



LIGHTHOUSE GREEN FUELS PROJECT

Preliminary Environmental Information Report Chapter 6: Noise and Vibration

The Inspectorate Reference: **EN010150**

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Volume 1



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6. NOISE AND VIBRATION

6.1. INTRODUCTION

- 6.1.1. This Chapter considers the impacts of the Proposed Scheme on Noise and Vibration during construction and operation, and any potential significant effects. It sets out the proposed methodology for the Noise and Vibration assessment and identifies those impacts that have been scoped out of the assessment. Where necessary, further assessment will be presented in the Environmental Statement (ES).
- 6.1.2. A desktop review of the Site and surrounding area has identified human receptors and ecological receptors which are considered sensitive to noise and/or vibration. This Chapter focuses on the noise and vibration assessment for sensitive human receptors.
- 6.1.3. The baseline noise and vibration survey methodology and results for the human and ecologically sensitive receptors are detailed in this Chapter.
- 6.1.4. Information regarding the noise and vibration assessment of ecological receptors, including the approach to the assessment of underwater noise, is provided within **Chapter 7: Terrestrial Ecology (Volume 1)** and **Chapter 8: Freshwater and Marine Ecology (Volume 1)**. The baseline data for the ecologically sensitive noise receptors is assessed in **Chapter 7: Terrestrial Ecology (Volume 1)**.
- 6.1.5. The SAF Plant emissions assumptions used to inform the preliminary noise modelling are included in **Appendix 6A: Operational Noise Data (Volume 3)**.

MATTERS SCOPED OUT

- 6.1.6. Matters scoped out of this assessment, as agreed with The Inspectorate are as follows:
- Construction Phase: Vibration from construction traffic.

6.2. POLICY, LEGISLATION, AND GUIDANCE

- 6.2.1. The policy, legislation, and guidance relevant to the assessment of the Proposed Scheme is detailed in **Appendix 4A: Policy, Legislation and Guidance (Volume 3)**. The key policy, legislation, and guidance most relevant to this Chapter are as follows:
- Policy:
 - Noise Policy Statement for England (NPSE) 2010¹
 - National Planning Policy Framework (NPPF) 2023²
 - Overarching National Policy Statement (NPS) For Energy (EN-1) 2023³
 - Stockton-on-Tees Borough Council (STBC) Local Plan 2019⁴
 - Redcar and Cleveland Borough Council (RCBC) Local Plan 2018⁵
 - Legislation:
 - Control of Pollution Act, 1974 (CoPA)⁶

- Environmental Protection Act 1990⁷
- Guidance:
 - BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites - Part 1: Noise (BS 5228-1)⁸
 - BS 5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites - Part 2: Vibration (BS 5228-2)⁹
 - Design Manual for Roads and Bridges (DMRB) LA111 - Noise and vibration. Revision 2 (LA111)¹⁰
 - Calculation of Railway Noise 1995 (CRN)¹¹
 - Calculation of Road Traffic Noise 1988 (CRTN)¹²
 - BS 4142:2014+A1:2019 Methods for rating and assessing industrial and commercial sound (BS 4142)¹³
 - Institute of Environmental Management and Assessment – Guidelines for environmental noise impact assessment: October 2014¹⁴
 - Additional Railway Noise Source Terms 1995¹⁵
 - Planning Practice Guidance: Noise¹⁶.

6.3. SCOPING OPINION AND CONSULTATION

- 6.3.1. An EIA Scoping Opinion¹⁷ was received by the Applicant from The Inspectorate on behalf of the Secretary of State on 01 September 2023. The responses from The Inspectorate and statutory consultees in relation to noise and vibration, and how these requirements should be addressed by the Applicant, are addressed in **Table 6-1**. Note that noise-related comments received from Natural England, included in the Scoping Opinion¹⁷, are addressed in the relevant Ecology Chapters (**Chapter 7: Terrestrial Ecology (Volume 1)** and **Chapter 8: Freshwater and Marine Ecology (Volume 1)**).

Table 6-1: Summary of the EIA Scoping Opinion in Relation to Noise and Vibration

Section ID	Applicant's Proposed Matters to Scope Out	The Inspectorate's Comments	Response
3.2.1	Vibration from construction traffic	The Applicant proposes to scope out impacts from vibration generated by construction traffic on the local road network. The justification provided is that the construction traffic vehicles would be similar to the vibration caused by any other vehicles that could legally use the route. The Inspectorate agrees that construction vehicles are unlikely to lead to significant vibration effects and agrees that this matter can be scoped out of the ES.	No response required.
3.2.2	Noise and vibration from commercial and fixed plant – operation	The Applicant proposes to scope out this matter on the basis that fixed plant and equipment are not anticipated to be located within the specified 500m Study Area for noise or 100m Study Area for vibration. On the basis that the location of the fixed plant and equipment is not yet confirmed, the Inspectorate does not agree to scope these matters out at this stage. Accordingly, the ES should include an assessment of these matters, or the information referred to demonstrating agreement with the relevant consultation bodies and the absence of a likely significant effect.	Whilst operational fixed plant are >100m from any receptors, noise will be scoped in on the basis that STBC requested it. Vibration is scoped out due to there being no sensitive receptors within 100m of the operational fixed plant locations.
3.2.3	Changes in road traffic noise – operation	The Applicant proposes to scope out this matter on the basis that traffic flows are anticipated to be minimal. The Scoping Report ¹⁸ does not provide indicative traffic	The matter is scoped in on the basis that noise impacts from development generated road traffic cannot be ruled out at this stage. A preliminary assessment is

Section ID	Applicant's Proposed Matters to Scope Out	The Inspectorate's Comments	Response
		numbers likely to be used during the operational phase, but paragraph 2.2.12 states that feedstock may be transferred by road. See also ID 2.2.2 in this regard. The Inspectorate does not agree to scope this matter out at this stage. The ES should assess the potential for traffic generated by the Proposed Scheme to lead to noise effects at sensitive receptors or demonstrate that significant effects would not occur based on traffic numbers being below established thresholds set out within guidance.	presented in Section 6.8 below using operational traffic assumptions. If the operational traffic data change, this assessment will be refined within the noise and vibration Chapter of the ES.
3.2.4	Rail noise impacts	<p>There is inconsistency within this Section of the Scoping Report¹⁸. It is stated in one row of Table 6-2 that the operation of the rail terminal would be unlikely to lead to significant noise effects based on the separation distance (of 800m) and the existing noise environment at sensitive receptors. However, it is also stated elsewhere in Table 6-2 and within paragraph 6.7.4 that rail noise from the operation of the Proposed Scheme is proposed to be scoped in due to the possibility of a significant effect.</p> <p>For the avoidance of doubt, the ES should assess the potential for likely significant effects resulting from the operation of the Proposed Scheme, including the use of the rail terminal or provide adequate justification that significant effects are unlikely to occur.</p>	<p>The matter has been scoped in on the basis that likely significant effects resulting from development generated rail movements cannot be ruled out at this stage.</p> <p>A assessment will be presented within the noise and vibration Chapter of the ES.</p>

Section ID	Applicant's Proposed Matters to Scope Out	The Inspectorate's Comments	Response
3.2.5	Rail vibration impacts	Table 6-2 indicates that noise impacts arising from operational rail movements are proposed to be assessed however there is no indication that vibration impacts would be assessed. The ES should assess the potential for rail movements to lead to significant effects in terms of vibration.	The matter has been scoped in on the basis that likely significant effects from vibration impacts due to development generated rail movements cannot be ruled out at this stage. A assessment will be presented within the noise and vibration Chapter of the ES.
3.2.6	Decommissioning phase	No reference is made to the decommissioning phase within this Section of the Scoping Report ¹⁸ . The ES should assess likely significant effects during the decommissioning phase where these are likely to occur.	The potential noise and vibration effects during the decommissioning phase will be detailed in the decommissioning plan which will be produced at a later date and form part of the ES. This will allow for a more accurate assessment, including any new noise sensitive receptors in the area and detailed information on the decommissioning processes.

- 6.3.2. **Table 6-2** provides a summary of consultation undertaken to date with respect to Noise and Vibration. The consultation undertaken with Natural England is detailed in **Chapter 7: Terrestrial Ecology (Volume 1)**.

Table 6-2: Consultation Summary Table

Date and Method of Consultation	Consultee	Summary of Key Topics Discussed and Key Outcomes
04 August 2023 Online meeting	Environmental Health Officer, STBC	Agreement of noise survey methodology, including monitoring locations and durations and the data to be gathered during the survey.

6.4. ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

- 6.4.1. The noise assessment of the Proposed Scheme has been undertaken in line with the legislation, policy and guidance summarised in **Section 6.2** of this Technical Chapter.

POTENTIAL SIGNIFICANT EFFECTS

- 6.4.2. As identified in the EIA Scoping Report¹⁸, the following effects are considered to be significant and have been considered further in this Chapter:
- Construction noise and vibration;
 - Construction traffic noise;
 - Development generated operational rail noise;
 - Development generated operational rail vibration;
 - Development generated operational road noise;
 - Noise impacts from operational fixed plant and equipment; and
 - Vibration impacts from operational fixed plant and equipment.

SENSITIVE RECEPTORS

- 6.4.3. The following sensitive receptors have been identified and will be considered within the noise and vibration impact assessment:

Human Receptors

- 6.4.4. Sensitive human receptors are considered to be places where people may be exposed to noise and/or vibration arising from the Proposed Scheme.
- 6.4.5. There are human receptors relatively close to the Site, including:
- Residential properties on Saltview Terrace, off Seaton Carew Road, to the south west of the Site, the closest of which is located 90m from the Heavy Haul Road, 70m from Wilton Engineering Wharf, 1,000m from Clarence Wharf, 800m from the

nearest operational aspect of the Site (this being the Railway Terminal), and approximately 1,850m from the Sustainable Aviation Fuel (SAF) Plant Site;

- Residential properties on Port Clarence Road (including those setback from the road on Samphire Street), to the south west of the Site, the closest of which is located 10m from the Heavy Haul Road, 7m from Wilton Engineering Wharf, 820m from Clarence Wharf, 900m from the nearest operational aspect of the Site (this being the Railway Terminal), and approximately 1,900m from the SAF Plant Site; and
- High Clarence Primary School located on Port Clarence Road, approximately 160m to the west of the closest construction aspect of the Proposed Scheme (this being the Heavy Haul Road), and approximately 2,300m from the closest operational aspect of the Site (this being the Railway Terminal).

6.4.6. The Proposed Scheme and the commercial and industrial premises surrounding the Site are not considered to be noise and vibration sensitive receptors and are, therefore, scoped out of the assessment, as agreed during consultation with STBC.

