16 NOISE AND VIBRATION

16.1 INTRODUCTION

16.1.1 This chapter of the ES provides an assessment of the noise and vibration impacts expected from AMEP upon nearby terrestrial noise sensitive receptors. In particular, the following aspects are addressed:

- potential airborne noise and ground-borne vibration impacts as a result of construction of the AMEP;
- potential noise impacts as a result of operation of the AMEP; and
- potential noise impact as a result of any traffic flow increases as a result of the construction and operation of the AMEP.

16.1.2 Consultation with NLC has been undertaken to agree on the assessment methodologies to be used in the EIA.

16.1.3 This chapter also considers the effects of changes in noise and vibration associated with the simultaneous construction of the proposed Compensation Site and the AMEP. It also identifies suitable mitigation measures to ensure that potential noise and vibration effects during construction and operation are effectively managed and reduced to acceptable levels where practicable. It then summarises any residual impacts that are expected after mitigation.

16.1.4 Effects from underwater noise emissions are assessed in *Chapter 10*.

16.1.5 A glossary of acoustic and vibration terms and definitions is contained in *Annex 16.1.*

16.2 LEGISLATION, POLICY AND GUIDANCE

General

16.2.1 Noise is generally defined as unwanted sound and is one of a number of statutory nuisances listed in S79 of the Environmental Protection Act 1990.

16.2.2 The NLC Local Plan Policy DS1 (iii) requires all development to incorporate a high standard of design and specifies that, *'no unacceptable loss of amenity to neighbouring land uses should result in terms of noise…'*.

16.2.3 The noise assessment has been conducted in general accordance with, or with reference to, the following relevant standards and guidelines. Detailed descriptions of these are contained in *Annex 16.2.*

Legislation, Policies, Guidance, Standards and other Guidelines

- The Environmental Protection Act 1990 (EPA 1990);
- Noise Insulation (Amendment) Regulations (1978) ;
- North Lincolnshire Council Local Plan DS1 and NLC Core Strategy;
- ERYC Local Plan;
- ERYC Considerate Contractor Advice Note;
- National Policy Statement for Ports;
- Planning Policy Guidance Note PPG24: Planning and Noise (DoE, 1994);
- BS 7445 Description and measurement of environmental noise;
- BS 4142 (1997) Method for rating industrial noise affecting mixed residential and industrial areas;
- BS 5228: Parts 1 and 2 (2009) Noise and vibration control on construction and open sites;
- Design Manual for Roads and Bridges (DoT 1994);
- BS 6472-2 (2008) Guide to evaluation of human exposure to vibration in buildings; and
- BS 7385 (1993) Evaluation and measurement for vibration in buildings — Part 2: Guide to damage levels from groundborne vibration.

16.3 ASSESSMENT METHODOLOGY AND CRITERIA

Overview

16.3.1 The construction and operation of the proposed quay and manufacturing facilities has the potential to result in noise impacts on the surrounding environment including the nearest residential properties and public spaces such as the coastal footpath.

Construction Phase

16.3.2 Noise associated with the construction phase may arise from the following activities:

- road traffic arising from additional traffic associated with construction of the proposed scheme; and

- construction activities in particular, piling, which may result in nuisance issues at nearby sensitive receptors.

16.3.3 The methods contained within *BS 5228 (2009)* will be used to predict the likely resultant noise and vibration from construction activities associated with the development. Noise source data for the assumed plant has been taken from the data tables from *BS 5228* or from the database contained within *Update of Noise Database for Prediction of Noise on Construction and Open Sites* published by DEFRA in 2005.

Operational Phase

16.3.4 *BS 4142: 1997 – method for rating noise affecting mixed residential and industrial areas* details a method of assessing the likelihood of complaints from industrial sources by rating it against the existing background noise level, $L_{A90,}$ at the closest noise sensitive locations.

16.3.5 In the case of a proposed new development, predicted L_{Aeq} noise levels or the specific noise level is rated against the existing background noise level (L_{A90}). Additional adjustments are applied to the rating, if appropriate, for noise of an impulsive or tonal nature. Assessment during the daytime is based on one hour duration, whilst at night a 5 minute assessment period is utilised.

16.3.6 In Section 8 of *BS 4142 - assessing the noise for complaint purposes* it is stated that an excess above the existing background L_{A90} noise level of up to 5 dB, due to noise from fixed plant at a new development, is of "marginal significance". An excess above the background noise level of greater than 10 dB can be taken as a positive indication that complaints are likely. Similarly, a rating noise level from the new plant of 10 dB or more below the background L_{A90} is stated to be a positive indication that complaints are unlikely. NLC has indicated that the rating level from the development would need to be at or below the existing background noise levels to be considered acceptable.

Sensitive Receptors - AMEP

16.3.7 Potential noise sensitive receptor areas have been identified in the vicinity of the proposed development and are shown in *Figure 16.1.* Most receptors in South and North Killingholme are a considerable distance from site; however, there are receptors (S1, S2, S3) that are

within close proximity (< 100 m) of the site boundary. Currently, the coastal footpath passes through the site.

16.3.8 Assessments of the potential impacts on terrestrial and marine ecological receptors are addressed in *Chapter 10* and *Chapter 11*.

Sensitive Receptors – North Humber

16.3.9 Noise sensitive receptors on the northern bank of the Humber Estuary, are shown in *Figure 16.2*. Additional noise sensitive receptors include birds, considering that the area is known to be important for feeding and roosting birds and are addressed in *Chapter 11*. Land use within the study area is predominantly agricultural consisting of arable fields and a network of drains and tracks. The closest main road that provides access to the proposed Compensation Site is the A1033 which is located approximately 4 km from Cherry Cobb Sands Road (a minor single-track road).

Road Traffic Noise

16.3.10 The advice contained in the *Design Manual for Roads and Bridges* (DoT, 1994) is used as a means of assessing the change in noise from road traffic using the $L_{A10,18hr}$ parameter.

16.3.11 From a review of the proposed traffic flow data provided by the traffic assessment (*Chapter 15*), attached in *Annex 16.6*, the overall changes based on the 18 hour daytime period are relatively minor. However, there are significant changes in road traffic volumes expected to occur during peak times during the the early morning, afternoon and evening periods for approximately 2 hours in duration. This is due to the arrival and departure of employees over the course of a typical day.

16.3.12 Hence an assessment of road traffic noise has been conducted based on hourly flows and calculated as $L_{Aeq, 1hr}$ noise levels.

16.4 CONSULTATION

Overview

16.4.1 Consultation with the NLC has been undertaken with regards to the baseline noise assessment methodology. Following the consultation NLC accepted the proposed baseline assessment methodology; attached as *Annex 16.5*.

16.4.2 *Annex 2.2* summarises our response to the various consultee comments relating to this chapter.

16.5 BASELINE

16.5.1 An important part of the baseline noise assessment is the quantification and understanding of the existing acoustic environment with particular focus on existing industrial noise, particularly during the night-time period.

16.5.2 To assess the potential noise impacts of the proposed development it is necessary to understand the existing baseline conditions. Following consultation with NLC, locations for baseline noise surveys were agreed.

16.5.3 The baseline noise survey was conducted from Thursday 9 December 2010 to Wednesday 15 December 2010 and between Thursday 6 January 2011 and Wednesday 12 January 2011. Good measurement conditions were reported throughout the survey such that excess wind or rain did not have any adverse affects on the noise levels monitored. Temperatures measured were within the standard operating tolerances of the equipment used.

16.5.4 It was noted at the start of the survey, that open fields and minor roads close to the measurement positions were covered in snow. Whilst the effect of absorption of sound from snow covered ground can be considered to be marginal over small distances, environmental noise effects can be noticed with a loss of traffic or slower vehicle speed amounting in an overall reduced ambient noise level.

16.5.5 During the measurement periods, it is assumed that the main roads of the surrounding area were operating with a normal flow of traffic, given that all of the major routes in the area were unaffected by snow. With the knowledge that no further snow fell during the measurement period, and that the existing ground snow melted from Thursday 9 December 2010, the overall effect of ground snow on the measurements recorded was considered to be negligible.

