being assessed is shown in Table 11-20.

11.6.9 As described in Chapter 4: Proposed Development (ES Volume I, Document Ref. 6.2), the programme currently anticipates construction of the Proposed Development over a four-year construction phase commencing shortly after the DCO is granted (expected in Q4 2022). It is envisaged that the power station and the carbon capture plant will be constructed by the same contractors within

an integrated construction schedule. The construction phases for the CO_2 Gathering Network, CO_2 Export Pipeline, Natural Gas Connection, Electrical Connection and Water Supply and Discharge Connections may partially overlap the PCC Site construction works.

11.6.10 Due to the early stage of project design, 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 adverse and significant adverse effects by comparison with construction noise LOAEL and SOAEL for each residential NSR.

11.6.11 Demolition of existing buildings and is programmed to take place during 2022 and has been included within the assessment presented in Section 11.6: Likely Impacts and Effects.

11.6.12 As outlined in Section 11.5: Development Design and Impact Avoidance, a detailed noise and vibration assessment will be undertaken once the contractor is appointed in order to identify specific mitigation measures to be included in the Final CEMP for the Proposed Development.

Table 11-20: Distances Between NSRs and Construction

Receptor	Minimum Distance to Construction (m)				
	PCC Site	CO_2 Gathering Network	CO_2 Export Pipeline	Natural Gas Connection	Electrical Connection
NSR1 - 58 Broadway West, Redcar	1300	900	1500	900	700
NSR2 - 51 York Road Redcar	1500	1300	1400	1300	N/A[1]
NSR3 - 131 Broadway West	N/A[1]	900	N/A[1]	900	500
NSR4 – Marsh House Farm	650	500	500	500	1000
NSR5 - Billingham (Charlton Close)	N/A[1]	700	N/A[1]	N/A[1]	N/A[1]
NSR6 -Haverton Hill	N/A[1]	600	N/A[1]	N/A[1]	N/A[1]
NSR7 - Northumbrian Water site offices	N/A[1]	50	N/A[1]	50	200
NSR8 - Seal Sands offices	N/A[1]	20	N/A[1]	20	N/A[1]

[1]Where an NSR is significantly further from the construction area than the closest NSRs, significant noise effects are not likely if noise levels are suitably controlled at the closer key representative receptors. Therefore, these NSRs have not been assessed and are marked “N/A”.

11.6.13 The construction noise predictions have been undertaken using noise data for plant and calculation methodologies from BS 5228 (2014a). As a conservative assumption, it is assumed that all plant and activities take place at the closest approach to each NSR (subject to the 20 m minimum distance). This is unlikely to occur for any significant duration, if at all.

11.6.14 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 required. Constant operation of equipment throughout the 07:00 – 19:00 working day is assumed. Further details of the noise prediction methodology, including a full list of construction plant and associated sound power levels (L_w) assumed for each construction phase, are presented in Appendix 11A: Construction Noise Assessment Methodology (ES Volume III, Document Ref. 6.4).

11.6.15 As advised by BS 5228, noise levels predicted at distances over 300 m 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 Site are significantly below the LOAEL, the margin of uncertainty is considered insignificant.

11.6.16 A summary of indicative construction noise predictions at the NSR locations for the PCC Site is presented in Table 11-21. Only NSR 1, NSR 2 and NSR 8 are included as these are the closest to the PCC Site. Free-field construction noise levels have been predicted to allow subsequent comparison with the ABC categories (and corresponding LOAELs and SOAELs) derived from free-field baseline ambient noise levels at NSRs. Noise levels during the piling and foundation construction phase are shown in Figure 11-2: PCC Site Piling Construction Phase (ES Volume II, Document Ref. 6.3). Demolition, site clearance and piling works will be restricted to daytime so only daytime predictions have been included. Table 11-21 also shows an indicative lower intensity working scenario for night-time construction during the 'Building' and 'Fit out' construction phases that only includes in predictions activities which may take place at night. Details of the night-time construction scenario are included in in Appendix 11A: Construction Noise Assessment Methodology (ES Volume III, Document Ref. 6.4). As a worst-case assessment, construction during the evening will be assumed to be undertaken at the same intensity as the daytime for the 'Building' and 'Fit out' construction phases.

11.6.17 With respect to prediction of noise levels during construction of the CO_2 Gathering Network and Natural Gas Connection, the values presented are for activities such as 'pipe stringing, pipe bending and pipeline welding', which are reasonable worst-case activities to apply for the purposes of the assessment. 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, ES Volume III, Document Ref. 6.4). This includes the crossings under the River Tees which will be via a bored tunnel or horizontal directional drilled. Both activities produce higher noise levels at the same distance as 'pipe stringing, pipe bending and pipeline welding' but as they are further from NSRs will result in lower noise levels at the receptors.

11.6.18 For construction of the CO_2 Gathering Network and Natural Gas Connection most activities will take place only during the day with the exception of drying of the pipeline using forced dry air which may be continuous through the night. The plant for this activity is conservatively assumed to be situated on the PCC Site so this is considered as part of the "Fit out" predictions in Table 11-21.

Table 11-21: Indicative Construction Noise Predictions for the Proposed Development within the Site Boundary

Receptor	Time Period	Predicted Free-field Noise Level for Daytime Construction Activity dB $L_{Aeq,12h}$					
		Demolition	Site clearance	Piling and foundation	Building	Fit out	Landscaping
NSR1 – 58 Broadway West, Redcar	Daytime	47	42	45	44	42	23
	Evening	N/A[2]	N/A[2]	N/A[2]	44	42	23
	Night-time	N/A[2]	N/A[2]	N/A[2]	34	34	23
NSR2 – 51 York Road Redcar	Daytime	50	44	47	47	44	25
	Evening	N/A[2]	N/A[2]	N/A[2]	47	44	25
	Night-time	N/A[2]	N/A[2]	N/A[2]	37	36	25
NSR4 – Marsh House Farm	Daytime	58	53	55	55	53	34
	Evening	N/A[2]	N/A[2]	N/A[2]	55	53	34
	Night-time	N/A[2]	N/A[2]	N/A[2]	45	45	34

Values above relevant thresholds are shown in bold (no predicted values in this table are above the relevant thresholds).

[2]N/A identifies where an activity will not take place during a time period.

Only the key receptors of NSR 1, NSR 2 and NSR 4 are included in this table. Where an NSR is significantly further from the construction area than the closest NSRs, significant noise effects are not likely if noise levels are suitably controlled at the closer key representative receptors.