Ecological Receptors

6.4.7. Information on noise and vibration sensitive ecological receptors and the preliminary assessment of noise and vibration at these receptors is provided within **Chapter 7: Terrestrial Ecology (Volume 1)** and **Chapter 8: Freshwater and Marine Ecology (Volume 1)**.

ASSESSMENT METHODOLOGY

Baseline Data Collection

- 6.4.8. A baseline noise and vibration survey has been undertaken between 11th and 19th October 2023 to establish the prevailing conditions at sensitive human receptors in the vicinity of the Proposed Scheme. Further details of the surveys, including monitoring locations and the results are detailed below in **Section 6.6**.
- 6.4.9. The approach to the baseline noise survey, including measurement locations and periods over which the data should be gathered, were discussed and agreed with the Environmental Health Department of STBC prior to the noise survey being undertaken.
- 6.4.10. All measurements were carried out using sound level meters compliant with Class 1 specification, as set out in BS EN 61672-1: 2013¹⁹.
- 6.4.11. The survey was undertaken by consultants competent in environmental noise and vibration monitoring, and in general accordance with the principles of BS 7445-2: 1991²⁰.
- 6.4.12. Any additional baseline noise monitoring requirements identified during consultation with RCBC will be included in the ES.

CONSTRUCTION PHASE ASSESSMENT METHODOLOGY

- 6.4.13. The adopted assessment methodology for sensitive human receptors will be applied to determine compliance with national and local policy and to allow for the identification of any significant noise and/or vibration effects as a result of the Proposed Scheme. The adopted assessment methodology draws upon the policies and guidance in **Section 6.2** above and **Appendix 4A: Policy, Legislation and Guidance (Volume 3)** as applicable to each impact being assessed.
- 6.4.14. Where appropriate, additional noise predictions will be carried out for sensitive terrestrial and marine ecological receptors and presented in the ES. Further details on the proposed assessment methodology and preliminary qualitative impact assessment are presented in **Chapter 7: Terrestrial Ecology (Volume 1)** and **Chapter 8: Freshwater and Marine Ecology (Volume 1)**.

Construction Noise

- 6.4.15. Construction noise will be predicted and assessed using the guidance in BS 5228:2009+A1:2014 Part 1. The Standard provides methods for determining the significance of construction noise levels by considering the change in the ambient noise level that would arise as a result of the construction operations. The ABC example assessment method in BS 5228:2009+A1:2014 Part 1⁹ is presented in **Table 6-3** and is adopted for this assessment.

Table 6-3: Threshold of Potential Significance Effect at Dwellings - ABC Method

Assessment category and threshold value period	Threshold value, in decibels $L_{Aeq,T}$ (dB)		
	Category (A) ^(A)	Category (B) ^(B)	Category (C) ^(C)
Night-time (23:00 – 07:00)	45	50	55
Evenings and weekends ^(D)	55	60	65
Daytime (07:00 – 19:00) and Saturdays (07:00 – 13:00)	65	70	75
<p>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.</p> <p>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 3dB due to site noise.</p> <p>NOTE 3: Applied to residential receptors only.</p>			
(A) Category A: threshold values to use when ambient levels (when rounded to the nearest 5dB) are less than these values.			

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

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

(D) 19.00-23.00 weekdays, 13.00-23.00 Saturdays and 07.00-23.00 Sundays

- 6.4.16. The results of the baseline noise survey have been used to determine appropriate construction noise level thresholds in line with the ABC method. Predictions of noise from the construction of the Proposed Scheme, including the use of the Heavy Haul Road, will be assessed against these thresholds. Predictions will be undertaken for a sample of the closest sensitive human receptors for each relevant Construction Phase of the Proposed Scheme. The predictions will include reasonable worst-case assumptions in relation to the proposed construction activities, construction plant and working methods and will be presented in the ES.
- 6.4.17. Appropriate mitigation measures will be presented, including best practicable means (BPM) and the good practice recommendations presented in BS 5228:2009+A1:2014 Part 1⁹.

Construction Vibration

- 6.4.18. Construction vibration will be predicted and assessed using the guidance in BS 5228:2009+A1:2014 Part 2¹⁰. Vibration levels will be predicted for a sample of construction activities that have the potential to produce vibration (e.g. piling, vibratory compaction and Heavy Haul Road activities). As for construction noise, the vibration predictions will include reasonable worst-case assumptions in relation to the proposed construction activities, construction plant and working methods and will be presented in the ES.
- 6.4.19. British Standard BS 5228:2009+A1 2014 Part 2¹⁰ describes ranges of vibration in terms of peak particle velocities (PPV) and the corresponding effects on people that might be expected. These are set out in Table B1 of Annex B to the British Standard, as replicated in **Table 6-4**.

Table 6-4: Guidance on Effects of Vibration Levels

Vibration level ^{A) B) C)}	Effect
0.14 mms⁻¹	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.
0.3 mms⁻¹	Vibration might be just perceptible in residential environments.
1.0 mms⁻¹	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.
10 mms⁻¹	Vibration is likely to be intolerable for any more than a very brief exposure to this level.
<p>A) The magnitudes of the values presented apply to a measurement position that is representative of the point of entry into the recipient.</p> <p>B) A transfer function (which relates an external level to an internal level) needs to be applied if only external measurements are available.</p> <p>C) Single or infrequent occurrences of these levels do not necessarily correspond to the stated effect in every case. The values are provided to give an initial indication of potential effects, and where these values are routinely measured or expected then an assessment in accordance with BS 6472-1²² or -2²³, and/or other available guidance, might be appropriate to determine whether the time varying exposure is likely to give rise to any degree of adverse comment.</p>	

6.4.20. Appropriate mitigation measures will be presented, including BPM and the good practice recommendations presented in BS 5228:2009+A1:2014 Part 2¹⁰.

Construction Traffic Noise

6.4.21. The assessment of changes in noise levels resulting from temporary construction traffic on the public highway has been carried out using the guidance in DMRB LA111¹¹. This desktop study has been informed by expected traffic movements provided by the Project Team, the assumptions for which are provided in **Chapter 16: Traffic and Transport (Volume 1)**. Noise level calculations have been undertaken in accordance with the methodology contained within CRTN¹³ and any changes in noise levels due to the construction traffic have been assessed using the guidance set out in DMRB LA111¹¹.

6.4.22. DMRB LA111 provides a magnitude of impact scale based on the increase in traffic noise resulting from construction movements. This scale is replicated in **Table 6-5**.

Table 6-5: Construction Traffic Noise – Magnitude of Impact

Magnitude of Impact	Increase in BNL (dB)
Major	Greater than or equal to 5.0
Moderate	Greater than or equal to 3.0 and less than 5.0
Minor	Greater than or equal to 1.0 and less than 3.0
Negligible	Less than 1.0

OPERATIONAL PHASE ASSESSMENT METHODOLOGY

Development Generated Rail Noise

- 6.4.23. The assessment of the permanent operational noise from rail movements associated with the Proposed Scheme will be carried out using the IEMA Guidelines¹⁵.
- 6.4.24. The railway line and Navigator Rail Terminal serving the Proposed Scheme is infrequently in use and, therefore, noise from the Navigator railway line was not captured during the baseline noise survey. Discussions are being held with Navigator to obtain existing rail movement and these will be presented in the ES. The noise levels from development generated rail movements will be derived by prediction only using information provided by the project's rail consultant and the calculation procedures in the Department of Transport's Calculation of Railway Noise (CRN) 1995¹³.
- 6.4.25. The predictions will be based on a number of input parameters, including (where available):
- The frequency of freight service;
 - Train type, length and number of carriages;
 - Train speed;
 - Track type (continuously welded rail or jointed);
 - Locations of cuttings, bridges and structures; and
 - Gradients and other areas where the train is likely to be 'on-power'/accelerating.
- 6.4.26. The calculation procedure also includes additional noise source terms provided in the Additional Railway Noise Source Terms 1995¹⁶ which will be utilised for the predictions.
- 6.4.27. Any changes in rail noise (including from the Navigator Rail Terminal itself) likely to be generated as a result of the operation of the Proposed Scheme will be assessed against the existing baseline using the approach recommended in the IEMA Guidelines¹⁵ for the classification of magnitude of impact, sub-divided into short-term impacts and long-term impacts.
- 6.4.28. Whilst proposed rail traffic data have not been confirmed, a worst-case assumption of three available trains slots per day has been assumed, although it is unlikely that all will be utilised. The three available slots would cover the full 24 hour period and trains may run during night. Other data, as listed in **paragraph 6.4.25**, are being gathered and will

be presented in the ES. The assessment of rail noise will consider the opening year of the Proposed Scheme and will assume that the development will immediately run with up to three trains per day. This assessment using the short-term magnitude of impact framework below presents a worst-case scenario as long-term assessment criteria are less onerous.

6.4.29. **Table 6-6** sets out the guideline noise assessment framework for magnitude of impact for operational noise as a result of the Proposed Scheme.

Table 6-6: Guideline Impact and Effect Assessment Framework – Short-term Noise Change for Rail

Noise Level Change, $L_{Aeq,T}$ dB*	Magnitude of Impact
0 to <1	Negligible
1 to <3	Minor
3 to <5	Moderate
>5	Major
*T = either 16 hour day or 8 hour night	

Development Generated Rail Vibration

- 6.4.30. The Rail Terminal (and associated existing railway line) serving the Proposed Scheme is used infrequently and no trains were identified from the baseline survey data, therefore, railway vibration did not form a component of the measured baseline vibration levels. Using information on proposed rail movements and the data listed in **paragraph 6.4.25**, the anticipated level of rail vibration will be estimated and presented in the ES.
- 6.4.31. The assessment of the permanent operational vibration from rail movements associated with the Proposed Scheme and any associated vibration at the Rail Terminal will be carried out using the guidance in BS 6472-1: Guide to the evaluation of human exposure to vibration in buildings – Part 1²¹.
- 6.4.32. Predictions of future Vibration Dose Values (VDV) for the 16h day and 8h night-time periods will be calculated based on the predicted train pass-by PPV for representative rail movements and the anticipated number of rail movements to the Proposed Scheme.
- 6.4.33. Table 1 of BS 6472-1²² (as replicated in **Table 6-7**) provides VDV ranges which might result in various probabilities of adverse comment.