16.5.6 The baseline noise monitoring survey at the AMEP site consisted of unattended continuous noise monitoring, and operator attended noise monitoring at representative receptor locations identified in the methodology to quantify and characterise noise emissions from all noise sources in the area such as road traffic, industrial noise, rail, and shipping.

16.5.7 Observations from the long term unattended noise monitoring locations are discussed and presented in *Annex 16.3* presenting detailed results, daily assessment background levels for the daytime (07:00 to 23:00) and night-time (23:00 to 07:00) and the representative background levels for each period. A summary of the resulting representative background noise levels for each of the receptor "catchment areas" are presented in *Table 16.1.*

Determining Representative Background Noise Levels

16.5.8 Representative background L_{A90} noise levels for each location were determined using the following procedure:

- Data affected by adverse weather conditions (rain and wind speeds greater than 5 m/s) and/or extraneous noise was excluded.

- The data was sorted into the daytime and night-time assessment periods; the tenth percentile (the lowest tenth percentile value) is determined for each assessment period for each day of monitoring – this could be referred to as a (daily) assessment background level (ABL).

- The representative background level (RBL) to be used for assessment purposes is taken to be the lower 10th percentile value of the corresponding daytime and nightime assessment background levels.

- Where the RBL is less than 30 dB(A), it has been considered acceptable that a Rating Level of 35 dB(A) can be applied as this would still protect residential amenity.

Table 16.1 Baseline Noise Levels - AMEP (long term measurement)

Noise Monitoring Location	Overall Daytime L_{A90}, dB(A)	Overall Night Time L_{A90}, dB(A)	Overall Daytime L_{Aeq}, dB(A)	Overall Night Time L_{Aeq}, dB(A)
S1 Station Road	35 (32)	35	49	46
S2 Station Road	38	36	55	54
ECO 1	43	40	53	48
S3 Hazeldene Marsh Lane	47	45	58	57
SK2 Staple Road, South Killingholme	41	40	54	53
NK1 Nicholson Road, North Killingholme	37	35 (32)	64	46
EH5 Swinster Lane, East Halton	35 (31)	35 (27)	46	39

Notes: RBL values in bracket are the calculated RBL by the agreed determination method. Where existing L_{A90} noise levels are less than 30 dB(A), a Rating Level of 35 dB(A) is applied.

Operational Noise Assessment Criteria

16.5.9 This section considers the potential for noise impacts on human receptors from operation of the proposed AMEP. Impacts from the operation on ecological receptors are addressed in *Chapter 10* and *Chapter 11*.

16.5.10 During the development of the baseline noise assessment methodology, NLC stated that the rating level from the development would need to be at or below background level to be considered acceptable. Hence the following acceptable noise criteria have been developed from the baseline noise survey for the daytime (07:00 to 23:00) and night time periods (23:00 to 07:00) for each of the representative receptor areas and are presented in *Table 16.2*.

Table 16.2 Operational Assessment Criteria (Noise limits agreed by NLC)

Monitoring Location	**Daytime Noise Rating Level, $L_{Aeq, 1hr}$, dB(A)**	**Night time Noise Rating Level, $L_{Aeq, 5min}$, dB(A)**
EH1 Dean Street, East Halton	35	35
EH2 Chase Hill Lane, East Halton	35	35
EH3 Brick Lane East Halton	35	35
EH4 Scrub Lane, East Halton	35	35
EH5 Swinster Lane, East Halton	35	35
NK1 Nicolson Road, North Killingholme	37	35
NK2 Farm, North Killingholme	37	35
NK3 Clarkes Road, North Killingholme	37	35
NK4 Chase Road, North Killingholme	37	35
S3 Marsh Lane	47	45
SK1 Humber Road, South Killingholm	41	40
SK2 Staple Road, South Killingholme	41	40

Note daytime (07:00 to 23:00) and night time (23:00 to 07:00)

16.5.11 Baseline noise levels measured at each representative receptor location for each catchment area have been applied to the specific receptor location in the catchment areas. Hence, the baseline at the representative receptor EH5 (for the East Halton catchment area) has been adopted for the other East Halton receptors EH1, EH2, EH3 and

EH4. Similarly NK1 has been adopted for NK2, NK3, and NK4; and SK2 has been adopted for SK1.

Construction Noise Assessment Criteria

16.5.12 This section considers the potential for construction noise impacts on human receptors from the proposed AMEP. Impacts from construction on marine and ecological receptors are addressed in *Chapter 10* and *Chapter 11* utilising the same construction noise predictions based on the same assumptions.

Department of Environment Advisory Leaflet 72 (AL 72)

16.5.13 AL 72 gives advice on preferred maximum levels of construction site noise at residential locations during day time hours of (0700-1900). The criterion of speech interference forms the basis of the recommendations within AL 72 and is applicable to commercial buildings as well as residential properties.

16.5.14 BS 5228 sets out indicative noise level outputs, in terms of Sound Power Levels (SWL or Lw) and Activity L_{Aeq} (the A-weighted equivalent noise level), for a wide range of construction plant. The standard also gives advice on noise mitigation measures and sets out a prediction methodology. The factors that are considered in the prediction methodology include:

- sound pressure levels associated with various processes and plant;
- periods of operation of processes and plant; and
- distances between the noise source and the receptor

16.5.15 Other factors such as meteorological conditions (eg wind speed and direction), atmospheric absorption, and ground attenuation also influence the level of noise received from day to day. However, predicting these effects is complex and instead a conservative approach has been adopted by assuming still air and no atmospheric absorption, which potentially over-predicts noise levels.

16.5.16 An inventory of construction site plant has been used for each stage of construction, from which an effective total $L_{Aeq, Period}$ has been calculated for each construction activity. This has been used to estimate noise levels ($L_{Aeq, Period}$) at noise-sensitive receptors based on the distance from the receptor to the construction plant team.

16.5.17 AL 72 states that the noise level outside the nearest occupied room should not exceed:

- 75 dB(A) in urban areas near to main roads in heavy industrial areas; or

- 70 dB(A) in rural, suburban and urban areas away from main road traffic and industrial noise.

Construction Noise Assessment Criteria Adopted

16.5.18 As there are no universal criteria for assessing construction noise in the UK, guidance is taken from AL72 and BS 5228:1 The guidance suggests that acceptable noise levels in the evening (1900-2200 hours) may need to be 10 dB(A) lower than daytime levels. It also suggests that noise levels at the facades of occupied dwellings should be low enough to avoid sleep disturbance of the occupants at night. If windows are open it is generally accepted that an external facade noise level of 45 dB(A) L_{Aeq} will not result in sleep disturbance within the building.

16.5.19 A summary of the relevant criteria for the assessment of the impact of construction noise on the surrounding residential properties is presented in *Table 16.3*.

Table 16.3 Criteria for Construction Noise Assessment

Period	Façade Noise Level, dB(A) $L_{Aeq, Period}$
Day (0700-1900)	70
Evening (1900-2200)	60
Night (2200-0700)	45 or baseline, whichever is higher

16.5.20 The noise levels proposed in *Table 16.3* are not necessarily aimed at providing noise limits for construction activities but are proposed as criteria for the assessment of the impacts of the predicted noise levels.

Construction Vibration Assessment Criteria Adopted

16.5.21 BS 6472 offers guidance on predicting human response to vibration in buildings and advises the use of estimated vibration dose value (VDV) and how to it is determined by taking into account factors such event duration, characteristics (continuous, intermittent etc) and times of day to determine the probability of adverse response from occupants.

16.5.22 Direct measurement of VDV requires specialist equipment and prediction of VDV requires many factors that are at this stage not known. However, Peak Particle Velocity (PPV) can be easily measured and reference material is generally expressed in mm/s. Therefore for the purpose of impact assessment the construction vibration criterion is expressed in terms of PPV.

16.5.23 Vibration criteria are given in BS 5228:2 indicates PPV levels of between 0.15 and 0.3 mm/s represents the threshold of human perception and that vibration events up to 1 mm/s are unlikely to attract complaints in

a residential environment. Hence a PPV of 1 mm/s is considered an acceptable threshold to avoid the likelihood for complaints.

16.5.24 In the absence of specific vibration criteria criteria relating to underground infrastructure & services, BS 5228:2 recommends that the follwing limits be used:

a) a maximum PPV for intermittent or transient vibrations 30 mm/s; and

b) a maximum PPV for continuous vibrations 15mm/s.