11.6.19 Predictions of construction noise levels for the CO_2 Export Pipeline show values for the use of 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, ES Volume III, Document Ref. 6.4). For this activity noise producing plant will be situated at the northern boundary of the PCC Site.

11.6.20 Laydown areas/construction compounds for construction materials for the CO_2 collection network and gas connections will be required. The locations of these are shown on Figure 5-1: Access and Laydown (ES Volume II, Document Ref. 6.3). These compounds are located at significant distances from the nearest residential NSRs (at least 950 m) and therefore the likelihood of significant effects occurring is very low. Further assessment of noise from the compounds has therefore been scoped out.

11.6.21 The Electrical Connection between the substation at the Low-Carbon Electricity Generating Station and National Grid's Tod Point sub-station would comprise installation of electrical cables and control system cables (below ground) as well as the construction works associated with the new NZT substation at Tod Point and NGET's extension to the existing Tod Point substation . For the purposes of this noise assessment, this comprises predictions of top-soil strip works, which is the construction activity associated with the Electrical Connection works expected to produce the highest noise levels.

11.6.22 Within the Water Supply and Discharge Corridors, trenchless technologies and open cut trenches will be required. These works are located at significant distances from the nearest residential NSRs and minor in comparison to nearby PCC Site construction work and therefore the likelihood of significant effects occurring is again very low. Further specific assessment of noise from these works has therefore been scoped out.

11.6.23 Predicted construction noise levels due to construction of this below ground connection have been included in Table 11-22. These predictions are also shown in Figure 11-3: CO_2 Gathering Network Construction, Figure 11-4a: CO_2 Export Pipeline Construction and 11-4b: CO_2 Export Pipeline Construction (with Screening) (ES Volume II, Document Ref. 6.3).

Table 11-22: Indicative Construction Noise Predictions for the Proposed Development outside of the PCC Site

Receptor	Predicted Free-field Noise Levels for Daytime Construction Activities dB $L_{Aeq,12h}$			
	CO_2 Gathering Network	CO_2 Export Pipeline	Natural Gas Connection	Electrical Connections
NSR1 - 58 Broadway West, Redcar	45	37	45	47
NSR2 - 51 York Road Redcar	43	35	43	N/A[1]
NSR3 - 131 Broadway West	45	N/A[1]	45	50
NSR4 - Marsh House Farm	50	45	50	44
NSR5 - Billingham (Charlton Close)	47	N/A[1]	N/A[1]	N/A[1]
NSR6 - Haverton Hill	48	N/A[1]	N/A[1]	N/A[1]
NSR7 - Northumbrian Water site offices	**69**	N/A[1]	**69**	55
NSR8 - Seal Sands offices	**78**	N/A[1]	**78**	N/A[1]

Values above relevant thresholds are shown in bold.

[1]Where an NSR is significantly further from the construction area than the closest NSRs, significant noise effects are not likely if noise levels are suitably controlled at the closer key representative receptors. Therefore, these NSRs have not been assessed and are marked "N/A".

Noise Effects During Construction of the PCC Site

11.6.24 The effects of predicted construction noise levels resulting from activities undertaken within the PCC Site (as presented in Table 11-21) have been classified. The effect classifications include consideration of the ABC noise limit value given in Table 11-19, and uses the semantic scales in Table 11-14 and The effect resulting from each individual potential impact type is classified according to the magnitude of the impact and the sensitivity or value of the affected

receptor using the matrix presented in Table 11-15 below, but where necessary also considering the context of the acoustic environment.

11.6.25 Table 11-15. The effects are summarised in Table 11-23.

Table 11-23: Indicative Noise Effects During Construction of the PCC Site

Receptor	Time Period	Classification of Effect					
		Demolition	Site clearance	Piling and foundations	Building	Fit out	Landscaping
NSR1 – 58 Broadway West, Redcar	Daytime	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse
	Evening	N/A[2]	N/A[2]	N/A[2]	Negligible adverse	Negligible adverse	Negligible adverse
	Night-time	N/A[2]	N/A[2]	N/A[2]	Negligible adverse	Negligible adverse	Negligible adverse
NSR2 – 51 York Road Redcar	Daytime	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse
	Evening	N/A[2]	N/A[2]	N/A[2]	Negligible adverse	Negligible adverse	Negligible adverse
	Night-time	N/A[2]	N/A[2]	N/A[2]	Negligible adverse	Negligible adverse	Negligible adverse
NSR4 – Marsh House Farm	Daytime	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse
	Evening	N/A[2]	N/A[2]	N/A[2]	Minor adverse	Minor adverse	Negligible adverse
	Night-time	N/A[2]	N/A[2]	N/A[2]	Minor adverse	Minor 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
[2]N/A identifies where an activity will not take place during a time period.

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

11.6.27 It may be necessary for some construction activities to take place continuously over day, evening and night periods during the peak construction period (expected to be in 2024). Noise threshold values during non-weekday daytime periods have been defined in Table 11-19. A lower intensity working scenario for night-time construction for the ‘Building’ and 'Fit out’ phases is shown in Table 11-23, to account for the confirmation that some activities will not take place at night.

11.6.28 No significant effects are predicted for construction on the PCC Site. Comparison of the predicted daytime noise levels for the lower intensity working scenario construction on the PCC Site against the lower noise threshold values

for evening and weekend working indicate minor adverse or negligible effects at all NSRs. Comparison of the predicted construction noise levels for the lower intensity working scenario for night-time working also indicate minor adverse or negligible effects at all NSRs. Construction activities, particularly those 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 11-19. Potential measures to ensure that appropriate embedded mitigation is in place during the works have already been discussed in Section 11.5: Development Design and Impact Avoidance.

Noise Effects During Construction away from the PCC Site

11.6.29 The effects of predicted construction noise levels for the construction of the CO_2 Gathering Network, CO_2 Export Pipeline, Natural Gas Connection and Electrical Connection away from the PCC Site (as presented in Table 11-22) are shown in Table 11-24. The effect classifications include consideration of the daytime ABC noise limit value given in Table 11-19, and uses the semantic scales in Table 11-7, Table 11-14 and The effect resulting from each individual potential impact type is classified according to the magnitude of the impact and the sensitivity or value of the affected receptor using the matrix presented in Table 11-15 below, but where necessary also considering the context of the acoustic environment.