Table 6-7: Vibration Dose Value Ranges Which Might Result in Various Probabilities of Adverse Comment Within Residential Buildings

Place and time	Low probability of adverse comment $ms^{-1.75}$, 1)	Adverse comment possible $ms^{-1.75}$	Adverse comment probable $ms^{-1.75}$, 2)
Residential buildings 16 h day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8 h night	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8
1) Below these ranges adverse comment is not expected 2) Above these ranges adverse comment is very likely			

Development Generated Road Noise

- 6.4.34. An exercise has been carried out using road traffic flows for the Proposed Scheme to consider any changes in road traffic noise due to development-generated traffic.
- 6.4.35. The exercise is based on predicted noise levels which utilise the calculation methodology within CRTN¹³. Predictions are based on traffic flows along roads within the Study Area, and account for, but are not limited to, the following:
- Traffic volume (provided as Annual Average Weekday Traffic (AAWT) over an 18-hour period, between 00:00 and 18:00 during weekdays);
 - The average traffic speed, in kilometres per hour;
 - The composition of the traffic as a percentage of heavy vehicles (defined as over 3.5 tonnes unladen weight);
 - Road surface type; and
 - Distance and ground type between source and sensitive receptor.
- 6.4.36. The assessment is consistent with the guidance in DMRB LA111¹¹ and makes the recommendation to undertake a further and more detailed assessment if any of the following criteria are met:
- The Proposed Scheme is likely to cause a change in the Basic Noise Level (BNL) of 1dB $LA_{10,18hr}$ in the do-something opening year (DSOY) compared to the do-minimum opening year (DMOY);
 - The Proposed Scheme is likely to cause a change in the BNL of 3dB $LA_{10,18hr}$ in the do-something future year (DSFY) compared to the do-minimum opening year (DMOY);
 - The Proposed Scheme involves the construction of new road links within 600m of noise sensitive receptors; and

- There is a reasonable stakeholder expectation that an assessment would be undertaken.

6.4.37. The magnitude of impact criteria for development-generated road noise are determined based upon the classification of noise level changes for operational traffic, as detailed within DMRB LA111¹¹. The magnitude of impact criteria for short and long-term noise changes, as defined in DMRB LA111¹¹, are detailed in **Table 6-8** and **Table 6-9** respectively.

Table 6-8: DMRB Magnitude of Change – Short Term

Short term magnitude	Short term noise change (dB L _{A10, 18hr} or L _{night})
Major	Greater than or equal to 5.0
Moderate	3.0 to 4.9
Minor	1.0 to 2.9
Negligible	Less than 1.0

Table 6-9: DMRB Magnitude of Change – Long Term

Long term magnitude	Long term noise change (dB L _{A10, 18hr} or L _{night})
Major	Greater than or equal to 10.0
Moderate	5.0 to 9.9
Minor	3.0 to 4.9
Negligible	Less than 3.0

Noise Impacts from Fixed Plant and Equipment

6.4.38. Noise levels have been predicted at a number of sensitive human receptors using the methodology set out in BS 4142:2014+A1:2019⁹. The calculation procedure takes account of the following:

- Sound power level of the plant items;
- Number of items of plant;
- Operational duration of each item, expressed as a percentage on-time within the assessment period;
- Distance to receptors; and
- Type of intervening ground and screening.

6.4.39. Sound power levels for each item of fixed plant or equipment have been provided by the Project Team, or Design Team's archived source data.

6.4.40. The assessment of noise impacts from fixed plant and equipment is based on the comparison between the background sound level at the residential locations and the

rating level of the sound source under consideration. The relevant parameters in this instance are as follows:

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

6.4.41. When determining the rating level, BS 4142¹⁴ allows for the following adjustments or penalties to be applied to the specific level:

- Tonality: for sound ranging from not tonal to prominently tonal, a correction of between 0 dB and +6 dB can be applied. Subjectively, this can be converted to a penalty of +2 dB for a tone which is just perceptible at the receptor location, +4 dB for a clearly perceptible tone, and +6 dB for a highly perceptible tone;
- Impulsivity: ranging between a sound that has no impulsive character to one which is highly impulsive (i.e. containing short pulses of high frequency components), at the receptor location. Subjectively, this can be converted to a penalty of +3 dB for impulsivity which is just perceptible at the receptor location, +6 dB where it is clearly perceptible, and +9 dB where it is highly perceptible;
- Intermittency: for a sound with identifiable on/off conditions, a penalty of 3 dB can be applied; and
- Other sound characteristics: where the specific sound features characteristics that are neither tonal, nor impulsive, nor intermittent, though still distinctive against the background acoustic environment, a +3 dB penalty can be applied.

6.4.42. The difference between the resultant level (the rating level), and the background noise level at the sensitive receptor has been assessed to determine the magnitude of impact. The context of any impact is important, and the Standard allows for the initial impact to be modified, depending on the context.

6.4.43. BS 4142 notes the following on this comparison:

- “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; and
- 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.”

Vibration Impacts from Fixed Plant and Equipment

6.4.44. Above, **Table 6-1** shows that the study area for vibration from commercial and fixed plant is 100m. The closest vibration-sensitive human receptor to the Site is >800 m from the SAF Plant Site and approximately 2 km from the Navigator Wharf (used for SAF export). Operational vibration from fixed plant and equipment is, therefore, scoped out due to there being no receptors within the agreed study.

SIGNIFICANCE CRITERIA

6.4.45. The following terms have been used to define the significance of the effects identified, as illustrated in **Table 6-10**:

- Major effect: where the Proposed Scheme could be expected to have a very significant effect (either adverse or beneficial) on receptors;
- Moderate effect: where the Proposed Scheme could be expected to have a noticeable effect (either adverse or beneficial) on receptors;
- Minor effect: where the Proposed Scheme could be expected to result in a small, barely noticeable effect (either adverse or beneficial) on receptors; and
- Negligible: where no discernible effect is expected as a result of the Proposed Scheme on receptors.

6.4.46. The significance of effect has been determined by consideration to both the impact magnitude and the sensitivity of the receptor, according to the matrix in **Table 6-10**. The sensitivity of the closest noise and vibration sensitive human receptors to the Proposed Scheme have all been identified as “High”.

Table 6-10: Matrix for Determining the Significance of Effects

Magnitude of Impact	Sensitivity of Receptor/Receiving Environment to Impact/Change			
	High	Medium	Low	Negligible
High	Major	Moderate to Major	Minor to Moderate	Negligible
Medium	Moderate to Major	Moderate	Minor	Negligible
Low	Minor to Moderate	Minor	Negligible to Minor	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible
Note: only Moderate, Moderate to Major and Major effects are considered significant.				

6.4.47. Where significant effects are identified, they will be considered as short-term, medium-term or long-term. All noise and vibration effects are considered as direct, rather than indirect.

Construction Phase

Construction Noise

6.4.48. The following significance criteria will be applied for the assessment of construction noise and are based on the noise levels presented in **Table 6-3** and the Significance matrix in **Table 6-10**.

Table 6-11: Construction Noise – Significance Criteria

Construction noise level ($L_{Aeq,T}$, dB)	Magnitude of Impact	Significance of Effect
≥ 5.1 dB above receptor ABC assessment criterion	High	Major
3.1 to 5 dB above receptor ABC assessment criterion	Medium	Moderate to Major
0.1 to 3 dB above receptor ABC assessment criterion	Low	Minor to Moderate
< Receptor ABC assessment criterion	Negligible	Negligible

Construction Vibration

6.4.49. The following significance criteria will be applied to construction vibration, based on the vibration levels presented in **Table 6-4** and the Significance matrix in **Table 6-10**.

Table 6-12: Construction Vibration – Significance Criteria

Construction vibration level, mms^{-1} (PPV)	Magnitude of Impact	Significance of Effect
> 5.1	High	Major
1.1 > 5.0	Medium	Moderate to Major
0.4 > 1.0	Low	Minor to Moderate
< 0.3	Negligible	Negligible

Construction Traffic Noise

6.4.50. The following significance criteria will be applied to construction traffic noise, based on the magnitude of change presented in **Table 6-5** and the Significance matrix in **Table 6-10**.

Table 6-13: Construction Traffic Noise – Significance Criteria

Increase in BNL (dB)	Magnitude of Change	Significance of Effect
> 5.0	High	Major
3.0 to 4.9	Medium	Moderate to Major
1.0 to 2.9	Low	Minor to Moderate
< 1.0	Negligible	Negligible

Operational Phase

Development Generated Rail Noise

6.4.51. The following magnitude of change and significance criteria will be applied for the assessment of development generated rail noise (also including noise from the Rail Terminal) and are based on the IEMA Guidelines and the Significance matrix in **Table 6-10**.

Table 6-14: Development Generated Rail Noise – Significance Criteria

Noise Level Change, $L_{Aeq T}$ dB T = either 16hr day or 8hr night	Magnitude of Change	Significance of Effect
>5.1	High	Major
3.1 < 5	Medium	Moderate to Major
1.1 < 3.0	Low	Minor to Moderate
0 < 1.0	Negligible	Negligible

Development Generated Rail Vibration

6.4.52. The following significance criteria will be applied for the assessment of development generated rail vibration (including from the Rail Terminal), based on the vibration levels presented in **Table 6-7** and the Significance matrix in **Table 6-10**.

Table 6-15: Development Generated Rail Vibration - Significance Criteria

Vibration Level $ms^{-1.75}$ (VDV)		Magnitude of Impact	Significance of Effect
16 h day	8 h night		
Greater than 1.6	Greater than 0.8	High	Major
0.9 to 1.6	0.5 to 0.8	Medium	Moderate to Major
0.2 to 0.8	0.1 to 0.4	Low	Minor to Moderate
Less than 0.2	Less than 0.1	Negligible	Negligible

Development Generated Road Noise

6.4.53. The significance criteria for development generated road noise are summarised in **Table 6-16** and **Table 6-17**. These draw on the guidance within DMRB LA111¹¹.

Table 6-16: Development Generated Road Noise – Short-Term Significance Criteria

Short-term noise change (dB $L_{A10, 18hr}$ or L_{night})	Magnitude of Change	Significance of Effect
Greater than or equal to 5.0	High	Major
3.0 to 4.9	Medium	Moderate to Major
1.0 to 2.9	Low	Minor to Moderate
Less than 1.0	Negligible	Negligible

Table 6-17: Development Generated Road Noise – Long-Term Significance Criteria

Long-term noise change (dB $L_{A10, 18hr}$ or L_{night})	Magnitude of Change	Significance of Effect
Greater than or equal to 10.0	High	Major
5.0 to 9.9	Medium	Moderate to Major
3.0 to 4.9	Low	Minor to Moderate
Less than 3.0	Negligible	Negligible

6.4.54. For noise sensitive receptors where the magnitude of change in the short-term is minor, moderate, or major, a determination of final significance is made based on consideration of a number of factors including: the location, absolute noise levels, the acoustic character of the environment, and how the change in noise may be perceived by residents, as detailed in DMRB LA111¹¹, Table 3.60.