16.5.25 These criteria should be applied at the nearest point (of the infrastructure item) to the vibration source or vibration generating activity.

16.5.26 BS 7385:2 suggests that damage to building structures is not likely below PPV levels of 15-50 mm/s, depending on building type and frequency of the vibration.

Noise Modelling

Operational Noise – Typical Operations

16.5.27 Bruel & Kjaer's Predictor V8.0 noise modelling software has been employed to predict noise propagation from the facility towards the selected receptor locations. This software implements the calculation method identified within ISO 9613 Part 2 for operational noise and BS 5228 for construction noise.

16.5.28 The noise model has been used to calculate noise emissions from the proposed AMEP for Typical Operations, for both the daytime and night-time periods based on the following assumptions:

- all acoustically significant plant and equipment operates simultaneously; and

- mobile noise sources were modelled at typical locations and assumed to operate in repetitive cycles.

16.5.29 Source data for all plant associated with the proposed development are detailed within *Annex 16.4*.

16.5.30 All significant topographical detail and buildings that may influence the transmission of noise to affected receptors are included in the noise model. A digital terrain model, created using ground elevation contours, has been used to position buildings and other noise sources at the correct height.

16.5.31 Receptor locations, at which noise levels have been predicted, are the same as those selected as construction noise receptor locations shown in *Figure 16.1* and *Figure 16.2* for those nearest the Compensation Site.

16.5.32 Predicted noise levels at the receptor locations have been assessed in relation to the noise levels measured during the background noise survey and in accordance with BS 4142 prior to determining the magnitude of any noise impact.

Operational Noise – Road Traffic

16.5.33 Projected road traffic flows on the surrounding road network for the years 2014 and 2025, assuming the development is in place, have been compared against traffic flows for the same years assuming the development is not in place.

Operational Vibration

16.5.34 No significant sources of operational vibration have been identified, and considering the relatively large distances between the site and closest receptor locations, the quantitative assessment of vibration levels has been scoped out of this assessment

Construction Noise Sources

16.5.35 Maritime construction activities are sheet piling, piling, dredging operations and backfilling including "rainbowing" operations.

16.5.36 Terrestrial construction activities would typically include activities such as earthworks, fabrication and erection, concreting, paving, welding, crane lifts and heavy vehicle deliveries.

16.5.37 Construction noise sources have been identified as maritime or terrestrial noise generating activities. Construction is proposed to be undertaken at the times detailed in *Chapter 4*. The terrestrial construction noise sources consisted of two construction teams comprising the items shown in *Annex 16.4*

16.5.38 The assessment conducted is considered to be a worst case scenario as it involves two terrestrial construction teams operating simultaneously with the marine based construction equipment shown in *Annex 16.4* and the operating hours shown in *Chapter 4*.

Magnitude and Significance Criteria

16.5.39 The magnitude and significant criteria for assessing noise impacts are presented in *Table 16.4* and *Table 16.5*.

Table 16.4 Magnitude Criteria - Residential Receptors

Subject Area	Impact magnitude			
	Major	**Moderate**	**Minor**	**Negligible**
Construction Noise Daytime	Noise levels over 75 dB(A)	Noise levels generally between 65 dB(A) and 75 dB(A)	Noise levels generally between 55 dB(A) and 65 dB(A)	Noise levels normally less than 55 dB(A)
Construction Noise Night time	Noise level above 55dB(A) and above baseline	Noise level between 45 and 55 dB(A) and above baseline	Noise level below 45 dB(A) but above baseline	Noise level below 45 dB(A) or below baseline
Operational Noise	Noise Rating Level greater than 10 dB(A) above Background Noise Level	Noise Rating Level 0 to 10 dB(A) greater than Background Noise Level	Noise Rating Level between 0 to 10dB below Background Noise Level	Rating Level greater than 10dB below Background Noise Level
Traffic Noise LAeq, 1hr	Change in traffic noise levels of more than 10 dB(A)	Changes in traffic noise levels between 3 and 10 dB(A)	Changes in traffic noise levels between 1 and 3 dB(A)	Changes in traffic noise levels of less than 1 dB(A)

Table 16.5 Significance Criteria- Residential Receptors

Subject Area	Significant	Not significant
Construction - daytime	Long term (more than a few days) Major or Moderate Impact	Minor or Negligible Impact
Construction – night time	Long term (more than a few days) Major or Moderate Impact	Minor or Negligible Impact
Operational noise	Major or Moderate Impact	Minor or Negligible Impact
Traffic noise and vibration	Major or Moderate Impact	Minor or Negligible Impact

16.5.40 The development of the assessment criterion is based on the guidance contained in the draft IEMA / IOA document: 'guidelines for noise impact assessment' 2002 and the standards noted in *Section 16.2*.

16.5.41 The noise ranges used in these criteria are based on the guidance contained in the draft IEMA / IOA document: guidelines for noise impact assessment 2002.

16.6 IMPACTS

Construction Noise – AMEP & Compensation Site

16.6.2 Predicted noise levels from the (worst case daytime) simultaneous construction of the proposed AMEP and the Compensation Site inclusive of all marine and terrestrial construction noise sources are shown in *Table 16.6.* Predicted noise levels from the AMEP site for the night time period are presented in *Table 16.8,* Daytime construction noise levels at receptors on the northern side of the Humber, nearest to the Compensation Site are generally dominated by the noise sources on the Compensation Site and hence the contribution from the MEP construction and Compensation Site construction activities are shown separately to exhibit the contributions from the two construction sites.

16.6.3 Cumualtive construction noise levels for receptors on the northern side of the Humber, inclusive of all marine and terrestrial construction noise sources from both the AMEP site and the Compensation Site are presented in *Section 16.9*.

Table 16.6 Daytime Construction Impact Assessment (Un-mitigated)

Description	Predicted MEP Construction Noise Level, $L_{Aeq, T}$	Pre Construction Noise Level, $L_{Aeq, T}$	Predicted MEP plus Pre Construction Noise Level, $L_{Aeq, T}$	Impact
EH1 Dean Street, East Halton	46	46	49	Negligible
EH2 Chase Hill Lane, East Halton	44	46	48	Negligible
EH3 Brick Lane East Halton	44	46	48	Negligible
EH4 Scrub Lane, East Halton	44	46	48	Negligible
EH5 Swinster Lane, East Halton	44	46	48	Negligible
EH6 East Halton	43	46	48	Negligible
NK1 Nicholson Rd, North Killingholme	44	52	53	Negligible
NK2 Farm, North Killingholme	44	52	53	Negligible
NK3 Clarkes Road, North Killingholme	42	52	52	Negligible
NK4 Chase Road, North Killingholme	44	52	53	Negligible
S3 Marsh Lane	52	58	59	Minor
SK1 Staple Road, South Killingholme	43	54	54	Negligible
SK2 Humber Road South Killingholme	43	54	54	Negligible

Table 16.7 Daytime Construction Impact Assessment (Un-mitigated - North side of Humber)

Description	Predicted Construction Noise Level, $L_{Aeq, T}$		Pre Construction Noise Level, $L_{Aeq, T}$	Predicted Total Noise Level (Construction plus existing), $L_{Aeq, T}$	Impact
	MEP	Comp site			
Far Marsh Farm	< 25	47	40	48	Negligible
Sands Farm	< 25	56	40	56	Minor
Sands House	31	61	40	61	Minor
Stone Creek Farm	< 25	47	40	48	Negligible
The Marsh	< 25	47	40	48	Negligible
Thorn Marsh Farm	< 25	47	40	48	Negligible
Thorney Crofts	< 25	47	40	48	Negligible
West Farm	< 25	47	40	48	Negligible
White House Farm	< 25	47	40	48	Negligible
Crown Farm	< 25	47	40	48	Negligible
Fairview	42	65	40	65	Minor
Keyingham Grange	< 25	47	40	48	Negligible
Stone Creek House	42	61	40	61	Minor
Little Humber	< 25	47	40	48	Negligible
Marsh House	< 25	47	40	48	Negligible
Nearmarsh Farm	< 25	47	40	48	Negligible
New House Farm	42	50	40	51	Negligible
Old Little Humber	< 25	47	40	48	Negligible
Salthaugh Grange	< 25	47	40	48	Negligible
Salthaugh Sands	< 25	56	40	56	Minor