11.6.30 Table 11-15.

Table 11-24: Indicative Worst-Case Construction Effects for Construction away from the PCC Site

Receptor	Time Period	Classification of Effect			
		CO_2 Gathering Network	CO_2 Export Pipeline	Natural Gas Connection	Electrical Connection
NSR1 – 58 Broadway West, Redcar	Daytime	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse
	Evening	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse
	Night-time	N/A[2]	Negligible adverse	N/A[2]	Minor adverse
NSR2 – 51 York Road Redcar	Daytime	Negligible adverse	Negligible adverse	Negligible adverse	N/A[1]
	Evening	Negligible adverse	Negligible adverse	Negligible adverse	N/A[1]
	Night-time	N/A[2]	Negligible adverse	N/A[2]	N/A[1]
NSR3 - 131 Broadway West	Daytime	Negligible adverse	N/A[1]	Negligible adverse	Negligible adverse
	Evening	Negligible adverse	N/A[1]	Negligible adverse	Negligible adverse
	Night-time	N/A[2]	N/A[1]	N/A[2]	Minor adverse
NSR4 - Marsh House Farm	Daytime	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse
	Evening	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse
	Night-time	N/A[2]	Minor adverse	N/A[2]	Minor adverse
	Daytime	Negligible adverse	N/A[1]	N/A[1]	N/A[1]

Receptor	Time Period	Classification of Effect			
		CO_2 Gathering Network	CO_2 Export Pipeline	Natural Gas Connection	Electrical Connection
NSR5 - Billingham (Charlton Close)	Evening	Negligible adverse	N/A[1]	N/A[1]	N/A[1]
	Night-time	N/A[2]	N/A[1]	N/A[1]	N/A[1]
NSR6 - Haverton Hill	Daytime	Negligible adverse	N/A[1]	N/A[1]	N/A[1]
	Evening	Negligible adverse	N/A[1]	N/A[1]	N/A[1]
	Night-time	N/A[2]	N/A[1]	N/A[1]	N/A[1]
NSR7 - Northumbrian Water site offices	All time periods	Minor adverse	N/A[1]	Minor adverse	Negligible adverse
NSR8 - Seal Sands offices	All time periods	Minor adverse	N/A[1]	Minor adverse	N/A[1]

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

[1]Where an NSR is significantly further from the construction area than the closest NSRs, significant noise effects are not likely if noise levels are suitably controlled at the closer key representative receptors. Therefore, these NSRs have not been assessed and are marked “N/A”.

[2]N/A identifies where an activity will not take place during a time period.

11.6.31 No significant effects are predicted for construction away from the PCC Site. Up to minor adverse effects are predicted during the evening or night-time for the residential NSRs. Most construction activities will take place during the daytime and evening, however, night work should be planned, managed, controlled and minimised appropriately. Potential measures to ensure that appropriate mitigation is in place during the works have already been discussed in Section 11.5: Development Design and Impact Avoidance.

11.6.32 While daytime effects of construction noise are classified as negligible adverse, predicted construction noise levels are still higher in some cases than the measured ambient levels in Table 11-18 and therefore above the LOAEL. Therefore, appropriate mitigation as discussed in Section 11.5 will be required and a detailed noise and vibration assessment will be undertaken to assist preparation of the Final CEMP.

11.6.33 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. During the evening noise effects are also classed as negligible. CO_2 Gathering Network Pipeline construction will not generally take place at night. At NSR7 and NSR8 predicted levels are above the daytime thresholds, however, as these are classed as medium sensitivity receptors in Table 11-14 effects are minor using the matrix given in The effect resulting from each individual potential impact type is classified according to the magnitude of the impact and the sensitivity or value of the affected receptor using the matrix presented in Table 11-15 below, but where necessary also considering the context of the acoustic environment.

11.6.34 Table 11-15.

11.6.35 For construction within the Electrical Connection Corridor construction noise effects are predicted to be negligible adverse during the daytime and up to minor adverse at night (not significant) when working at the closest approach.

11.6.36 The noise effects at the nearest residential NSRs during construction of the CO_2 Export Pipeline are predicted to be negligible adverse during the day and up to minor adverse at night (not significant). This is largely because of the distances from residential NSRs to the CO_2 Export Pipeline.

Construction Traffic Noise

11.6.37 For the purposes of assessment, it is assumed that construction traffic access to the proposed construction area (including for both the PCC Site and pipeline construction works) will be via the A1085, A1042, A1380, A66, A1046, A178, A1053, unnamed Seal Sands road and A174. Traffic data have been provided from the Transport Assessment (see Appendix 16A: Transport Assessment in ES Volume III, Document Ref. 6.4) for the traffic scenarios '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.

11.6.38 It has been assumed traffic speeds will remain the same for both scenarios and HGV traffic access the proposed construction area for the PCC Site via Tees Dock Road.

11.6.39 The potential changes in road traffic noise from these roads as a result of the Proposed Development have been considered by calculating the CRTN basic noise level (BNL) for both 'without' and 'with' scenarios, and establishing the noise change. Table 11-25 presents the results of the assessment.

Table 11-25: 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	16820	10.2%	70	17238	9.9%	70	+0.1	Negligible adverse
A1085 Trunk Road, 1345m south of West Coatham Lane	24677	12.9%	82	25999	12.6%	82	+0.2	Negligible adverse
A1042 Kirkleatham Lane, 85m south of Staintondale Avenue	14141	6.7%	52	14345	6.6%	52	0.0	Negligible adverse (no change)
A1085 Trunk Road, 500m north of A1053 Tees Dock Road	25800	15.6%	83	27122	15.1%	83	+0.2	Negligible adverse
A1085 Broadway, 235m east of Birchington Avenue	11382	6.9%	53	11712	6.7%	53	+0.1	Negligible adverse
A1380 High Street, 50m east of Lackenby Lane	11624	9.8%	50	11668	9.7%	50	0.0	Negligible adverse (no change)
A66, 140m east of Whitworth Road	28931	20.6%	66	29792	20.2%	66	+0.1	Negligible adverse
A1046 Port Clarence Road, 20m north of Beech Terrace	9701	12.1%	47	9831	12.0%	47	0.0	Negligible adverse (no change)

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	9920	14.3%	72	10050	14.2%	72	0.0	Negligible adverse (no change)
Unnamed Road, 725m east of A178 Seaton Carew Road	5395	18.4%	59	5439	18.7%	59	+0.1	Negligible adverse
A1053 Greystone Road	23412	13.0%	97	23543	13.1%	97	0.0	Negligible adverse (no change)
A174 (west of Greystone Roundabout);	40520	7.6%	97	40605	7.7%	97	0.0	Negligible adverse (no change)

11.6.40 Table 11-25 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/no change) at local residential NSRs. Based upon the above, no further specific mitigation measures are proposed in addition to those listed in Section 11.5: Development Design and Impact Avoidance.