Noise Impacts from Fixed Plant and Equipment

6.4.55. The following significance criteria will be applied to noise from fixed plant and equipment, based on the Significance matrix in **Table 6-10** and the guidance in BS 4142.

Table 6-18: Noise from Fixed Plant and Equipment – Significance Criteria

Difference between Background Level, $L_{A90, T}$, and Rating level, $L_{Ar, Tr}$	Magnitude of Impact	Significance of Effect
Greater than +10	High	Major
+5.1 to +10	Medium	Moderate to Major
+0.1 to +5	Low	Minor to Moderate
Less than or equal to 0	Negligible	Negligible

Vibration Impacts from Fixed Plant and Equipment

- 6.4.56. The following significance criteria will be applied to vibration from fixed plant and equipment, based on the Significance matrix in **Table 6-10**.

Table 6-19: Vibration for Fixed Plant and Equipment - Significance Criteria

Vibration Level $\text{ms}^{-1.75}$ (VDV)		Magnitude of Impact	Significance of Effect
16 h day	8 h night		
Greater than 1.6	Greater than 0.8	High	Major
0.9 to 1.6	0.5 to 0.8	Medium	Moderate to Major
0.2 to 0.8	0.1 to 0.4	Low	Minor to Moderate
Less than 0.2	Less than 0.1	Negligible	Negligible

6.5. STUDY AREA

- 6.5.1. The Study Areas considered for sensitive human receptors are as follows:

■ Construction Phase:

- For construction noise, a Study Area of 150m from the defined areas of construction will be adopted (as defined in **Chapter 2: Site and Proposed Scheme Description (Volume 1)**). This falls within the distance for which the BS 5228 1:2009+A1:2014⁹ prediction methodology is valid. This is considered sufficient to ensure that all potentially significant noise effects will be identified.
- For construction vibration, a Study Area of 100m from the closest construction activity (as defined in **Chapter 2: Site and Proposed Scheme Description (Volume 1)**) with the potential to generate vibration will be adopted. This falls within the distance for which the BS 5228 2:2009+A1:2014⁹ prediction methodology is valid. Furthermore, DMRB LA111¹¹ states; “A Study Area of 100m from the closest construction activity with the potential to generate vibration is normally sufficient to encompass vibration sensitive receptors.”
- For construction traffic noise, a 50m Study Area from public roads with an expected increase of 1dB(A) or more due to construction traffic will be adopted. This is in line with the guidance in DMRB LA111¹¹ which does not require the assessment of effects at receptors more than 50m from roads which experience the 1dB(A) increase.

■ Operational Phase:

- For development generated rail noise (including from the Rail Terminal), a 300m Study Area will be adopted for which the CRN prediction methodology would be valid. This is considered sufficient to ensure that all potentially significant noise effects will be identified.
- For development generated rail vibration (including from the Rail Terminal), a Study Area of 100m from the railway line will be adopted. This is based on

professional judgement and is considered sufficient to ensure all potentially significant vibration effects will be identified.

- For development generated road noise a Study Area of 300m from the closest road traffic noise source is considered sufficient to ensure that all potentially significant noise effects will be identified. This is informed by the validity of the CRTN calculation methodology.
- For operational noise from fixed plant and equipment, a Study Area of 500m from the operational areas of the Proposed Scheme will be adopted. This is based on professional judgement and considered sufficient to ensure that all potentially significant noise effects will be identified. However, sources of operational noise from the Proposed Scheme (the SAF Plant Site) are anticipated to be located at a distance of greater than 800m from the nearest human receptors, however, given the number of plant items proposed and at the request of STBC, an assessment of the SAF Plant will be undertaken for completeness.
- For operational vibration from fixed plant and equipment, a Study Area of 100m from the operational areas of the Proposed Scheme will be adopted. This is based on professional judgement and is considered sufficient to ensure that all potentially significant vibration effects will be identified. However, sources of operational vibration from the Proposed Scheme are anticipated to be located at a distance of greater than 100m from the nearest human receptors. On this basis, operational vibration impacts from fixed plant are scoped out of this assessment.

6.5.2. As the design evolves and more detail becomes available, professional judgement may be used to amend the above Study Areas, as appropriate and in consultation with STBC and RCBC.

6.6. BASELINE CONDITIONS AND FUTURE BASELINE

6.6.1. The existing baseline is informed by both a desktop study and a noise and vibration survey. Each is detailed below.

6.6.2. Additionally, there are two earth bunds, as described below, which influence the noise climate in the area and these will be retained.

- An earth bund of approximately 4m in height and 800m in length exists on the western boundary of the proposed SAF Plant Site. This will have the effect of attenuating noise levels from activities which are not at height during both the construction and operational phases.
- An earth bund runs along the eastern side of the proposed SAF Plant Site, which may serve to reduce noise levels to the east from any construction activities.

EXISTING BASELINE

Desktop Study

- 6.6.3. A desktop study has been undertaken to identify Noise Important Areas (NIAs)²² based on the 3rd round noise mapping for the Environmental Noise Directive (END)²³, legally in force in England through the Environmental Noise (England) Regulations²⁴.
- 6.6.4. The following NIAs have been identified within 500m from the Site:
- IA ID 2344, road source next to the A178 Seaton Carew Road, owned by STBC; and
 - IA ID 2343, road source next to the A1046 Port Clarence Road, owned by STBC.
- 6.6.5. A desktop review of the Site and surrounding area has been conducted using online aerial photography and design drawings. The Site is in a predominantly industrial area in Seal Sands, Stockton-on-Tees with a pipeline link to the Bran Sands Wastewater Treatment Plant on the east of the River Tees which is also in a predominantly industrial area. To the north, east and south of the Seal Sands area of the Proposed Scheme are various commercial and industrial premises including chemical manufacturers, waste management and power generation sites. The nearest human receptors are in the village of Port Clarence located to the south west of the Site, whilst several ecological areas considered sensitive to noise are located to the south and west of the Site, including RSPB Dorman Pool Nature Reserve and RSPB Saltholme East Pool Nature Reserve.
- 6.6.6. The existing noise environment at the nearest sensitive human receptors in the village of Port Clarence is dominated by road traffic on the A1046 Port Clarence Road, and to a lesser extent the A178 Seaton Carew Road and local road network.
- 6.6.7. Noise generated by activities associated with the Calor site to the north of Port Clarence Road, and other industrial sources to the south, across the River Tees, also contribute to the existing noise environment at the nearest sensitive human receptors to the south west of the Site, particularly during lulls in road traffic during the night-time period.
- 6.6.8. To the north, south and west of the Bran Sands area of the Proposed Scheme are works associated with the Port of Tyneside, a British Steel works and various smaller-scale industrial sites respectively. The closest human receptors to the Site and to the south of the Tees are in Dormanstown to the east at a distance of approximately 1km from the Site. The existing noise environment in this area is likely to be influenced by the nearby industrial sites and local road traffic.

Baseline Noise and Vibration Survey

- 6.6.9. The baseline noise and vibration survey was undertaken between 11 and 19 October 2023. The purpose of the survey was to obtain baseline noise levels at human and ecological receptors and baseline vibration levels at human receptors only. Whilst the

baseline survey data are presented in this Chapter, the survey data for the ecological positions is used in **Chapter 7: Terrestrial Ecology (Volume 1)**.

- 6.6.10. Baseline noise measurements have been undertaken at two monitoring locations, representative of the closest noise sensitive human receptors. A baseline vibration survey was also undertaken at one of these locations. Baseline noise measurements have been undertaken at a further four monitoring locations, representative of the closest noise sensitive ecological receptors.
- 6.6.11. The monitoring locations, as agreed with STBC (for human receptors), are shown in **Figure 6-1 (Volume 2)** and **Figure 6-2 (Volume 2)** for human and ecological receptors respectively, and described in **Table 6-20** below along with the survey periods and a description of the noise climate. Note that the Navigator Rail Terminal serving the Proposed Scheme is used infrequently and, therefore, the baseline vibration climate from the existing rail line is very low and will be reported in the ES when further information regarding the existing rail movements is known. Any additional baseline noise surveys required in the ecologically sensitive areas labelled as Areas 13 and 14 in **Appendix 7A: Preliminary Ecological Appraisal (Volume 3)** will be presented in the ES. Note that these areas may be amended, depending on the results of further ecological surveys which are yet to be undertaken.
- 6.6.12. At all locations, noise measurements were undertaken in line with the guidance in BS 7445-2 at a height of 1.5m above ground level in free-field conditions. Meteorological conditions were measured with data showing no significant rainfall and wind speeds below 5ms⁻¹. No noise survey data have been excluded due to adverse meteorological conditions during the noise survey period.
- 6.6.13. The calibration of the sound level meters was checked before and after measurements with no significant drift noted.

Table 6-20: Baseline Noise and Vibration Surveys - Monitoring Locations

ID	Location	Date and time	Description of noise environment
NML1 and VML1	Port Clarence Road – Lat,Lon: 54.585948 , - 1.2255848	11/10/2023 16:00 to 19/10/2023 12:00	Daytime: Dominated by local traffic noise; contributions from industrial noise sources. Nighttime: Traffic noise through early part of night, while industrial noise from 24hr facilities dominates in the latter part of the night-time period.

ID	Location	Date and time	Description of noise environment
NML2	RSPB/Teesside Environmental Trust land to north of Samphire Street – Lat,Lon: 54.587734, - 1.2261128	12/10/2023 09:00 to 13/10/2023 12:15	Daytime: Dominated by local traffic noise; contributions from industrial noise sources. Nighttime: Traffic noise through early part of night, while industrial noise from 24hr facilities dominates in the latter part of the night-time period.
ENML1	RSPB Dorman's Pool Nature Reserve Lat, Lon: 54.598224, - 1.203468	12/10/2023 15:35 to 13/10/2023 12:10	Dominated by local road traffic. Occasional aircraft were audible.
ENML2	RSPB Saltholme East Pool Nature Reserve Lat, Lon: 54.601431, - 1.212221	11/10/2023 14:25 to 12/10/2023 14:25	Dominated by local road traffic. Occasional aircraft were audible.
ENML3	Maurice Nixon Land, off Port Clarence Road Lat, Lon: 54.585099, - 1.223813	12/10/23 09:25 to 11:35, 14:00 to 17:05, 19:55 to 21:00 and 13/10/2023 01:00 to 03:00	Low level of road traffic dominant in the evening and occasional transportation sounds from southern side of the River Tees. A low level of industrial noise was occasionally audible, sometimes being the dominant source.
ENML4	ICGL Site, Huntsman Drive Lat, Lon: 54.5850039, - 1.2087815	12/10/2023 11:00 to 13/10/2023 11:30	Road traffic and industrial noise were audible.