Table 16.8 Night time Construction Impact Assessment (Un-mitigated)

Description	Predicted MEP Construction Noise Level, $L_{Aeq, T}$	Pre Construction Noise Level, $L_{Aeq, T}$	Predicted MEP plus Pre Construction Noise Level, $L_{Aeq, T}$	Impact
EH1 Dean Street, East Halton	35	39	40	Negligible
EH2 Chase Hill Lane, East Halton	33	39	40	Negligible
EH3 Brick Lane East Halton	33	39	40	Negligible
EH4 Scrub Lane, East Halton	34	39	40	Negligible
EH5 Swinster Lane, East Halton	33	39	40	Negligible
EH6 East Halton	33	39	40	Negligible
NK1 Nicholson Rd, North Killingholme	34	46	46	Negligible
NK2 Farm, North Killingholme	33	46	46	Negligible
NK3 Clarkes Road, North Killingholme	33	46	46	Negligible
NK4 Chase Road, North Killingholme	34	46	46	Negligible
S3 Marsh Lane	42	57	57	Negligible
SK1 Staple Road, South Killingholme	33	52	52	Negligible
SK2 Humber Road South Killingholme	33	52	52	Negligible

Table 16.9 Night time Construction Impact Assessment (Un-mitigated - North side of Humber)

Description	Predicted MEP Construction Noise Level, $L_{Aeq, T}$	Pre Construction Noise Level, $L_{Aeq, T}$	Predicted MEP plus Pre Construction Noise Level, $L_{Aeq, T}$	Impact
Far Marsh Farm	< 25	40	40	Negligible
Sands Farm	< 25	40	40	Negligible
Sands House	31	40	41	Negligible
Stone Creek Farm	< 25	40	40	Negligible
The Marsh	< 25	40	40	Negligible
Thorn Marsh Farm	< 25	40	40	Negligible
Thorney Crofts	< 25	40	40	Negligible
West Farm	< 25	40	40	Negligible
White House Farm	< 25	40	40	Negligible
Crown Farm	< 25	40	40	Negligible
Fairview	34	40	41	Negligible
Keyingham Grange	< 25	40	40	Negligible
Stone Creek House	34	40	41	Negligible
Little Humber	< 25	40	40	Negligible
Marsh House	< 25	40	40	Negligible
Nearmarsh Farm	< 25	40	40	Negligible
New House Farm	34	40	41	Negligible
Old Little Humber	< 25	40	40	Negligible
Salthaugh Grange	< 25	40	40	Negligible
Salthaugh Sands	< 25	40	40	Negligible

Road Traffic Noise - Construction

16.6.4 Road traffic noise levels from the construction phase have been calculated and compared to the existing road traffic noise levels along the routes identified in the traffic assessment around the project site. A detailed set of hourly results are presented in *Annex 16.6*.

16.6.5 From analysis of the proposed traffic flow data, changes in road traffic noise are expected to occur generally in the early morning peak (05:00-07:00). The significant (> 3 dB) changes in noise levels are expected to be along Rosper Road during the morning peak. This is most likely due to the arrival and departure of construction employees over the course of a typical day. The significant impacts generally occur on roads that currently don't experience high traffic volumes.

16.6.6 Although this is a significant change in road traffic noise, there are no noise sensitive receptors along Rosper Road, and hence no impact is expected to occur from construction road traffic.

Operational Noise - AMEP

16.6.7 Predicted noise levels from typical operations are shown in *Table 16.10* and *Table 16.11* based on the methodology presented in *Section 16.3* and noise source levels presented in *Annex 16.4*. Predicted noise levels expressed as noise contour plots are contained in *Annex 16.8*.

Table 16.10 Daytime Operational Impact Assessment (Un- mitigated)

Description	Predicted Noise Level LAeq dB(A)	Criteria	Difference	Impact
EH1 Dean Street, East Halton	34	35	-1	Negligible
EH2 Chase Hill Lane, East Halton	32	35	-3	Negligible
EH3 Brick Lane East Halton	31	35	-4	Negligible
EH4 Scrub Lane, East Halton	32	35	-3	Negligible
EH5 Swinster Lane, East Halton	29	35	-6	Negligible
EH6 East Halton	30	35	-5	Negligible
NK1 Nicholson Rd, North Killingholme	32	37	-5	Negligible
NK2 Farm, North Killingholme	30	37	-7	Negligible
NK3 Clarkes Road, North Killingholme	28	37	-9	Negligible
NK4 Chase Road, North Killingholme	33	37	-4	Negligible

Description	Predicted Noise Level LAeq dB(A)	Criteria	Difference	Impact
S3 Marsh Lane	43	47	-4	Negligible
SK1 Staple Road, South Killingholme	31	41	-10	Negligible
SK2 Humber Road South Killingholme	31	41	-10	Negligible
Receptors on North Side of Humber	< 25	35	-10	Negligible

Table 16.11 Night time Operational Impact Assessment (Un mitigated)

Description	Predicted Noise Level LAeq dB(A)	Criteria	Difference	Impact
EH1 Dean Street, East Halton	34	35	-1	Negligible
EH2 Chase Hill Lane, East Halton	32	35	-3	Negligible
EH3 Brick Lane East Halton	31	35	-4	Negligible
EH4 Scrub Lane, East Halton	32	35	-3	Negligible
EH5 Swinster Lane, East Halton	29	35	-6	Negligible
EH6 East Halton	30	35	-5	Negligible
NK1 Nicholson Rd, North Killingholme	32	35	-3	Negligible
NK2 Farm, North Killingholme	30	35	-5	Negligible
NK3 Clarkes Road, North Killingholme	28	35	-7	Negligible
NK4 Chase Road, North Killingholme	33	35	-2	Negligible
S3 Marsh Lane	43	45	-3	Negligible
SK1 Staple Road, South Killingholme	31	40	-9	Negligible
SK2 Humber Road South Killingholme	31	40	-9	Negligible
Receptors on North Side of Humber	< 25	35	-10	Negligible

16.6.8 Rating noise levels from the proposed AMEP development are predicted to meet the project-specific noise criteria at all residential receivers for the daytime and night-time periods, resulting in negligible impacts.

Road Traffic Noise – Operational Phase

16.6.9 Road traffic noise levels from the operational phase have been calculated and compared to the existing road traffic noise levels along the identified routes around the project site. A detailed set of hourly results are presented in *Annex 16.6*.

16.6.10 From analyis of the proposed traffic flow data, changes in road traffic noise are expected to peak generally in the early morning peak (05:00-06:00), afternoon (13:00 – 14:00) and evening times (21:00 – 22:00) when worker trips peak and are summarised as such in *Table 16.12* showing the significant (>3dB) changes in noise levels. This is due to the arrival and departure of employees over the course of a typical day. The significant impacts generally occur on roads that currently don't experience high traffic volumes or the volume at the time of day when the proposed shift changes are to occur.

Table 16.12 Road Traffic Noise Assessment Summary – Operational Phase

Road	Location[1]	Change in traffic noise level, $L_{Aeq, 1hr}$					
		Morning Peak		Afternoon Peak		Evening Peak	
		05:00	06:00	13:00	14:00	21:00	22:00
A180	East of M180 J5	**3.6**	1.6	0.8	0.7	1.8	2.4
A160	South of K	**5.3**	2.7	1.4	1.3	2.9	**3.7**
A1077	Ulceby Rd West of K	**6.8**	**3.7**	2.0	1.9	**4.0**	**5.0**
A160	Between K and D	**6.0**	**3.1**	1.6	1.5	**3.4**	**4.2**
A160	Between D and L	**6.6**	**3.6**	1.9	1.8	3.9	**4.8**
A160	Between L and E	**7.8**	4.4	2.5	2.4	4.7	**5.8**
Humber Rd	Between E and C	**10.2**	**6.4**	**3.9**	**3.7**	**6.7**	**8.0**
Rosper Rd	North of C	**13.0**	**8.9**	**5.9**	**5.8**	**9.3**	**10.7**
A1173	South of E	**7.3**	**4.0**	2.2	2.1	**4.3**	**5.3**
A1173	North of A	**7.2**	**4.0**	2.2	2.1	**4.3**	**5.3**
Manby Rd	South of A	**7.9**	**4.5**	2.5	2.4	**4.8**	**5.9**
A1173	East of A	**6.1**	**3.2**	1.7	1.6	**3.5**	**4.4**
A1173	Between G and H	**6.0**	**3.2**	1.7	1.6	**3.4**	**4.3**
A1173	Between H and I	**4.4**	2.1	1.1	1.0	2.3	**3.0**

Note 1 road locations are detailed in *Annex 16.6*

16.6.11 To determine the impact of the change in road traffic noise level, a understanding of the Noise Sensitive Recptors (NSR's) along the roadways has been gained by a review of aerial photography of the area. The approximate number of dwellings was estimated to provide a means of assessing the potential impact from the change in road traffic noise levels and is presented in *Table 16.13*.