11.6.41 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).

11.6.42 The construction noise management measures listed within the Section 11.5 will be developed as the Proposed Development progresses using lessons learned which will assist in minimising adverse effects at nearby NSRs.

Construction Traffic Vibration

11.6.43 Given that the changes in road traffic flows, %HGVs and resulting noise levels shown in Table 11-25 are very low, it is not expected that there would be any significant change in construction traffic-induced vibration. It is therefore considered that no significant effects are likely and so no further assessment is required.

Construction Vibration from the PCC Site

11.6.44 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.

11.6.45 There are no residential or industrial receptors in close proximity to the PCC Site that it is considered would be significantly affected by construction vibration. Due to distances of at least 650 m to residential or industrial receptors, vibration effects are likely to be negligible.

Pipeline Construction Vibration

11.6.46 Both the CO_2 Gathering Network and Natural Gas Connection Corridor are in close proximity to industrial receptors in some locations. There is the potential for some vibration impacts upon industrial buildings during construction of both connections. 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) and it is not expected that heavy earthworks, vibratory rollers or other significant vibration producing operations will be required to take place in close proximity to any sensitive buildings during pipeline construction. However, 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 although potential effects will be short term while construction is close to receptorsindustrial. Therefore there will be specific consideration regarding the control and mitigation of vibration, within the Final CEMP. Potential

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

Operational Noise

11.6.47 Operational noise modelling has been based on plant sound emission data taken from similar power projects where available. Specific sound level data for the carbon capture plant to be constructed are currently unavailable due to the "First Of A Kind" nature of the Proposed Development and as detailed design works have not yet been undertaken. However, conservative assumptions have been applied.

11.6.48 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;
- available sound power levels (L_W) used in the modelling of previous similar projects have been used for all principal noise emitting buildings/ elements (including air inlet filters, electrical buildings, transformers, workshops etc.) and adjusted for the known differences between the sites. A level of embedded sound mitigation was already included within the available data, therefore through further comparison with the data for other CCGT projects, a 7 dB L_A increase to the CCGT plant sound power levels has been included to conservatively model an unmitigated scenario of the specific conditions and layout of the Site;
- the CO_2 Absorber stack exhaust and CO_2 Compressor Station (at the point of emission to atmosphere) produce a worst-case unmitigated sound pressure level of 85 dB $L_{Aeq,T}$ at 1 m from the building or plant item; and
- the CO_2 Absorber and stack casing (adjacent to the stack casing rather than at the point of emission to atmosphere) sound power level has been calculated based upon the Absorber being an open structure which produces 77 dB $L_{Aeq,T}$ at 1 m. This is considered to be a reasonable worst case based on available data.

11.6.49 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 (ES Volume III, Document Ref. 6.4).

11.6.50 The assessment has assumed that potential operational noise of a tonal, impulsive or intermittent nature will be designed out of the Proposed Development during the detailed design phase by the selection of appropriate plant, building cladding, louvres and silencers/ attenuators as necessary, although a penalty has been conservatively applied as outlined below. This is consistent with the assessment of other similar approved Power Station NSIP projects.

11.6.51 At all three residential NSRs assessed for operational noise there are other industrial sound sources closer than the Proposed Development. However, a +3 dB character correction for other distinctive character (including intermittency in the operation of the Proposed Development, has been

included at this stage as a conservative approach for NSR 4 as there is the potential that the Proposed Development may be identifiable in the acoustic environment once operational.

11.6.52 However, the predicted sound levels produced by the Proposed Development are below Background Sound Levels at NSR 1 and NSR 2 as shown in Table 11-27. It is therefore not expected that noise from operation of the Proposed Development will be distinctive above the residual acoustic environment at these NSRs. Therefore, no correction has been applied for other sound characteristics.

11.6.53 The predicted free-field operational *specific sound levels* at the NSRs around the PCC Site are presented in Table 11-26. The NSRs presented have the highest predicted levels of any NSR assessed within the Study Area. The results presented during the daytime are for the ground floor of the property and at night-time for the first floor. Assuming continual 24-hr operation, the predicted *specific sound levels* apply to both the 1-hour daytime or 15-minute night-time BS 4142 assessment periods. Operational *specific sound levels* are also presented on Figure 11-5: PCC Operational Noise Levels (ES Volume II, Document Ref. 6.3).

Table 11-26: Indicative Predicted Operational *Specific Sound Levels*

Receptor	Predicted Operational *Specific Sound Level* $L_{Aeq,T}$ dB	
	Daytime	Night-time
NSR1 – 58 Broadway West, Redcar	32	33
NSR2 – 51 York Road Redcar	32	34
NSR4 – Marsh House farm	41	41

11.6.54 The daytime and night-time BS 4142 assessments are presented in Table 11-27. In addition, the magnitude of impact and initial significance of effect classification (before consideration of context) has been included based upon the BS 4142 assessment outcomes, with reference to the semantic scales in Table 11-13, Table 11-14 and Table 11-15.

11.6.55 The representative *Background Sound Levels* used are those presented in Table 11-17, to present an assessment against existing baseline conditions.

11.6.56 At NSR 1 and NSR 2 during both the daytime and night-time the indicative BS 4142 *rating level* is below the *Background Sound Levels*. Predicted effects are therefore categorised as negligible (not significant) with no additional specifically designed mitigation in place.

11.6.57 At NSR 4 during the day and night the indicative BS 4142 *rating level* is 5 dB above the *background sound level*. Predicted effects are therefore initially categorised as minor adverse, before consideration of context, and before the addition of any specifically designed acoustic mitigation.

Table 11-27: Indicative BS 4142 Assessment

Receptor	NSR1		NSR2		NSR4	
Time Period	**Daytime**	**Night-time**	**Daytime**	**Night-time**	**Daytime**	**Night-time**
Specific sound level L_S ($L_{Aeq,Tr}$), dB	32	33	32	34	41	41
Acoustic feature correction, dB	+0	+0	+0	+0	+3	+3
Rating level ($L_{Ar,Tr}$), dB	32	33	32	34	44	44
Representative *background sound level* ($L_{A90,T}$), dB	45	43	50	40	39	39
Excess of *rating level* over background sound level ($L_{Ar,Tr}$ - $L_{A90,T}$), dB	-13	-10	-18	-6	+5	+5
BS 4142:2014 assessment outcome	Low impact	Low impact	Low impact	Low impact	Adverse impact	Adverse impact
Magnitude of impact (assigned from Table 11-13)	Very low	Very low	Very low	Very low	Low	Low
Initial classification of effect (assigned from Table 11-15)	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse	Minor adverse	Minor adverse

Uncertainty: Given the variability of environmental sound levels, data obtained during the surveys is representative 'snapshot', although the longer term measurements were intentionally designed to reduce uncertainty. The example analysis used in BS 4142 is the 'mode'. However, in this assessment the mode has been considered alongside the median of the measured $L_{A90,15mins}$ values and the graphical representation of all of the $L_{A90,15mins}$ data at each location. As a result, *Background Sound Levels* equal to or lower than the mode have been assigned as 'representative' in this assessment. Therefore, conservative ('worst case') assessment results are provided.