6.6.14. A summary of the daytime noise survey results is presented in **Table 6-21** For the human receptor locations, the background (L_{A90}) and level exceeded for 10% of the time (L_{A10}) are the arithmetic average of the measured one hour values and the maximum noise levels (L_{Amax}) are the highest of the measured one hour values in the corresponding period. For the ecological receptor locations, only the ambient (L_{Aeq}) and maximum noise levels are provided, as these are all that are required for the assessment presented in **Chapter 7: Terrestrial Ecology (Volume 1)**.

Table 6-21: Baseline Noise Survey – Daytime Measurements

ID	Date and Time	Period	Measured noise levels			
			L _{Aeq, T} , dB	L _{A10, T} , dB	L _{A90, T} , dB	L _{AFmax, T} , dB
NML1	11/10/2023 16:00 to 23:00	7 h	52.8	54.3	45.6	87.8
	12/10/2023 07:00 to 23:00	16 h	54.1	54.7	47.7	85.1
	13/10/2023 07:00 to 23:00	16 h	54.0	54.1	47.8	76.7
	14/10/2023 07:00 to 23:00	16 h	51.5	50.5	44.4	85.7
	15/10/2023 07:00 to 23:00	16 h	49.1	48.2	41.6	77.1
	16/10/2023 07:00 to 23:00	16 h	54.0	53.9	47.6	78.4
	17/10/2023 07:00 to 23:00	16 h	53.8	53.5	46.6	81.6
	18/10/2023 07:00 to 23:00	16 h	54.1	55.3	48.4	81.6
	19/10/2023 07:00 to 12:00	5 h	54.6	55.9	50.4	73.5
NML2	12/10/2023 09:00 to 23:00	14 h	58.6	61.6	43.9	83.6
	13/10/2023 07:00 to 12:00	5 h	62.1	66.0	47.7	89.4
ENML1	Representative 16 hour daytime		47	-	-	74
ENML2	Representative 16 hour daytime		54	-	-	81
ENML3	Representative 16 hour daytime		49	-	-	89
ENML4	Representative 16 hour daytime		52	-	-	86

6.6.15. **Table 6-22:** presents the night time noise levels which have been derived as described above.

Table 6-22: Baseline Noise Surveys – Night-time Measurements

ID	Date and Time	Period	Measured noise levels			
			L _{Aeq, T} , dB	L _{A10, T} , dB	L _{A90, T} , dB	L _{AFmax, T} , dB
NML1	11/10/2023 23:00- 12/10/2023 07:00	8 h	50.5	47.4	41.3	76.5
	12/10/2023 23:00- 13/10/2023 07:00	8 h	50.0	47.4	40.9	75.1
	13/10/2023 23:00- 14/10/2023 07:00	8 h	49.0	48.6	41.4	74.8
	14/10/2023 23:00- 15/10/2023 07:00	8 h	44.9	42.6	38.7	72.6
	15/10/2023 23:00- 16/10/2023 07:00	8 h	50.1	47.2	41.1	74.7
	16/10/2023 23:00- 17/10/2023 07:00	8 h	52.0	51.7	44.4	77.9
	17/10/2023 23:00- 18/10/2023 07:00	8 h	49.7	46.5	38.5	76.4
	18/10/2023 23:00- 19/10/2023 07:00	8 h	53.9	56.1	48.1	75.4
	12/10/2023 23:00- 13/10/2023 07:00	8 h	56.9	51.5	38.1	87.6
	12/10/2023 23:00- 13/10/2023 07:00	8 h	56.9	51.5	38.1	87.6
ENML1	Representative 8 hour night		43	-	-	65
ENML2	Representative 8 hour night		50	-	-	65
ENML3	Representative 8 hour night		36	-	-	67
ENML4	Representative 8 hour night		44	-	-	62

6.6.16. Representative ambient noise levels have been determined for each of the human noise sensitive receptors using logarithmic averages of one hour L_{Aeq, T} for the day and night-time periods. The background noise levels have been derived using 15 minute measured

values and the statistical method contained within BS 4142:2014+A1:2019 Part 1. These are summarised in **Table 6-23**. The levels for the ecological receptors should be taken from the tables above; no further analysis is required for the data gathered at these locations.

Table 6-23: Representative Baseline Noise Levels

Time period	NML1– 2 Port Clarence Road	NML2 – land to north of Samphire Street
Daytime L_{Aeq} , dB (07:00 – 23:00)	53	60
Daytime L_{A90} , dB (07:00 – 23:00)	47	45
Night-time L_{Aeq} , dB (23:00 – 07:00)	51	57
Night-time L_{A90} , dB (23:00 – 07:00)	38	38

6.6.17. Information on the baseline noise environment in relation to ecological receptors is provided in **Chapter 7: Terrestrial Ecology (Volume 1)** and **Chapter 8: Freshwater Ecology (Volume 1)**.

FUTURE BASELINE

6.6.18. The future baseline noise and vibration environment at sensitive human receptors would be determined by any changes in road and rail traffic movements and other noise sources associated with nearby existing and/or major proposed developments.

6.6.19. From reviewing the list of committed developments presented in **Appendix 19A: Long list of Other Developments (Volume 3)**, it is not anticipated that any major proposed developments are in the planning process which would substantially change the future baseline noise and/or vibration levels. However, there may be temporary increases in noise levels in the area, should the Construction Phases of the Proposed Scheme and other schemes in the area overlap. This is a qualitative approach to determining the future baseline and a full assessment will be presented in the ES.

6.7. EMBEDDED DESIGN, MITIGATION AND ENHANCEMENT MEASURES

6.7.1. This section sets out the embedded design, mitigation and enhancement measures relevant to the noise and vibration assessment. Please see **Chapter 3: Approach to EIA (Volume 1)** for a definition of embedded design, mitigation and enhancement measures. Further information will be provided in the ES as the design develops.

CONSTRUCTION PHASE

6.7.2. Opportunities for mitigation during the Construction Phase of the Proposed Scheme are likely to include Best Practicable Means (BPM) as defined in CoPA⁷, which will be detailed in the ES and included in the Outline Code of Construction Practice (OCoCP) for the Proposed Scheme. They are anticipated to include, but not be limited to:

- Prior consent agreement for any works outside core hours, where there is potential for significant adverse effects;
- Contact details for nominated site personnel to allow local residents to raise concerns and/or complaints directly;
- Consideration of localised screening around the main noise producing plant and items/activities;
- Ensuring that modern plant is used, complying with applicable UK noise emission requirements, and selection of inherently quiet plant where possible;
- Where reasonably practicable, pneumatic percussive tools will be provided with effective silencers/acoustic covers;
- Acoustic covers to engines will be kept closed when the engines are in use and idling;
- Hydraulic techniques for breaking to be used, where practicable, in preference to percussive techniques;
- Use of low impact piling techniques (e.g. rotary bored or hydraulic jacking) rather than driven piling techniques, where reasonably practicable;
- Offsite pre-fabrication for components of the Proposed Scheme, 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 vibration and switched off when not in use;
- Machines such as cranes that may be in intermittent use will be shut down between work periods or should be throttled down to a minimum. Machines will not be left running unnecessarily;
- Where reasonably practicable, the contractor will use quieter working methods, the most suitable plant and, reasonable hours of working for noisy operations;
- Where possible, the items of plant will be located the furthest distance from the nearby noise sensitive receptors. Plant known to emit noise strongly in one direction will, when possible, be orientated so that the noise is directed away from sensitive receptors;
- Loading and unloading of vehicles, dismantling of site equipment such as scaffolding or moving equipment or materials within the Site to be conducted in such a manner as to minimise noise and vibration generation, as far as reasonably practicable;

- Employees, subcontractors and persons employed on the Site will receive toolbox talks to prevent unnecessary noise resulting from their activities (e.g. excessive 'revving' of vehicle engines, shouting and general behaviour);
- When operating plant, the use of noise-control equipment such as jackets on pneumatic drills, acoustic covers on compressors, shrouds on piling rigs and cranes will be implemented where practicable;
- Site electrical supply to be from mains supply in preference to diesel power generators where possible and feasible;
- Audible warning systems (including reversing alarms) will be switched to the minimum setting required by the Health and Safety Executive;
- Use of less intrusive alarms, such as broadband vehicle reversing alarms, where necessary; and
- Appropriate routing of construction traffic on public roads and along access tracks, to reduce construction traffic noise, as far as reasonably practicable.

Construction Working Hours

- 6.7.3. As detailed in **Chapter 2: Site and Proposed Scheme Description (Volume 1)**, it is anticipated that daytime working hours of 07:00 – 19:00 Hours on Monday – Friday and 07:00 – 14:30 Hours on Saturday will be implemented during the Construction Phase.
- 6.7.4. For noise-generating critical path activities, working on Sundays and for 24 hours (such as for concrete pours) may be required. In these cases, it is anticipated that such hours would require agreement with the local authority in advance of works taking place and the local residents would be notified. The critical path activities will be outlined in the ES and secured via a DCO requirement as part of a Noise Management Plan.
- 6.7.5. These measures serve to limit disturbance to residents located in noise sensitive areas and limit the likelihood of complaints occurring. These measures will be included in the OCoCP for the Proposed Scheme.

Construction Delivery Routes

- 6.7.6. As detailed in **Chapter 2: Site and Proposed Scheme Description (Volume 1)**, it is proposed that larger modules and equipment will be delivered to Site via the River Tees to the chosen marine infrastructure location. It is expected that up to 300 marine movements to facilitate the delivery of construction materials will be required via this route over an 18-month period within the three year Construction Phase.
- 6.7.7. A total of 250 abnormal load vehicles (self-propelled modular transporters (SPMTs)) will be needed to facilitate movement of the plant from the wharf location to the required location for installation in the Proposed Scheme, at specific stages within the programme. Wilton Engineering Wharf (Option 1) of the marine infrastructure options would require access initially onto a short section of public highway (Port Clarence Road north of the Middlesbrough Transporter Bridge) before transitioning onto the Heavy Haul Road (as

shown in **Figure 1-2 (Volume 2)**). Clarence Wharf (Option 2) would only require the abnormal loads to be driven to the SAF Plant Site utilising the Heavy Haul Road.

- 6.7.8. The use of marine transport infrastructure and the Heavy Haul Road, predominantly away from the public highway, limits the widespread noise impact of larger deliveries to the Site at noise sensitive receptors throughout the Construction Phase.
- 6.7.9. These measures will be included in the OCoCP for the Proposed Scheme.