Table 16.13 Road Traffic Noise Significant NSR's

Road	Location[1]	Maximum Change in Road Traffic Noise Level, $L_{Aeq, 1hr}$, dB(A)	Noise Sensitive Receptors Identified	Impact
A180	East of M180 J5	3.6	Nil	Moderate
A160	South of K	5.3	Nil	Moderate
A1077	Ulceby Rd West of K	6.8	Approx 20 dwellings nr railway station	Moderate
A160	Between K and D	6.0	Nil	Moderate
A160	Between D and L	6.6	Approx 25 Houses on rear of School road	Moderate
A160	Between L and E	7.8	Nil	Moderate
Humber Rd	Between E and C	10.2	Nil	Major
Rosper Rd	North of C	13.0	Nil	Major
A1173	South of E	7.3	Nil	Moderate
A1173	North of A	7.2	Nil	Moderate
Manby Rd	South of A	7.9	Approx 40 dwellings along Kings Road	Moderate
A1173	East of A	6.1	Nil	Moderate
A1173	Between G and H	6.0	Nil	Moderate
A1173	Between H and I	4.4	Nil	Moderate

Note 1 road locations are detailed in Annex 16.6

16.6.12 As presented in *Table 16.13*, potential road traffic noise impacts shown are generally negligible, except where there are residential properties bordering the roads in Ulceby, South Killingholme and Immingham where the traffic noise impacts have been rated as Moderate.

Vibration Assessment

Construction

16.6.13 The most significant source of vibration during the construction works will be from the tubular steel piling and sheet piling for the quayside wall. BS 5228 provides guidance for the prediction of an upper estimate of vibration from piling operations which is based on the energy per blow or cycle (determined by the type of piler and ram weight), the distance of the receptor from piling and generalised soil conditions.

16.6.14 Reference vibration levels from Table D8 Item C32 of BS 5228 for similar piling operations, indicated a measured PPV of 7.4 mm/s and 3.3 mm/s at plan distances of 27m and 55m respectively. The calculation formulae provided in Annex E of BS 5228 were adjusted to these measured values to calculate expected vibration emissions. The calculated levels, summarised in *Table 16.14* at relevant distances or threshold values and plotted in *Figure 16.3,* are based on a hammer delivering a maximum energy per blow of 500 KJ. Additonal estimated off set distances for threshold vibration levels are also provided for higher and lower energy levels per blow. However, as indicated by the piling contractor (Hochtief) the 300 KJ hammer is most likely to be used on the site.

16.6.15 These results refer to vibration levels outside the building, and the results do not take into account any amplification of vibration that can occur from the outside of building to a floor structure inside some types of building.

Table 16.14 Estimated Vibration from Tubular Piling and Sheet Piling Operations

Threshold Value, PPV mm/s	Sheet Piling Plan Distance, m	Tubular Steel Piling Plan Distance, m		
		500 KJ	300 KJ	200 KJ
50	2	6	5	4
25	3	11	9	8
20	4	13	20	9
10	6	22	18	15
5	10	37	30	26
1	32	126	104	89
0.5	52	213	175	150
0.3	75	300	258	220

16.6.16 Ground vibration from pile driving is likely to be perceptible at the nearest sensitive receptors S1 and S2 when piling activities approach within a distance of 120 m to 250 m based on 300 KJ hammer.

16.6.17 Location S1 is potentially within 50 m of the nearest piling location and could experience vibration levels in the order of 5 to 10 mm/s. This would not normally present any significant concerns of cosmetic damage to a building, but would be noticeable by the occupant and likely to cause adverse comment and/ or complaint. In addition to this, at Location S1 is the Killingholme North Low Lighthouse and there is potential for amplification of the ground vibration through the structure. As the lighthouse is taller than a single level building, it is likely to be affected by unwanted vibration levels at each floor above ground due to amplification.

Underground Infrastructure & Services

16.6.18 To comply with the recommended vibration criteria for underground services and infrastructure, pile driving would need to be a minimum distance of 13 metres to achieve 15mm/s; and 8 metres to achieve 30mm/s (based on 300 KJ hammer energy).

Operations

16.6.19 There are no significant vibration generating sources from the operation and hence impacts from vibration are not expected to occur.

16.6.20 During construction it is recommended that:

- Structural condition surveys are carried out before and after the works, so that in the unexpected event of any damage occurring, it could be more reliably attributed to the works.

- A survey to be conducted to identify relevant infrastructure and services that are in the area such as pipelines to avoid unwanted effects from vibration when piling activities are approaching the shore.

- During piling operations, monitoring of vibration levels should take place on nearby potentially sensitive structures.

- Where vibration levels look likely to exceed threshold levels for structural damage, then the maximum energy per blow should be reduced although this could have the effect of extending piling operations.

- Construction contractors will be required to implement best practicable means to reduce noise and vibration impacts upon the local community.