Consideration of Context

11.6.58 At all three residential NSRs considered in the assessment there were other industrial noise sources identified during the baseline sound surveys. There are several new industrial sources proposed, which are discussed in Chapter 24: Cumulative and Combined Effects (ES Volume I, Document Ref. 6.2) and the area has a history of industrial noise sources including from the Redcar Steelworks site on which the Proposed Development will be constructed. This is likely to mean that many residents in the local communities are already accustomed to an industrial sound environment.

11.6.59 Table 11-28 presents the existing *ambient sound levels* (as presented in Table 11-17) and future predicted *specific sound levels* at NSR 4 (Marsh House Farm) (as presented in Table 11-26). The existing *ambient sound levels* were measured in January 2021 while COVID-19 restrictions were in place and so potentially lower levels were measured. This means Table 11-28 presents a worst-case scenario.

Table 11-28. Comparison of Ambient Sound Levels at NSR 4

Time Period	Existing *Ambient Sound Level*, $L_{Aeq,T}$, dB	Predicted *Specific Sound Level*, L_S ($L_{Aeq,Tr}$), dB	Sum of Existing *Ambient Sound Level* with Predicted *Specific Sound Level*, $L_{Aeq,T}$, dB	Predicted Increase in *Ambient Sound Level* due to the Proposed Development, $L_{Aeq,T}$, dB
Daytime (16hr)	46	41	47	+1
Night-time (8hr)	41	41	44	+3

11.6.60 As shown in Table 11-28, there is a predicted increase in the daytime ($L_{Aeq,16hr}$) *ambient sound level* of 1 dB; this change in instantaneous sound level is not perceptible under normal environmental conditions. During the night-time the *ambient sound level* ($L_{Aeq,8hr}$) is predicted to increases by 3 dB; a change in instantaneous sound level which may be just perceptible under normal environmental conditions.

11.6.61 BS8233:2014 and WHO 'Guidelines for Community Noise' recommended indoor *ambient sound level* for resting during the daytime sleeping at night-time. The recommended internal criterion is 35 dB $L_{Aeq,16h}$ during the day 30 dB $L_{Aeq,8h}$ at night, which would be equivalent to an external criterion of 50 dB $L_{Aeq,16h}$ and 45 dB $L_{Aeq,8h}$ respectively assuming open windows for ventilation. During both the day and night the predicted future *ambient sound level* (i.e. the existing *ambient sound level* summed with the predicted *specific sound level* from the Proposed Development) is below these criteria.

11.6.62 In addition, the *specific sound levels* predicted using ISO 9613 assume downwind sound propagation; therefore, this predicted level of *ambient sound level* change is considered an exaggerated worst-case for the majority of the time when prevailing wind conditions would be towards the northeast.

11.6.63 On the basis of the above and the BS 4142 *rating level* being at the LOAEL (no greater than +5 dB excess of *rating level* over *background sound level*) effects of minor adverse or less (not significant) are expected.

Decommissioning

Decommissioning of the PCC Site

11.6.64 Indicative predictions for noise during the decommissioning phase of the Proposed Development at the PCC Site have been prepared. These are shown in Table 11-29.

11.6.65 Noise effects due to decommissioning of the PCC Site are predicted to result in negligible adverse effects during the daytime.

Table 11-29: Indicative Noise Levels for Decommissioning of the PCC Site

Receptor	Predicted Free-field Noise Level dB $L_{Aeq,12h}$	Classification of Daytime Effect
NSR1 – 58 Broadway West, Redcar	47	Negligible adverse
NSR2 – 51 York Road Redcar	51	Negligible adverse
NSR4 – Marsh House farm	60	Negligible adverse

Decommissioning away from the PCC Site

11.6.66 Decommissioning of the Proposed Development away from the PCC Site will result in similar impacts and effects to those presented for construction. Potential measures to ensure that appropriate mitigation is in place during the works have already been discussed in Section 11.5: Development Design and Impact Avoidance.

Proposed Development Combined Effects

11.6.67 As the construction phases of CO_2 Gathering Network, CO_2 Export Pipeline, Natural Gas Connection, Electrical Connection and PCC Site may overlap there is possibility of effects combining to produce a greater collective effect from all construction phases. Up to minor adverse daytime construction noise effects have been identified when working at the closest approach to NSRs.

11.6.68 At the residential receptors (NSR 1 – NSR 6) daytime construction noise levels presented in Table 11-21 and Table 11-22 are significantly below daytime construction noise limit values given in Table 11-19 (below by at least 7 dB) so overlapping daytime construction phases would not be expected to cause new significant adverse effects. Should there be a need to undertake construction works on the PCC Site simultaneously with works way from the PCC Site during the evening or at night, the timing of works and the effects of overlapping construction will be considered in the Final CEMP.

11.6.69 At the industrial office receptors (NSR 7 and NSR 8) combining the levels produced at the closest approach for both the CO_2 Gathering Network and Natural Gas Connection would result in an increase in predicted effects from minor adverse to moderate adverse. However, it would be unlikely that both sets of construction works would be undertaken at the closest approach simultaneously. Nevertheless, the timing of works and the effects of overlapping construction will be considered in the Final CEMP.

Proposed Development Cumulative Effects

Construction

11.6.70 There is the potential for cumulative effects where the impacts of noise associated with the Proposed Development interact with those associated with other planned projects and developments. These could act together to result in a greater significance of effect. Therefore, cumulative effects are assessed using predictions available in this chapter and information available in noise assessments for other major developments that may have noise impacts.

11.6.71 Information regarding each relevant planning application has been gathered from their respective noise assessments. However, not all of the other developments considered have yet been consented yet, so are not certain to go ahead and therefore Table 11-30 presents a potentially exaggerated worst-case scenario.

11.6.72 Predicted cumulative effects of construction noise are shown in Table 11-30. The effects have been classified by considering the daytime ABC noise limit value given in Table 11-19, and using the semantic scales in Table 11-7, Table 11-14 and The effect resulting from each individual potential impact type is classified according to the magnitude of the impact and the sensitivity or value of the affected receptor using the matrix presented in Table 11-15 below, but where necessary also considering the context of the acoustic environment.