OPERATIONAL PHASE

- 6.7.10. As described in **Chapter 2: Site and Proposed Scheme Description (Volume 1)**, it is proposed that a significant proportion of imports of Biocarbon Feedstock, and export of SAF and Naphtha will be transferred by rail or marine infrastructure. This reduces the volume of import and export using road transport, thereby reducing the noise impact of development generated road traffic during the operational phase.
- 6.7.11. Operational phase embedded mitigation and enhancement measures will be reviewed and updated, where appropriate, as the design of the Proposed Scheme evolves during the ES stage.

6.8. PRELIMINARY ASSESSMENT OF LIKELY IMPACTS AND EFFECTS

- 6.8.1. This section details the preliminary assessment of impacts and effects of the Proposed Scheme during both the construction and operational phases, taking into account the embedded design, mitigation and enhancement measures detailed in **Section 6.7** (where relevant).
- 6.8.2. The assessment is relevant to the current design stage and a full noise and vibration assessment will be undertaken for the ES as information on the design and (hence) noise and vibration levels are refined. The preliminary noise modelling presented below is for the operational SAF plant only. The ES will present a full assessment of the areas presented in the bullet point list in **Paragraph 6.4.2** above.

CONSTRUCTION PHASE

Construction Noise

Construction Noise Limits

- 6.8.3. Construction noise levels are likely to vary during different Construction Phases, depending on the location of works and their proximity to noise-sensitive receptors. Based on the current ambient noise levels at monitoring locations representative of receptors to the south west of the Proposed Scheme and the BS 5228 ABC assessment methodology in **Table 6-3**, preliminary construction noise limits for these locations are:
 - NML1 – representative of noise sensitive receptors on Port Clarence Road:
 - 65 dB L_{Aeq, 12hr} (Cat A) during daytime working hours;

- 50 dB LAeq, 8hr (Cat B) during night-time working hours (if applicable).
- NML2 – representative of noise sensitive receptors on Samphire Street and Saltview Terrace:
 - 65 dB LAeq, 12hr (Cat A) during daytime working hours;
 - 55 dB LAeq, 8hr (Cat C) during night-time working hours (if applicable).

- 6.8.4. Provided these preliminary noise limits, or any updated limits based on additional baseline data, are not exceeded the construction noise levels would constitute a negligible magnitude of impact and would not be deemed to cause a significant effect. An exceedance of >3dB above the limits shown above could constitute a medium/high magnitude of impact and could be deemed to cause a significant effect.
- 6.8.5. An assessment of construction noise impacts will be undertaken and presented in the ES.

Preliminary Construction Noise Assessment

- 6.8.6. Construction of the Proposed Scheme has the potential to result in temporary noise impacts at the closest noise sensitive receptors to the Proposed Scheme.
- 6.8.7. This preliminary assessment identifies the main activities during the construction stage which have the potential to generate significant effects, which are those closest to the sensitive receptors and include:
- Heavy Haul Road construction (albeit construction work will be limited to relatively small areas); and
 - Associated activities such as upgrade works to Clarence Wharf (Option 2 of the Marine Infrastructure options described in **Chapter 2: Site and Proposed Scheme Description (Volume 1)**).
- 6.8.8. Much of the excavated material will be retained and used onsite, however, in some instances there will be a need for additional materials depending on the Heavy Haul Road alignment and topography.
- 6.8.9. The potential for significant effects during the Construction Phase is likely to be limited to when construction activities are situated at the western extents of the heavy haul route, closest to human receptors in Port Clarence. Any potential significant effects during the construction period will be temporary. During this time, there is the potential for medium to high adverse impacts, potentially resulting in effects of **Moderate to Major Adverse (significant)**. This is based on professional judgement and experience of working on construction noise assessments of a similar scale. Construction noise modelling will be undertaken and presented in the ES.
- 6.8.10. A summary of the receptors that could be temporarily affected during some construction activities include:
- Residential properties at Saltview Terrace and Samphire Street; and
 - Residential properties at Port Clarence Road.

Construction Vibration

- 6.8.11. The level of vibration impact at sensitive 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.
- 6.8.12. Typically, construction works requiring piling or heavy machinery such as vibratory rollers can be associated with potentially significant levels of vibration. Piling is currently expected to be required during construction of the Proposed Scheme, however, as detailed construction information is not available, the proposed location of piling is unknown. Once this information is available, where piling is anticipated to take place within 100m of human receptors, this will be assessed in the ES.
- 6.8.13. Construction works on the existing Heavy Haul Road are proposed, but it is not yet known whether vibratory rollers would be required. Should vibratory rollers be required in close proximity to residential and/or educational receptors on Port Clarence Road, based upon professional judgement, there is the potential for medium to high adverse impacts, potentially resulting in effects of **Moderate to Major Adverse (significant)**.
- 6.8.14. As with the construction noise, an assessment of construction vibration will be undertaken and presented in the ES.

Construction Traffic Noise

- 6.8.15. Construction related traffic flows have been provided by the Project Team and used to predict the change in noise levels on the local road network during construction. Traffic flows data have been provided for the 2026 baseline (i.e. with no construction traffic) and the 2026 "do-something" (i.e. baseline plus construction traffic) scenarios for the roads which are likely to be used by the construction traffic. Please refer to **Chapter 16: Traffic and Transport (Volume 1)** for assumptions applied in the derivation of the construction traffic flows.
- 6.8.16. BNL predictions show that, for each road link assessed, the change in noise level resulting from construction vehicles is no greater than +0.7dB. When compared to the criteria in **Table 6-5**, it can be seen that construction traffic is likely to result in a negligible magnitude of impact, resulting in a **Negligible** effect.
- 6.8.17. As the assessment of construction traffic noise has resulted in a negligible effect, it will be scoped out of the ES. However, if there are any changes to the construction traffic flows, an updated construction traffic noise assessment will be presented in the ES.

OPERATIONAL PHASE

Development Generated Rail Noise

- 6.8.18. It is anticipated that three rail slots will be required per day, although it is unlikely that they will all be utilised. The calculation of rail noise requires detailed information (see

paragraph 6.4.25) which are being gathered and the predicted noise levels and an assessment of any changes in railway noise as a result of the proposed additional movements will be presented in the ES.

- 6.8.19. Noise sensitive receptors most likely to be impacted by increases in rail movements (and any associated noise from the Rail Terminal) are those on Port Clarence Road, directly adjacent to the railway line. Due to the existing railway line and Rail Terminal being used infrequently, there is the potential for the Proposed Scheme to result in medium to high adverse impacts, potentially resulting in effects of **Moderate to Major Adverse (significant)**.
- 6.8.20. A detailed assessment of noise impacts due to proposed rail movements will be undertaken and reported in the ES.

Development Generated Rail Vibration

- 6.8.21. Whilst the number of rail movements associated with the Proposed Scheme is known, further information is being sought and researched regarding the expected vibration levels generated by the proposed train types. It is, therefore, not possible at this stage to provide an accurate and informed assessment of development generated rail vibration.
- 6.8.22. Vibration sensitive receptors most likely to be impacted by increases in rail movements are those on Port Clarence Road, directly adjacent to the railway line. Due to the existing railway line and Rail Terminal being used infrequently, there is the potential for the Proposed Scheme to result in medium to high adverse impacts, potentially resulting in effects of **Moderate to Major Adverse (significant)**.
- 6.8.23. A detailed assessment of vibration impacts due to proposed rail movements will be undertaken and reported in the ES.

Development Generated Road Noise

- 6.8.24. Operational road traffic flows have been provided by the Project Team and used to predict the change in noise levels on the local road network during the Operational Phase of the Proposed Scheme. Traffic flows have been provided for the 2028 baseline (i.e. with no operational traffic) and the 2028 "do-something" (i.e. baseline plus operational traffic) scenarios.
- 6.8.25. BNL predictions show that, for each road link assessed, the change in noise level resulting from Operational Phase vehicles is no greater than 0.3dB. When compared to the short-term assessment criteria in **Table 6-8**, it can be seen that Operational Phase traffic is likely to result in a negligible magnitude of impact, resulting in a Negligible effect.
- 6.8.26. If there are any changes to the operational traffic flows presented in the ES, an updated operational traffic noise assessment will be presented in the ES.

Noise Impacts from Fixed Plant and Equipment

- 6.8.27. Preliminary information on the plant selections and locations for the SAF Plant, namely a full list of the plant items, locations and noise levels are provided in **Appendix 6A: Operational Noise Data (Volume 3)**. Note that the feedstock conveyor required between the Rail Terminal and the SAF plant Site (as described in **Chapter 2: Site and Proposed Scheme Description (Volume 1)**), will be included in the ES noise model; it has not been included in the preliminary noise modelling results presented below.
- 6.8.28. These data have been used to predict noise levels at human and ecologically sensitive receptors using the modelling software CadnaA. The noise modelling methodology requires detailed information and so a number of assumptions have been made, as provided below, including an explanation of how they may be refined as the noise model is updated for the ES:
- The plant locations are as per the information in **Appendix 6A: Operational Noise Data (Volume 3)**;
 - Where plant are located within a building, it has been assumed that the footprint of the building occupies a relatively large area and there are no open areas of the building (i.e. no open doors, windows, extracts etc). The size and design of the buildings will be refined in the ES noise model as the detail of the SAF plant Site evolves. The building fabric will attenuate the noise levels by 15 dB;
 - The noise model includes items of plant known to generate the highest noise levels. Other, quieter, plant items have not been included in the model on the basis that they are unlikely to contribute to the overall SAF Plant Site noise levels at the receptors; and
 - The SAF Plant items operate over the 24 hour period, therefore daytime (07:00 to 23:00 hours) and night-time (23:00 to 07:00 hours) predicted noise levels are identical.
- 6.8.29. The noise model also includes the bunds to the west and east of the SAF Plant Site, and topographical information for the Site and surrounding area and residential and ecologically sensitive receptors.
- 6.8.30. The SAF Plant noise levels have been predicted at the closest noise-sensitive receptors and the results are presented in **Table 6-24** below. **Figure 6-3 (Volume 2)** represents noise levels during both the daytime and night-time hours. The level is predicted at a height of 1.5 m above the ground. Whilst night-time noise levels for residential receptors would usually be predicted at 4 m above the ground to reflect the height of the first floor of the dwelling where bedrooms would usually be located, the difference between the levels at 1.5 m and 4 m above the ground is less than 1 dB. Given the preliminary nature of the calculations, it is deemed acceptable to present only predicted levels at 1.5 m above the ground, given there is no difference between daytime and night-time noise levels and those predicted at 1.5m and 4m above the ground. The noise contours are shown in **Figure 6-3 (Volume 2)**.