Figure 16.3 Estimated Vibration from Tubular Piling Operations

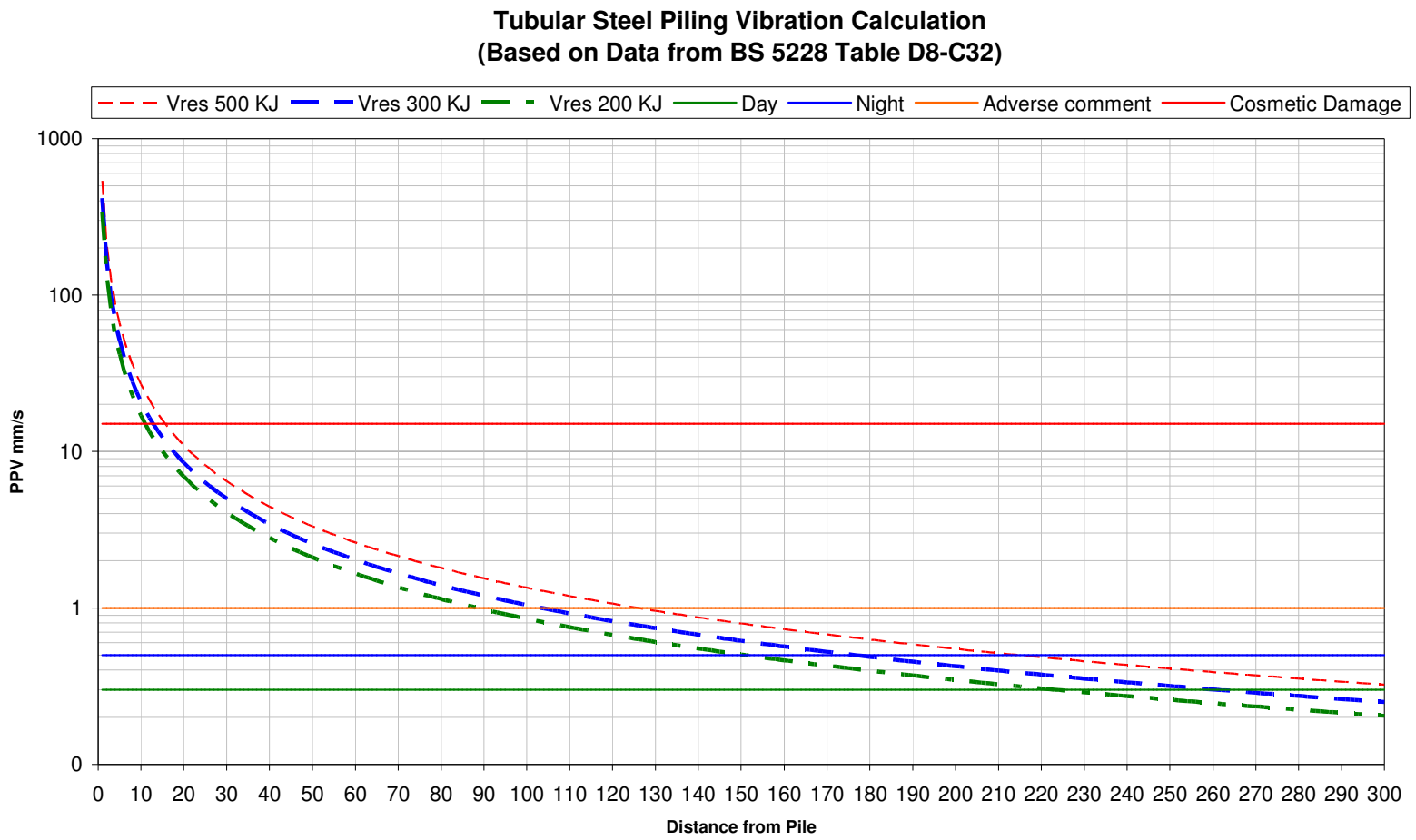
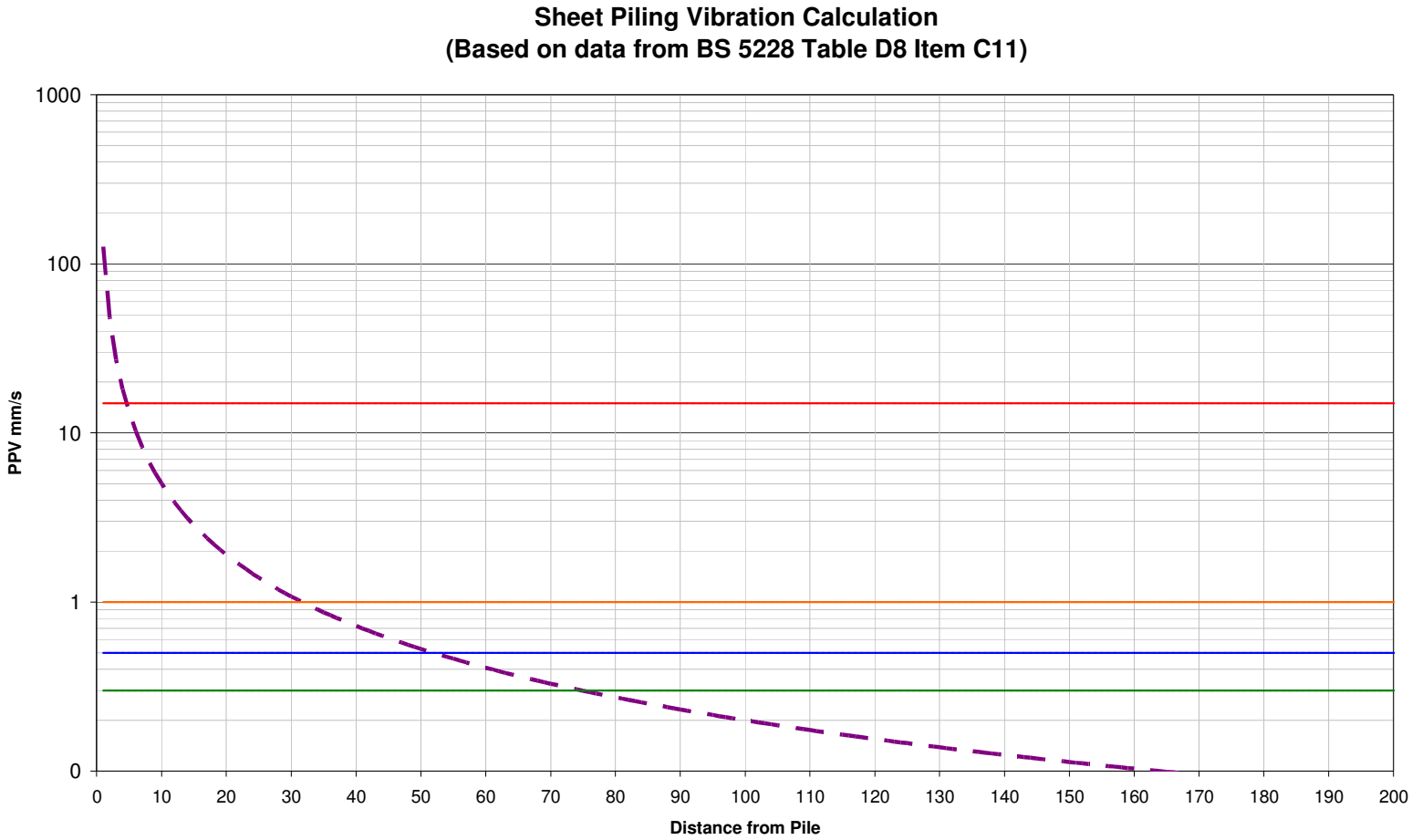


Figure 16.4 Estimated Vibration from Sheet Piling Operations



16.7 MITIGATION – CONSTRUCTION

Overview

16.7.1 The assessment has not identified any significant potential noise impacts, however any acute or potential construction noise impacts will be managed in accordance with the *Code of Construction Practice*.

Construction Phase (Noise) – AMEP Site

16.7.2 Construction hours are detailed in *Chapter 4*.

16.7.3 The following noise mitigations have been implemented into the construction methodology.

16.7.4 Piling noise mitigation includes shrouds and soft starts. Details of the reduction achieved is contained in Hotchief Piling presentation extract contained in *Annex 16.7*; and

16.7.5 It is expected that the construction contractor will follow best practicable means to reduce the noise impact upon the local community including the following:

- All construction plant and equipment should comply with EU noise emission limits.

- Implementation of Best Available Technology Economically Achievable (BATEA). and Best Management Practice (BMP) across the site by all contractors on site.

- Proper use of plant with respect to minimising noise emissions and regular maintenance. All vehicles and mechanical plant used for the purpose of the works should be fitted with effective exhaust silencers and should be maintained in good efficient working order.

- Selection of inherently quiet plant where appropriate. All major compressors should be 'sound reduced' models fitted with properly lined and sealed acoustic covers which should be kept closed whenever the machines are in use and all ancillary pneumatic percussive tools should be fitted with mufflers or silencers of the type recommended by the manufacturers.

- Machines in intermittent use should be shut down in the intervening periods between work or throttled down to a minimum.

- All ancillary plant such as generators, compressors and pumps should be positioned so as to cause minimum noise disturbance. If

necessary, acoustic enclosures should be provided and/or acoustic screening.

- Construction contractors would be obliged to adhere to the codes of practice for construction working and piling given in BS 5228 and the guidance given therein minimising noise emissions from the site.

Vibration Mitigation

16.7.6 The following vibration mitigations have been implemented into the construction methodology:

- flap anchors; and
- soft starts.

16.7.7 In addition to these mitigation measures, construction works and vibration generating activities will be guided by best practices outlined in BS 5228 and where feasible methods are identified shall be implemented into the *Code of Construction Practice*.

16.7.8 It is recommended that the local community and in particular sensitive receptors most likely to be affected by vibration from piling activities be advised of the piling programme.

Mitigation Road Traffic Noise

16.7.9 Potential for traffic noise impacts is dependant on the management of traffic for the construction and operational phases of the project. Suitable mitigation and/ or management of potential traffic noise impacts will need to be developed and should include the following traffic specific noise mitigation measures to minimise any potential impacts:

- avoid queueing and bunching of heavy vehicle movements such as deliveries to the site or removal of spoil and waste from the site;

- implement appropriate speed limits in areas with greater sensitivity to road traffic noise;

- provide all staff, contractors and HGV drivers with information in the form of site induction or training to create awareness of the potential for noise impacts from road traffic and in particular, heavy vehicles;

- perform regular checks/ audits on driver behaviour through the noise sensitive areas;

- stagger shift changes to avoid high peak traffic flows; and

- review performance and manage public enquiries.