11.6.73 Table 11-15. As a worst-case assumption, the construction phase producing the highest construction noise levels for each development occurring simultaneously is shown in Table 11-30. In practice this is unlikely to occur for prolonged periods, or at all.

Table 11-30. Assessment of Construction Cumulative Effects

Applicant	Highest Predicted Free-field Noise Level for Daytime Construction Activity dB $L_{Aeq,12h}$							
	NSR1	NSR 2	NSR 3	NSR 4	NSR 5	NSR 6	NSR 7	NSR 8
2 - York Potash Harbour	37	30	59	37	30	30	50	40
3 - Tees CCPP	41	N/A	41	N/A	N/A	N/A	N/A	N/A
4 - Dogger Bank Teesside A / Sofia Offshore Wind Farm	40	40	40	38	N/A	N/A	N/A	N/A
13 - CBRE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
27 - Sirius Minerals	N/A	N/A	N/A	N/A	N/A	N/A	40	45
71 – York Potash	57	N/A	57	42	N/A	N/A	N/A	N/A
77 - Redcar Energy centre	N/A	N/A	N/A	35	N/A	N/A	35	35
83-87 STDC	55	45	55	49	N/A	N/A	N/A	N/A
Cumulative construction noise level of all developments without NZT dB	59	46	62	50	30	30	50	47
NZT (The Proposed Development)	47	50	47	58	47	48	69	78
Cumulative construction noise level of all developments including NZT dB	60	52	62	59	47	48	69	78

Applicant	Highest Predicted Free-field Noise Level for Daytime Construction Activity dB $L_{Aeq,12h}$							
	NSR1	NSR 2	NSR 3	NSR 4	NSR 5	NSR 6	NSR 7	NSR 8
Classification of NZT effect	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse	Negligible adverse	Minor adverse	Minor adverse
Classification of cumulative effect	Negligible adverse	Negligible adverse	Minor adverse	Negligible adverse	Negligible adverse	Negligible adverse	Minor adverse	Minor adverse

Where levels are listed as "N/A" the receptor or receptors near it have not been included in the noise assessment so levels are assumed to be low enough as to not affect the assessment

11.6.74 As shown in Table 11-30 at all NSRs cumulative construction noise effects are not significantly increased compared with the predicted individual effects of the Proposed Development or the other committed developments. This is with the exception of NSR 3 where effects are predicted to increase from negligible to minor adverse (not significant) with the addition of simultaneous noise from construction of the Proposed Development and the other committed developments. Predicted minor adverse effects at NSR 7 and NSR 8, due to pipeline construction for the Proposed Development, remain unchanged when considering cumulative effects.

Operation

11.6.75 Cumulative effects of operational noise from the Proposed Development together with the predicted noise levels presented in the noise assessments of the other identified major development applications are presented in Table 11-31. Not all of the other developments assessed are consented so are not certain to go ahead and therefore Table 11-31 presents a potentially exaggerated worst-case. As a further worst-case approach, the assessment presented has been based on all of the other developments operating during the night-time period when *ambient sound levels* are lower and therefore when impacts are likely to be greater, and the highest of the operational sound levels predicted have been chosen for each development.

Table 11-31. Assessment of Night-time Operational Cumulative Effects

Applicant	Operational *Specific Sound Level* dB $L_{Aeq,T}$ dB		
	NSR1	NSR 2	NSR 4
2 - York Potash Harbour	20	N/A	19
3 - Tees CCPP	28	N/A	N/A
4 - Dogger Bank Teesside A / Sofia Offshore Wind Farm	20	20	20
13 - CBRE	43*	N/A	39*
27 - Sirius Minerals	34	N/A	34
71 - York Potash	39	N/A	21
77 - Redcar Energy centre	35	35	35
83-87 STDC	44	37	43

Applicant	Operational *Specific Sound Level* dB $L_{Aeq,T}$ dB		
	NSR1	NSR 2	NSR 4
Existing night-time *ambient sound level* (as shown in Table 11-17)	43	42	41
Cumulative operational sound level of other major developments (excluding NZT), summed with existing *ambient sound level*	49	44	47
NZT (The Proposed Development)	33	34	41
Cumulative operational sound level of other major developments, including NZT, and summed with existing *ambient sound level*	49	44	48

*Operational noise levels for this scheme are defined as the night-time *Background Sound Levels* so the values *of background sound level* from Table 11-17 are used

Where levels are listed as "N/A" the receptor or receptors near it have not been included in the noise assessment so levels are assumed to be low enough as to not affect the assessment

11.6.76 Table 11-31 shows *ambient sound level* increases at all NSRs, however for NSR 1 and NSR 2 this is as a result only of other developments and the increase would occur without the Proposed Development. The table shows a very small change in *ambient sound level* of 1 dB due to the Proposed Development at NSR 4 (Marsh House Farm). An increase of 1 dB in the *ambient sound level* ($L_{Aeq,T}$) is below the level of increase that is perceptible under normal environmental conditions. As the Proposed Development operational noise does not subjectively increase the cumulative ambient level this is not considered to result in a significant cumulative effect.

Noise Effects on Ecological Receptors

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 (ES Volume I, Document Ref. 6.2) and the Habitat Regulations Assessment Report (Document Ref. 5.13) submitted with the Application. The assessment of the effects of noise on ecological receptors in these chapters has concluded that there will be no significant effects from construction, operation or decommissioning of the Proposed Development.

11.7 Mitigation and Enhancement Measures

Construction

11.7.1 This assessment has identified effects of up to minor adverse (not significant) during construction. In addition, during construction there is the potential for some vibration effects at industrial 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: Development Design and Impact Avoidance 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 Final CEMP. 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: Residual Effects and Conclusions.

Operational Noise

11.7.5 The assessment has assumed that potential noise of a tonal, impulsive or intermittent nature will be designed out of the Proposed Development during the detailed design phase by the selection of appropriate plant, building cladding, louvres and silencers/ attenuators as necessary. However, a +3 dB correction for other sound characteristics has been applied to the *specific sound levels* predicted at NSR 4 (Marsh House Farm) from the PCC Site on the basis that the operational noise emissions may be distinctive above the residual acoustic environment. This correction also accommodates intermittency associated with dispatchable operation of the plant.