Table 6-24: Predicted SAF Plant Noise Levels, dB L_{Aeq,T}

Receptor	Noise Level
Dwellings on Port Clarence Road (No.1, 2 and 10 to 14)	38
Dwellings on Saltview Terrace (No. 5 to 8)	39
RSPB Dorman's Pool Nature Reserve	60
RSPB Saltholme East Pool Nature Reserve	51

6.8.31. Other noise sensitive receptors in the area are further from the SAF Plant than those listed above and will, therefore, have lower predicted noise levels.

6.8.32. The predicted SAF Plant noise levels at the ecological receptors are assessed in **Chapter 7: Terrestrial Ecology (Volume 1)**. The noise levels at the residential receptors are assessed in accordance with the BS 4142 methodology (see **paragraphs 6.4.38 to 6.4.43**) which requires representative background noise levels to be defined and these are set out in the following sub-section.

Fixed Plant and Equipment Noise Limits

6.8.33. Analysis of the measured noise levels at NML1 and NML2, summarised in **Table 6-25** and **Table 6-26** respectively, has been undertaken to determine representative day and night-time background noise levels (L_{A90}) for weekday and weekend periods. The methodology used follows the statistical analysis approach presented in BS 4142¹⁴.

6.8.34. Analysis of the measured levels, and a review of the statistical distribution of background noise levels throughout the measurement period, are used to determine the representative background noise levels.

Table 6-25: NML1 Background Noise Levels, dB(A)

Noise Index/Indicator	Daytime (07:00-23:00)	Night-time (23:00-07:00)
Arithmetic average L _{A90,15min}	47	42
Mode L _{A90,T}	47	38
Maximum L _{A90,T}	55	53
Minimum L _{A90,T}	38	35
Selected Representative Value	47	38

Table 6-26: NML2 Background Noise Levels, dB(A)

Noise Index/Indicator	Daytime (07:00-23:00)	Night-time (23:00-07:00)
Arithmetic average $L_{A90,15min}$	45	39
Mode $L_{A90,T}$	45	39
Maximum $L_{A90,T}$	55	54
Minimum $L_{A90,T}$	39	33
Selected Representative Value	45	38

6.8.35. Histogram charts showing the statistical distribution of the background noise levels over the measurement period for the two noise monitoring locations are shown in **Chart 6-1** to **Chart 6-4**.