16.8 RESIDUAL IMPACTS

Construction Phase – AMEP & Compensation Site

16.8.1 Predicted residual noise levels from construction with the piling mitigation controls outlined in *Section 16.7* are shown in *Table 16.15* and *Table 16.16*. There is potential for Minor impacts during the daytime period at Sands Farm, Sands House, Fariview, Stone Creek House and Saltaugh House. The noise levels predicted at these receptors are dominated by noise emissions from the construction activities at the Compensation Site.

16.8.2 The residual impact ratings for the construction phase are generally unchanged for the receptors on the north side of the Humber due to the dominance of noise from the construction of the Compensation Site.

Operational Phase

16.8.3 Due to predicted noise levels from typical operations without mitigation controls being below the threshold values, there are no residual impacts.

Table 16.15 Daytime Residual Construction Impact Assessment (Mitigated)

Description	Predicted MEP Construction Noise Level, $L_{Aeq, T}$	Pre Construction Noise Level, $L_{Aeq, T}$	Predicted MEP plus Pre Construction Noise Level, $L_{Aeq, T}$	Impact
EH1 Dean Street, East Halton	43	46	48	Negligible
EH2 Chase Hill Lane, East Halton	41	46	47	Negligible
EH3 Brick Lane East Halton	41	46	47	Negligible
EH4 Scrub Lane, East Halton	41	46	47	Negligible
EH5 Swinster Lane, East Halton	41	46	47	Negligible
EH6 East Halton	40	46	47	Negligible
NK1 Nicholson Rd, North Killingholme	42	52	52	Negligible
NK2 Farm, North Killingholme	41	52	52	Negligible
NK3 CLarkes Road, North Killingholme	40	52	52	Negligible
NK4 chase Road, North Killingholme	42	52	52	Negligible
S3 Marsh Lane	49	58	58	Negligible
SK1 Staple Road, South Killingholme	40	54	54	Negligible
SK2 Humber Road South Killingholme	40	54	54	Negligible

Table 16.16 Daytime Residual Construction Impact Assessment (Mitigated – North side of Humber)

Description	Predicted MEP Construction Noise Level, $L_{Aeq, T}$	Predicted Compensation Site Construction Noise Level, $L_{Aeq, T}$	Pre Construction Noise Level, $L_{Aeq, T}$	Predicted MEP & Compensation Site plus Pre Construction Noise Level, $L_{Aeq, T}$	Impact
Far Marsh Farm	< 25	47	40	48	Negligible
Sands Farm	< 25	56	40	56	Minor
Sands House	31	61	40	61	Minor
Stone Creek Farm	< 25	47	40	48	Negligible
The Marsh	< 25	47	40	48	Negligible
Thorn Marsh Farm	< 25	47	40	48	Negligible
Thorney Crofts	< 25	47	40	48	Negligible
West Farm	< 25	47	40	48	Negligible
White House Farm	< 25	47	40	48	Negligible
Crown Farm	< 25	47	40	48	Negligible
Fairview	38	65	40	65	Minor
Keyingham Grange	< 25	47	40	48	Negligible
Stone Creek House	38	61	40	61	Minor
Little Humber	< 25	47	40	48	Negligible
Marsh House	< 25	47	40	48	Negligible
Nearmarsh Farm	< 25	47	40	48	Negligible
New House Farm	38	50	40	51	Negligible
Old Little Humber	< 25	47	40	48	Negligible
Salthaugh Grange	< 25	47	40	48	Negligible
Salthaugh Sands	< 25	56	40	56	Minor

Table 16.17 Night time Residual Construction Impact Assessment (Mitigated)

Description	Predicted MEP Construction Noise Level, $L_{Aeq, T}$	Pre Construction Noise Level, $L_{Aeq, T}$	Predicted MEP plus Pre Construction Noise Level, $L_{Aeq, T}$	Impact
EH1 Dean Street, East Halton	35	39	40	Negligible
EH2 Chase Hill Lane, East Halton	33	39	40	Negligible
EH3 Brick Lane East Halton	33	39	40	Negligible
EH4 Scrub Lane, East Halton	34	39	40	Negligible
EH5 Swinster Lane, East Halton	33	39	40	Negligible
EH6 East Halton	33	39	40	Negligible
NK1 Nicholson Rd, North Killingholme	34	46	46	Negligible
NK2 Farm, North Killingholme	33	46	46	Negligible
NK3 Clarkes Road, North Killingholme	33	46	46	Negligible
NK4 Chase Road, North Killingholme	34	46	46	Negligible
S3 Marsh Lane	42	57	57	Negligible
SK1 Staple Road, South Killingholme	33	52	52	Negligible
SK2 Humber Road South Killingholme	33	52	52	Negligible

Table 16.18 Night time Residual Construction Impact Assessment (Mitigated – North Side of Humber)

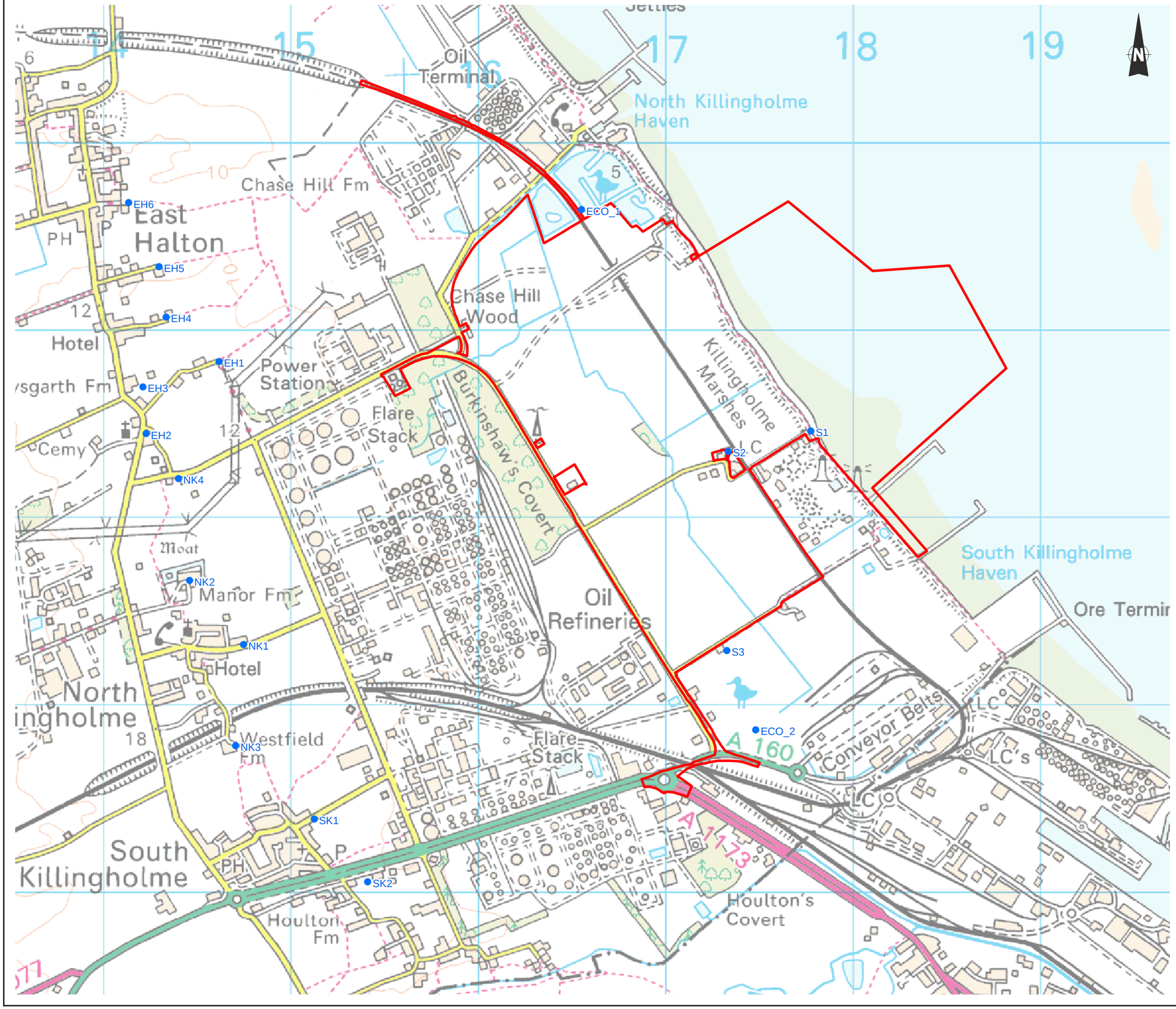
Description	Predicted MEP Construction Noise Level, $L_{Aeq, T}$	Pre Construction Noise Level, $L_{Aeq, T}$	Predicted MEP plus Pre Construction Noise Level, $L_{Aeq, T}$	Impact
Far Marsh Farm	< 25	40	40	Negligible
Sands Farm	< 25	40	40	Negligible
Sands House	31	40	41	Negligible
Stone Creek Farm	< 25	40	40	Negligible
The Marsh	< 25	40	40	Negligible
Thorn Marsh Farm	< 25	40	40	Negligible
Thorney Crofts	< 25	40	40	Negligible
West Farm	< 25	40	40	Negligible
White House Farm	< 25	40	40	Negligible
Crown Farm	< 25	40	40	Negligible
Fairview	34	40	41	Negligible
Keyingham Grange	< 25	40	40	Negligible
Stone Creek House	34	40	41	Negligible
Little Humber	< 25	40	40	Negligible
Marsh House	< 25	40	40	Negligible
Nearmarsh Farm	< 25	40	40	Negligible
New House Farm	34	40	41	Negligible
Old Little Humber	< 25	40	40	Negligible
Salthaugh Grange	< 25	40	40	Negligible
Salthaugh Sands	19	40	40	Negligible