11.7.6 Assessment has indicated that predicted sound levels at NSR 4 are equal to the LOAEL based upon the relative BS 4142 assessment comparison of predicted daytime and night-time *rating levels* and *Background Sound Levels*, without specific mitigation in place. In addition, the predicted change in the existing daytime and night-time *ambient sound levels* at NSRs would be just perceptible as a worst case.

11.7.7 Nevertheless, at the detailed design stage, the existing noise model will be refined, and additional acoustic assessment will be undertaken in consultation with the designers to further optimise the noise emissions from the Proposed Development, where possible. The findings of the further assessment will inform the design to ensure that *rating levels* meet with a target of no greater than +5 dB above the representative *background sound level* at each NSR. This would result in a low magnitude of impact and an overall minor adverse effect at worst, based upon the context of the environment.

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. 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 Final CEMP to minimise construction noise and vibration effects.

Operation

11.8.2 Lists of assumptions made during the noise modelling and assessment of the Proposed Development are as presented in paragraph 11.6.48 and in Appendix 11B: Operational Noise Information (ES Volume III, Document Ref. 6.4). Further uncertainties are detailed in Table 11-27 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 NSRs.

11.8.3 Sound emission data for key sound emitting plant/ buildings within the Proposed Development has been taken from a site with existing embedded mitigation. Through comparison and correlation with data from other current CCGT projects, the CCGT plant sound power levels have been increased for this project by 7 dB $L_{A,}$ to allow modelling of the specific conditions and layout of an unmitigated scenario of the Proposed Development Site. This is considered to be a conservative but reasonable approach to assessment.

11.8.4 The COVID-19 outbreak has presented challenges in obtaining representative baseline sound levels because typical road, air and rail transport usage has been reduced by travel restrictions and social distancing measures. Other sound sources may also have been affected – for example, due to changes in operating patterns at industrial and commercial premises.

11.8.5 Surveys have taken place in January 2021 during which baseline sound levels measured are likely to be lower than is typical for the area. The data can therefore be considered conservative and will likely have led to prediction of higher levels of noise impacts that would otherwise have been the case.

11.9 Residual Effects and Conclusions

11.9.1 A summary of the residual effects, assuming the implementation of all appropriate mitigation to reduce noise and vibration during the construction operational and decommissioning phases, is presented in Table 11-32.

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 and industrial NSRs during construction on the PCC Site	Negligible adverse during daytime working. Some predicted minor effects, should night-time works be required close to NSRs	Further detailed assessment and preparation of the Final CEMP once contractors appointed, particularly regarding working outside of daytime working hours	Minor adverse or less, on the basis that the mitigation is employed such that the BS 5228 ABC noise limits are met (not significant)	St, T, D
Construction	Noise effects on residential and industrial NSRs during construction of the CO_2 Gathering Network	Negligible/ minor adverse during daytime working. Some predicted minor adverse effects, should night-time works be required close to NSRs	Further detailed assessment and preparation of the Final CEMP once contractors appointed, particularly regarding working outside of daytime working hours	Minor adverse or less, on the basis that the mitigation is employed such that the BS 5228 ABC noise limits are met (not significant)	St, T, D
Construction	Noise effects on residential and industrial NSRs during construction of the CO_2 Export Pipeline	Negligible adverse during daytime working. Some predicted minor adverse effects, should night-time works be required close to NSRs	Further detailed assessment and preparation of the Final CEMP once contractors appointed, particularly regarding working outside of daytime working hours	Minor adverse or less, on the basis that the mitigation is employed such that the BS 5228 ABC noise limits are met (not significant)	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 and industrial NSRs during construction of the Natural Gas Connection	Negligible/minor adverse during daytime working. Some predicted minor adverse effects, should night-time works be required close to NSRs	Further detailed assessment and preparation of the Final CEMP once contractors appointed, particularly regarding working outside of daytime working hours	Minor adverse or less, on the basis that the mitigation is employed such that the BS 5228 ABC noise limits are met (not significant)	St, T, D
Construction	Noise effects on residential and industrial NSRs during construction of within the Electrical Connection corridors	Negligible adverse during daytime working. Some predicted minor adverse effects, should night-time works be required close to NSRs	Further detailed assessment and preparation of the Final CEMP once contractors appointed, particularly regarding working outside of daytime working hours	Minor adverse or less, on the basis that the mitigation is employed such that the 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 preparation of the Final CEMP once contractors appointed.	Negligible adverse	St, T, D
Operation	Operation of the PCC Site effects on residential NSRs	Up to Minor adverse	Further detailed assessment at the design stage, in conjunction with design engineers to further reduced adverse effects, where possible	Minor adverse or less	Lt, P, D
Decommissioning	Noise effects during decommissioning of the PCC Site	Negligible adverse	Further detailed assessment at the decommissioning stage	Negligible adverse	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)
Decommissioning	Noise effects during decommissioning away from the PCC Site	Negligible/ Minor adverse during daytime working. Some predicted moderate adverse effects, should night-time works be required close to NSRs	Further detailed assessment at the decommissioning stage	Minor adverse or less, on the basis that the mitigation is employed such that the BS 5228 ABC noise limits are met (not significant), and that similar techniques are used to those assumed in indicative construction noise calculations	St, T, D

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

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Net Zero Teesside – Environmental Statement

Planning Inspectorate Reference: EN010103

Volume III – Appendices

Appendix 11B: Operational Noise Information

The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (as amended)

Prepared by: AECOM

Table of Contents

Tables

11B. Operational Noise Information

11.1 Noise Model Settings

11.1.1 This development was characterised in CadnaA (version 2021) acoustic modelling software. This software implements the sound propagation calculation methodology set out in ISO 9613-2.

Data Sources – Proposed Power Plant Site:

Table 11B-1: Modelling Input Data

Model element	Data package	Format	Source file	Received from	Received Data
Digital Terrain Map	LIDAR	.tiff	National-LIDAR-Programme-DTM-2018-NZ52ne.zip National-LIDAR-Programme-DTM-2018- NZ52se.zip National-LIDAR-Programme-DTM-2018- NZ62nw.zip National-LIDAR-Programme-DTM-2018- NZ62sw.zip	Downloaded from Open Survey Data (www.environment.data.gov.uk/DefraDataDownload)	22 July 2019
Topography; Building Height Attribute; Ground Absorption	OS MasterMap Topography Layer	.shp	OSMM_2020.zip	Project Team	25 July 2019
Site building dimensions	Scheme designs	.pdf	Various files	Project Team	Updated throughout project
Sound Source data	Kings Lynn Power station data ,Eggborough power station data, Keadby 3 power station data, Karsto FEED study	Various	Various files	Acoustics Team	Updated throughout project