Chart 6-1: NML1 Daytime (07:00-23:00) $L_{A90,15min}$ Histogram

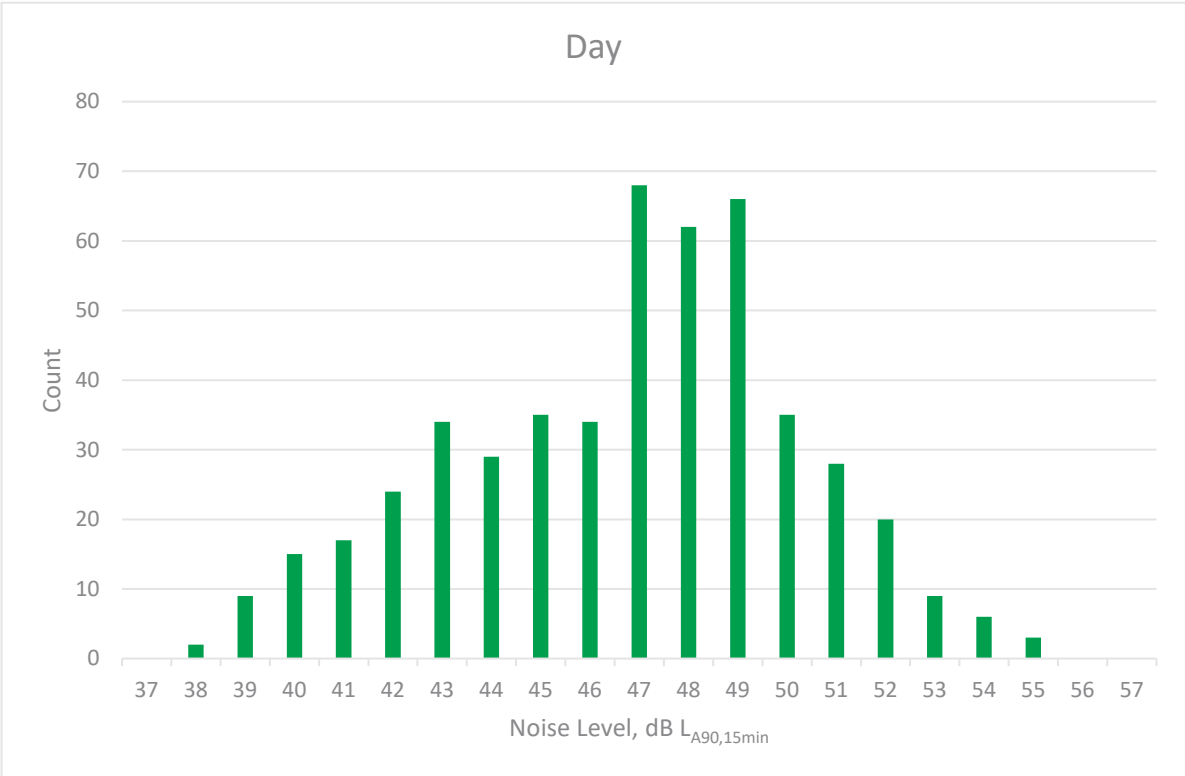


Chart 6-2: NML1 Night (23:00-07:00) $L_{A90,15min}$ Histogram

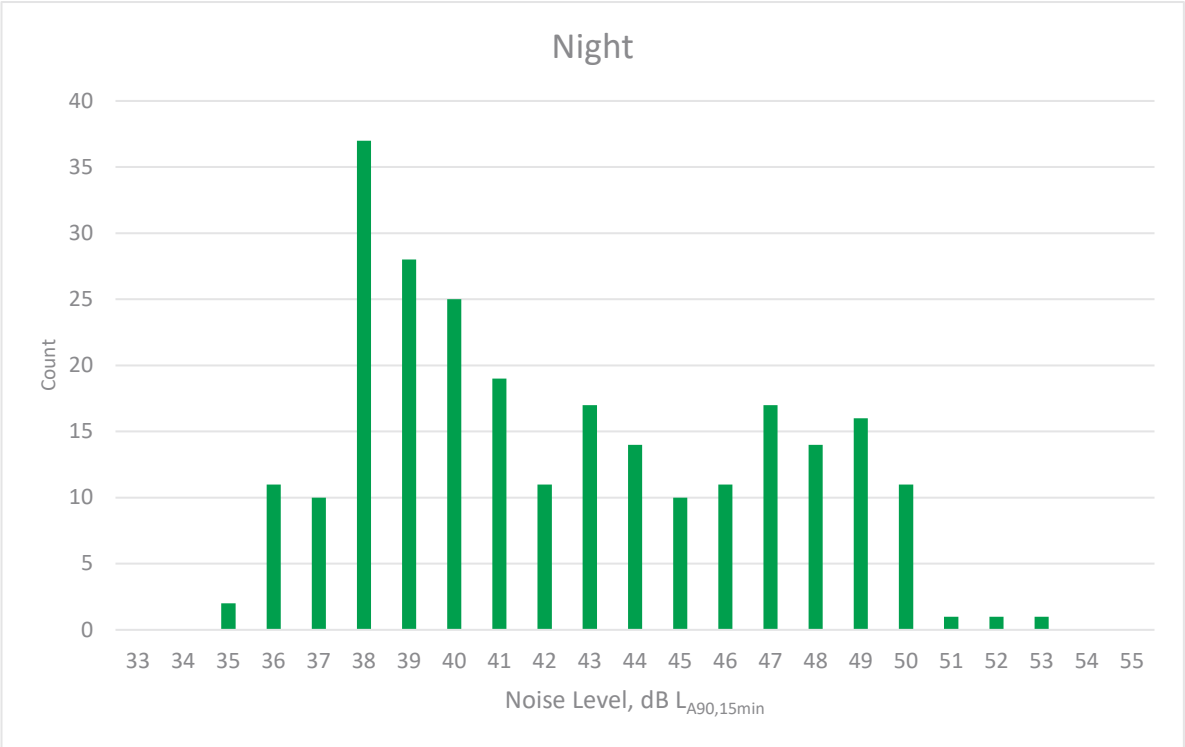


Chart 6-3: NML2 Daytime (07:00-23:00) LA90,15min Histogram

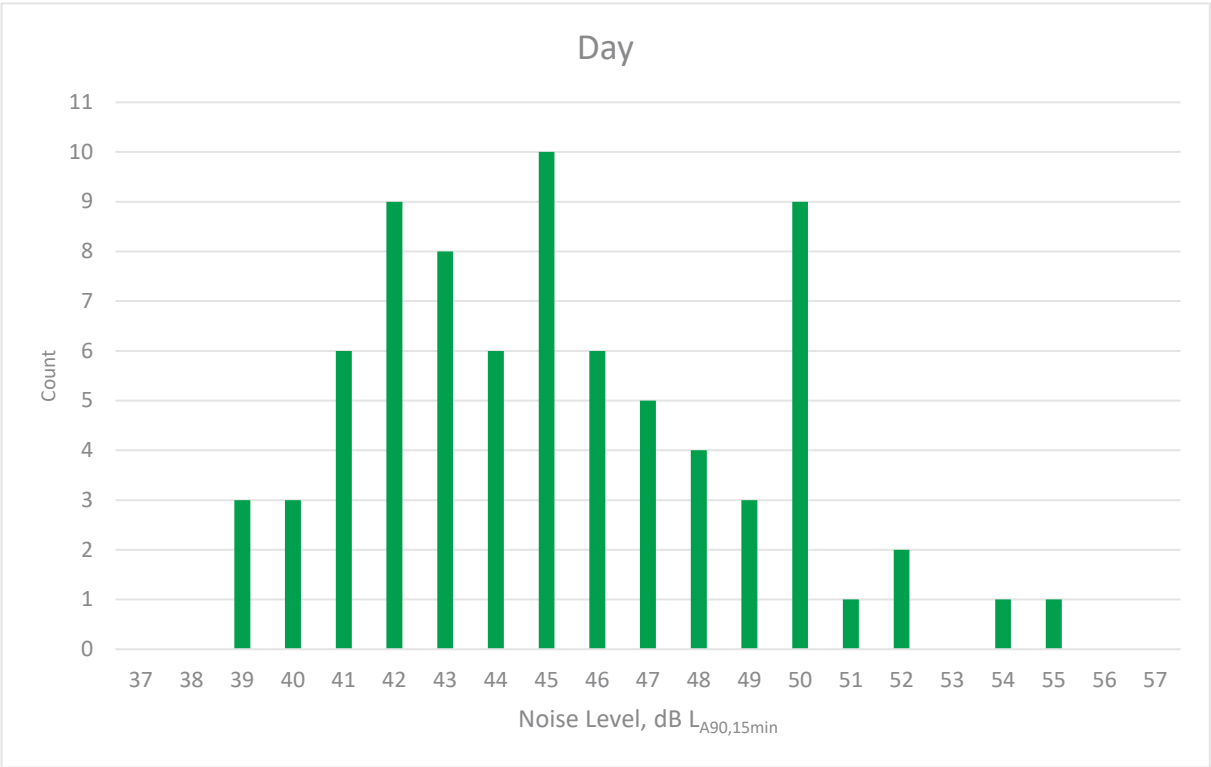
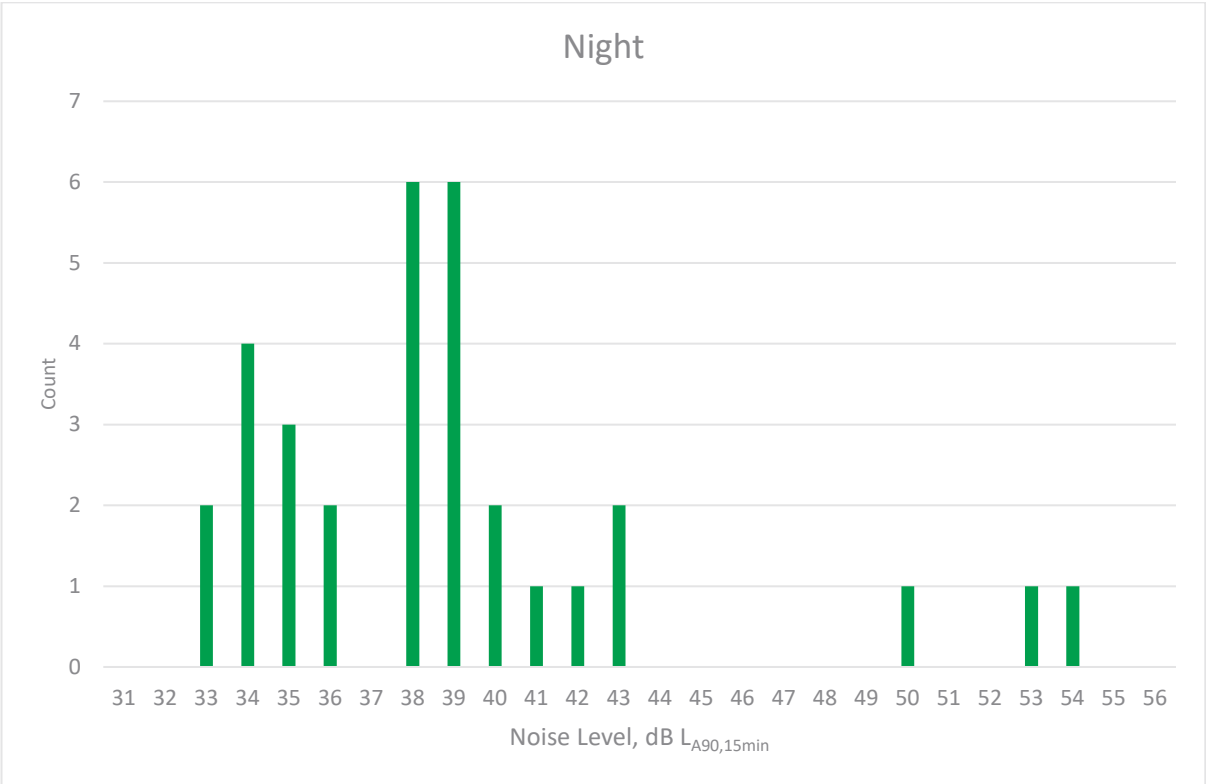


Chart 6-4: NML2 Night (23:00-07:00) LA90,15min Histogram



Assessment of SAF Plant Noise and Residential Receptors

6.8.36. **Table 6-27** below presents the BS 4142 assessment of SAF Plant noise at the closest residential receptors.

Table 6-27: BS 4142 Assessment for SAF Plant, dB

Receptor	SAF Plant Noise Level*	Background Noise Level (L_{A90})		Difference (SAF – Background)	
		Daytime	Night-time	Daytime	Night-time
Dwellings on Port Clarence Road (NML1)	38	47	38	-9	0
Dwellings on Saltview Terrace (NML2)	39	45	38	-6	+1
*dB $L_{A_{r,Tr}}$ (no character corrections have been added to the SAF Plant noise levels due to the distance to SAF Plant Site)					

6.8.37. Comparing the above assessment with the significance criteria in **Table 6-18** shows that there will be a negligible to low magnitude of impact resulting in a **Negligible to Minor Adverse** (not significant) effect.

6.9. ADDITIONAL DESIGN, MITIGATION AND ENHANCEMENT MEASURES

- 6.9.1. As the design evolves, the design, mitigation and enhancement measures will be identified, and a comprehensive list included in the ES. For human receptors, the mitigation measures outlined below will be considered.
- 6.9.2. Information on relevant design, mitigation and enhancement measures for ecological receptors is provided in the **Chapter 7: Terrestrial Ecology (Volume 1)** and **Chapter 8: Freshwater and Marine Ecology (Volume 1)**.

CONSTRUCTION PHASE

- 6.9.3. At the current stage of assessment, no additional construction phase design, mitigation and enhancement measures have been identified. Additional measures will be refined and presented in the ES, upon completion of the full assessment.

OPERATIONAL PHASE

- 6.9.4. The Overarching NPS for Energy EN-1⁵ states that mitigation measures may include engineering methods, such as noise reduction at point of generation, considerations related to the layout, for instance to ensure adequate distance between source and sensitive receptor, and administrative restrictions for example by specifying noise limits.
- 6.9.5. Mitigation measures during the Operational Phase are anticipated to include:

- Where feasible, selecting the location of plant and equipment onsite to minimise noise impacts;
- The use of enhanced building cladding, and acoustic enclosures and screening where appropriate;
- Noise limits applicable to fixed plant associated with the Operational Phase;
- Careful selection of the plant to be operated at the Site, e.g. selecting plant with low sound power levels; and
- Where required, noise-attenuating barriers in the form of either acoustic screens and/or earth bunds. Note that a 2 m high barrier on top of the earth bund to the west of the SAF Plant has been tested and provides attenuation of <1 dB and, considering the cost versus the attenuation it provides, will not be considered further in the assessment.

6.10. MONITORING

6.10.1. All monitoring strategies will be defined and discussed within the ES, when the full assessment is completed.

6.11. RESIDUAL EFFECTS

6.11.1. Due to the plant and mitigation design still being refined, at this stage it is not possible to provide a full discussion of the residual effects. **Table 6-28** provides a summary of the status of the assessment as of the submission of this PEIR.

CONSTRUCTION PHASE

6.11.2. Based on the construction information available at this stage, and with further noise assessment work to be undertaken in the ES, it is not possible to draw conclusions on the likely construction impacts or, therefore, the likely residual effects. The exception is noise from construction vehicles on the local road network which is likely to result in a **Negligible** (not significant) effect and has, therefore, been scoped out of the ES (unless there are any changes to the construction traffic flows).

6.11.3. However, given the large distances between the Site and the nearest noise sensitive receptors, and the implementation of best practicable measures, it is likely that the majority of construction activities would not cause significant impacts at noise sensitive receptors, with the only exception likely to be the construction activities on, and subsequent use of, the heavy haul route.

OPERATIONAL PHASE

6.11.4. As detailed design information for the Proposed Scheme is not yet available, it is not possible to draw definitive conclusions on aspects of the operational noise impact at this stage.

6.11.5. The preliminary noise modelling shows that residual effects from the SAF Plant noise are likely to be **Negligible** to **Minor** (not significant).

- 6.11.6. The operational road traffic noise assessment has shown that the residual effects on the local road network are likely to be **Negligible** (not significant).
- 6.11.7. Given that feedstock is proposed to be imported to site by road and/or rail, it is possible that development generated rail movements will cause noise impacts at sensitive receptors. There is, therefore, potential that these elements may cause a significant effect.

Table 6-28: Summary of Residual Effects for Noise and Vibration

Description of Effect	Sensitive Receptor	Significance of Effect with Embedded Mitigation	Additional Design, Mitigation, Enhancement Measure	Residual Effect
Construction Phase				
Construction Noise	Human receptors at Saltview Terrace, Samphire Street and Port Clarence Road	In the absence of assessment being undertaken, Moderate to Major Adverse (significant)	This assessment will be undertaken and reported in the ES.	
Construction Vibration	Human receptors on Port Clarence Road	In the absence of assessment being undertaken, Moderate to Major Adverse (significant)		
Construction Traffic Noise		Negligible (not significant)	None required	Negligible (not significant)
Operational Phase				

Description of Effect	Sensitive Receptor	Significance of Effect with Embedded Mitigation	Additional Design, Mitigation, Enhancement Measure	Residual Effect
Development generated Rail Noise	Human receptors on Port Clarence Road	In the absence of assessment being undertaken, Moderate to Major Adverse (significant)	This assessment will be undertaken and reported in the ES.	
Development generated Rail Vibration		In the absence of assessment being undertaken, Moderate to Major Adverse (significant)		
Development Generated Road Noise	Human receptors on Saltview Terrace and Samphire Street	Negligible (not significant)	None required	Negligible (not significant)

Description of Effect	Sensitive Receptor	Significance of Effect with Embedded Mitigation	Additional Design, Mitigation, Enhancement Measure	Residual Effect
Noise Impacts from Fixed Plant and Equipment	Human receptors in Port Clarence	Negligible to Minor Adverse (not significant)	None required	Negligible to Minor Adverse (not significant)

6.12. NEXT STEPS

6.12.1. As detailed in the sections above and as the design evolves, the following assessments will be undertaken as part of the ES:

- Construction Phase noise and vibration assessment.
- Operational Phase rail noise and vibration assessment.
- Operational Phase fixed plant and equipment noise assessment.
- Decommissioning Phase noise and vibration assessment.
- An assessment of changes in noise levels on the local road network resulting from decommissioning traffic.

6.12.2. During the remaining DCO process, consultation with STBC and RCBC will continue and the assessments updated in line with any agreed changes to the assessment methodology.

6.13. LIMITATIONS AND ASSUMPTIONS

6.13.1. To ensure transparency within the EIA process, the following limitations and assumptions have been identified:

- The assessment presented in this PEIR has been based on the preliminary design information on the Proposed Scheme. Assessments will be refined in the ES when full information on Construction and Operational phases is available.

6.14. REFERENCES

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