16.9 CUMULATIVE IMPACT

16.9.1 Predicted operational noise levels from the AMEP, generally below 35 dB(A), are significantly below the noise criteria developed for the project, which are essentially, the lower range of existing background (L_{A90}) noise levels.

16.9.2 A review of other approved projects in the NLC and ERYC areas reveal that noise emissions from these projects are generally predicted to be below the required noise criteria, and the the existing ambient L_{Aeq} noise levels, or at a level that the noise contribution from the MEP would not result in a detectable increase in noise levels.

16.9.3 In consideration of the existing ambient L_{Aeq} noise levels ranging from 45 dB(A) to 55 dB(A) in the vicinity of the East Halton, Killingholme and Immingham, it is reasonable to expect no adverse cumulative noise impacts from the operation of the AMEP.



Key

- Application Boundary
- Noise Receptors

PROJECTION: British National Grid

Rev	Date	Comments	Drw	Chk	App
A	01/12/2011	Preliminary Issue	MTC	WB	SP

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ERM

Project: ABLE Marine Energy Park

Client: ABLE UK Ltd

Title: Figure 16.1
Noise Sensitive Receptors and
Baseline Noise Monitoring Locations

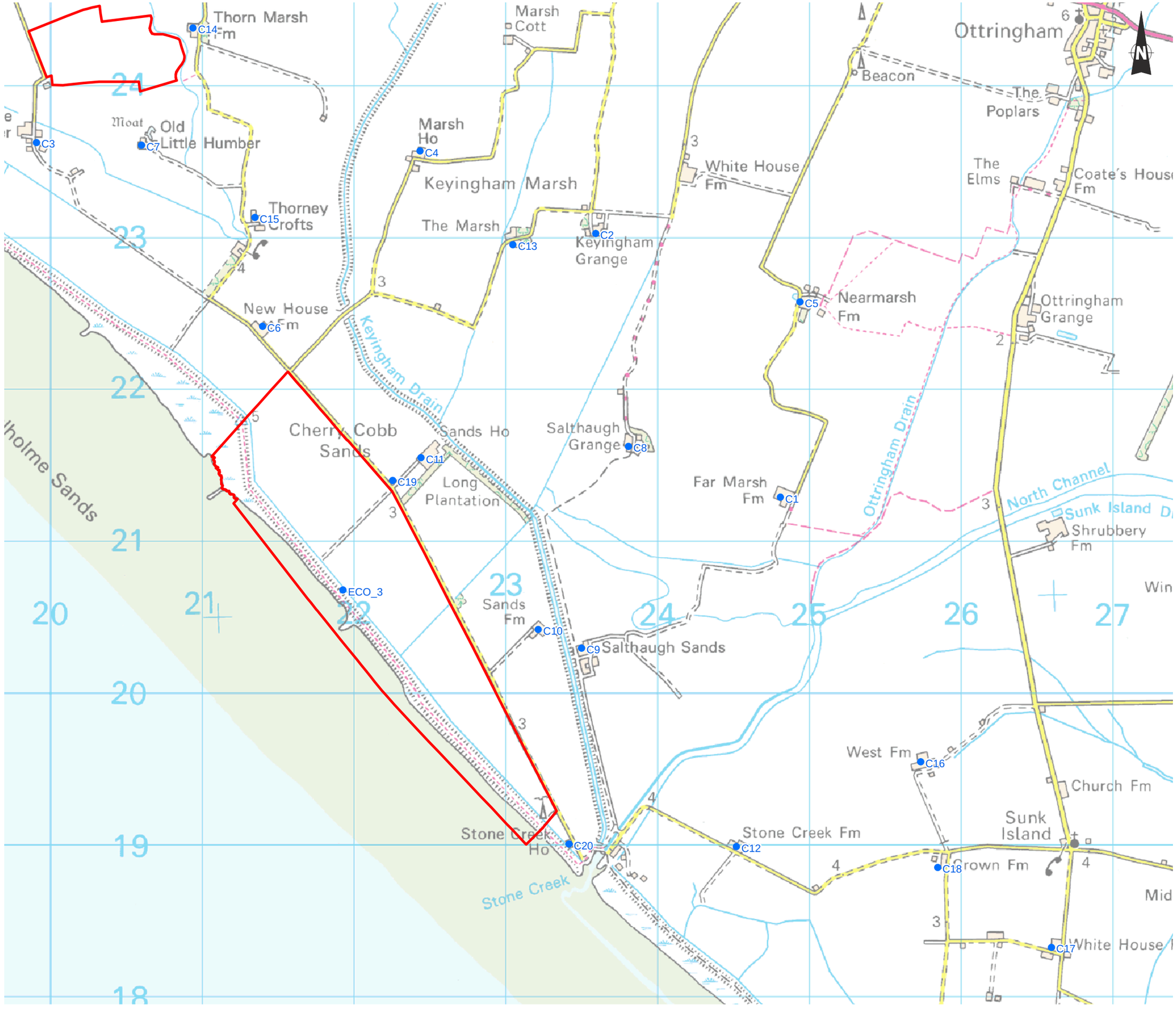
PRELIMINARY

Scale:	Drawn	Checked	Approved
1:20,000@A3	MTC	WB	SP
Date	01/12/2011	01/12/2011	01/12/2011

Drawing No. ABLE_NoiseMonitoringLocationsSouth.mxd

Revision:. A

File: 0120872AHP_MarineEnergyParkGIS_MTC_MKI\MAPS\ABLE Template Maps\ABLE_NoiseMonitoringLocationsSouth.mxd



Key

- Application Boundary
- Noise Receptors

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PROJECTION: British National Grid

Rev	Date	Comments	Drw	Chk	App
A	01/12/2011	Preliminary Issue	MTC	WB	SP

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ERM

Project: ABLE Marine Energy Park

Client: ABLE UK Ltd

Title: Figure 16.2
Northern Humberside Noise Sensitive Receptors

PRELIMINARY

Scale:	Drawn	Checked	Approved
1:20,000@A3	MTC	WB	SP
Date	01/12/2011	01/12/2011	01/12/2011

Drawing No. ABLE_NoiseMonitoringLocationsNorth.mxd

Revision:. A

File: 01208724NP_MarineEnergyParkGIS_MTC_MXDMAPS\ABLE Template Maps\ABLE_NoiseMonitoringLocationsNorth.mxd