Modelling Assumptions:

11.1.2 The model has been prepared with the following configurations and assumptions:

- maximum number of reflections: two;
- maximum source to receiver distance: 3 km;
- areas of ground absorption have been determined from the OS Topography Layer. Natural areas that are not water were assumed to be acoustically soft whilst all other ground was assumed to be acoustically hard;

- all buildings have been modelled with an absorption coefficient of 0.21 apart from those on the PCC Site, which are modelled with an absorption coefficient of 0;
- residence building heights of existing residences have been assumed to be 4 m for one storey, 6.5 m for two storeys and plus 2.5 m for every storey thereafter;
- the number of storeys for existing buildings has been determined using a combination of OS MasterMap Topography Layer data and a survey of images from Google Earth 'Streetview';
- receivers have been positioned at 1.5m above ground for one storey buildings, at 4m above ground for two storey buildings and plus 2.5 m for every storey thereafter;
- building dimensions have been modelled based upon data provided by the Project Team;
- sound emission data for key sound emitting plant/ buildings within the CCGT component of Proposed Development (turbine halls, heat recovery steam generator (HRSG), peaking plant) have been taken from the Kings Lynn and Eggborough Power Station Environmental Statements (ES) data. The Kings Lynn site included significant embedded mitigation, therefore it has been necessary to adjust the data to represent an unmitigated scenario for this assessment. Through comparison and correlation with data from other current CCGT projects, the CCGT plant sound power levels have been increased for this project by 7 dB $L_{A,}$ to allow modelling of the specific conditions and layout of an unmitigated scenario of the Site;
- sound level data for the CCP have been sourced using available data from the Project Team. This includes data from the FEED study for a similar CCP at Karsto, Norway, or has included the assumption that the CO_2 absorber stack exhaust and high-pressure compressors will each produce a sound pressure level of 85 dB $L_{Aeq,T}$ at 1m;
- the sound power level for the main tower of the CO_2 absorber has been modelled based upon the absorber being an open structure producing a sound pressure level (A-weighted) of 77 dB $L_{Aeq,T}$ at 1 m. The absorber stack exterior (adjacent to the stack casing rather than at the point of emission to atmosphere) has also been modelled as radiating a sound pressure level (A-weighted) of 77 dB $L_{Aeq,T}$ at 1 m;
- assumptions have been made in relation to areas in which pumps may be required (assumed to be absorber unit auxiliaries; amine pumps; chemical storage pumps; compressor pumps; direct contact cooler auxiliaries; fire water tank pumps; steam condensate pumps). Each area has been assumed to contain two pumps that each produce a sound pressure level of 85 dB $L_{Aeq,T}$ at 1 m; and
- stack outlets have been modelled as area sources, located 0.1 m above the top of each stack.

Table 11B-2: Source Data Inputs

Details	Linear sound power levels each frequency band dB									Number in power plant	L_{WA} dB
	31	63	125	250	500	1k	2k	4k	8k		
CCGT Plant											
400kV substation	99	105	97	84	68	49	55	64	66	2	85
Heat recovery steam generator (HRSG)	131	122	110	101	97	96	93	91	98	1	104
Gas turbinehall	118	110	103	87	81	84	77	78	91	1	91
Steam turbinehall	127	119	112	95	90	93	87	87	85	1	100
Gas compressor	98	102	101	90	79	72	70	68	65	1	88
Cooling pump	98	102	101	90	79	72	70	68	65	1	88
Hybrid cooling tower	118	113	116	111	98	90	95	95	91	1	106
Workshop	109	104	102	86	62	48	46	58	63	1	88
Generator step-up transformer (GSUT)	80	92	105	103	89	90	82	70	69	1	97

Details	Linear sound power levels each frequency band dB									Number in power plant	L_{WA} dB
	31	63	125	250	500	1k	2k	4k	8k		
Wastewater treatment area	102	96	98	88	80	74	74	66	59	1	86
Wastewater treatment plant	97	101	100	89	78	71	69	67	64	1	86
CCP Plant											
High pressure compressor*	141	130	109	81	68	64	52	45	42	2	106
Absorber	122	113	112	105	111	103	99	87	89	1	110
Absorber stack	111	102	101	94	100	92	88	76	78	1	99
Absorber stack exhaust*	110	101	100	103	100	91	86	74	77	1	100
Direct Contact Cooler	91	82	79	75	78	61	48	30	32	1	76
Pumps**	107	111	110	99	88	81	79	77	74	14	96
Inlet gas blower casing	94	93	93	98	91	83	83	72	65	3	93

*These source sound power levels have been calculated by assuming a sound pressure level of 85 dB $L_{Aeq,T}$ at 1 m in free field conditions

**two pumps for each of: absorber auxiliaries; amine pumps; chemical storage pumps; compressor pumps; direct contact cooler auxiliaries; fire water tank pumps; steam condensate pumps

Uncertainty:

11.1.3 It should be noted than any sound level predictions have an associated degree of uncertainty. Modelling and measurement processes have been carried out in such a way to reduce such uncertainty. In particular, the following sources of uncertainty have been noted:

- sound emission data for key sound emitting plant/ buildings within the Proposed Development has been taken from Kings Lynn ES. This site included significant embedded mitigation; therefore, it has been necessary to adjust the data to represent an unmitigated scenario for this assessment. Through comparison and correlation with data from other current CCGT projects, the CCGT plant sound power levels have been increased by 7 dB $L_{A,}$ to allow modelling of the specific conditions and layout of an unmitigated scenario of the Proposed Development Site.
- it has been assumed that the CO_2 Absorber stack exhaust and high-pressure compressors will each produce a sound pressure level of 85 dB $L_{Aeq,T}$ at 1m. This is assumed to be representative of the Proposed Development, although the precise methodology by which these data were gathered by third parties, and hence the uncertainty associated with these is not known.
- the sound power level for the main tower of the CO_2 Absorber has been modelled based upon the absorber being an open structure producing a sound pressure level (A-weighted) of 77 dB $L_{Aeq,T}$ at 1 m. The absorber stack exterior (adjacent to the stack casing rather than at the point of emission to atmosphere) has also been modelled as radiating a sound pressure level (A-weighted) of 77 dB $L_{Aeq,T}$ at 1 m. This has been determined as a reasonable worst case from available design information and other projects; and
- predictions of sound pressure levels according to ISO 9613 are based on an assumption of moderate downwind propagation, and hence could be considered as a worst-case calculation. However, the standard also indicates an estimated accuracy of ±3 dB(A) in predicted levels.