Appendix 11.3

Introduction

The purpose of this assessment was to identify the potential noise and vibration impacts of construction of the Proposed Scheme and to identify resulting temporary significant effects. This Appendix describes the scope of the construction assessment and how the effects of the impacts have been assessed, with regard to noise and vibration. The results of the assessment have been presented. The assessment has primarily been informed by the following guidance:

- BS 5228 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise: 2009+A1:2014; and
- BS 5228 Code of construction practice for noise and vibration control on construction and open sites – Part 2: Vibration: 2009+A1:2014.

Further details regarding this guidance are provided in **Appendix A11.1.**

Technical scope

The assessment of the effects on receptors arising from changes to levels of noise or vibration comprised the following elements:

- Construction noise has been predicted and assessed using methodology from BS5228. This was based upon knowledge of construction activities, plant inventories and programme available at the time of assessment; and
- Construction vibration was predicted and assessed using methodology from BS5228 informed by data from TRL Report 5374. This was based upon knowledge of construction activities, plant inventories and programme available at the time of assessment.

Spatial scope

For the construction phase, the spatial extent of the assessment includes:

- All locations where construction impacts generated by activities within the site boundary are predicted to be above SOAEL of $L_{Aeq,T}$ 65 dB at sensitive receptors; and

Temporal scope

The construction noise and vibration assessment encompasses:

- The baseline which is considered to be representative of the conditions prior to any works undertaken to implement the Proposed Scheme; and
- Duration of construction activities.

Apart from exceptional circumstances, construction activities will be undertaken during the daytime period only. The assessment is therefore limited to daytime only which is considered to be 07:00 – 19:00 weekdays and 07:00 – 13:00 on Saturdays.

Approach

For the purposes of this ES, impact is defined as a physical change to the baseline environment resulting from the Proposed Scheme. The consequence of the change to the baseline environment on any environmental receptor or particular value or sensitivity is defined as the effect.

Determining the Sensitivity of the Receptor

Noise and vibration effects people in a number of different ways. This may include factors such as annoyance, sleep disturbance, anxiety, enjoyment of quiet spaces, ability to communicate with others, ability to concentrate at home or at work, and participation in social and community activities.

It should be noted that, generally, the variation in the sensitivity of receptors in terms of noise effect is taken into account by applying different scales to classify magnitude of effect (e.g. by using different scales for day-time and night-time), rather than by varying the assignment of sensitivity to specific types of receptors.

The noise and vibration assessment focused on receptors regarded as having high sensitivity to noise and vibration. These are predominantly residential receptors but also include places of worship such as Christ Church on Walton Breck Road. Licenced premises in the vicinity of the Proposed Scheme have been assumed to be residential receptors.

Significance of Construction Noise and Vibration Effects

Construction Noise

BS 5228 does not define strict criteria to determine the significance of noise impacts, although example methods of assessing significance are provided. Example Method 2, the 5 dB(A) change method (BS5228-1 Annex E 'Significance of Noise Effects' Section E.3.3) has been adopted for the assessment of effects at sensitive receptors. The method states:

"Noise levels generated by site activities are deemed to be potentially significant if the total noise (pre-construction ambient plus site noise) exceeds the pre-construction ambient noise by 5 dB or more, subject to lower cut-off values of 65 dB, 55 dB and 45 dB L_{Aeq} from site noise alone, for the daytime, evening and night-time periods, respectively; and a duration of one month or more, unless works of a shorter duration are likely to result in significant effect".

This assessment has considered the only the daytime period only.

BS 5228–1 does not qualify what might constitute a significant noise impact from works of a shorter duration; however, the standard does provide an example of criteria for the significance of noise effects which might be used to determine whether a scheme for installation of noise insulation or the temporary rehousing of occupants is appropriate. This example cites the occurrence of the trigger noise levels reproduced in **Table A11.3.1**, subject to the following conditions:

- Predicted noise level exceeds the noise trigger level in **Table A11.3.1**;
- The total noise (baseline plus construction noise) is 5 dB or more above the existing baseline noise level; and
- The noise level exceeds the trigger level for ten or more days of working in any fifteen consecutive days, or for a total of days exceeding 40 in any six-month period.

Table A11.3.1: Examples of Time Periods, Averaging Times and Noise Levels Associated with the Determination of Eligibility for Noise Insulation.

Time	Relevant Time Period	Averaging Time, T	Noise insulation Trigger level dB $L_{Aeq,T}$
Monday to Friday	0700-0800	1h	70
	0800-1800	10h	75
	1800-1900	1h	70
	1900-2200	3h	65
	2200-0700	1h	55
Saturday	0700-0800	1h	70
	0800-1300	5h	75
	1300-1400	1h	70
	1400-2200	3h	65
	2200-0700	1h	55
Sunday and public holidays	0700-2100	1h	65
	2100-0700	1h	55

Construction Vibration

BS 5228-2 provides guidance on the effect of vibration and the likelihood it will cause complaint and cosmetic damage to buildings. BS 5228–2 does not indicate whether particular vibrations are significant.

BS 5228–2 provides the following guidance on effects:

- At a vibration level of peak particle velocity (PPV) 0.14mm/s vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction;
- At a vibration level of PPV 0.3mm/s vibration might be just perceptible in residential environments;
- At a vibration level of PPV 1.0mm/s "It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents"; and
- At a vibration level of PPV 10mm/s vibration is likely to be intolerable for any more than a very brief exposure period.

This guidance has been translated into degree of impact in Table **A11.3.2**.

Table A11.3.2 Magnitude of Impact for Construction Vibration

Vibration PPV (mm/s)	Degree of Impact
Less than 0.3	Negligible
0.3-0.9	Minor
1.0 – 9.9	Moderate
10 or greater	Major

Consideration of LOAEL and SOAEL

The assessment of significance for noise and vibration effects has also considered the concepts of Lowest Observed Adverse Effect Level (LOAEL) and Significant Observed Adverse Effect Level (SOAEL) introduced in the NPSE, which was further elucidated in PPG and the Institute of Environmental Management & Assessment (IEMA) Guidelines for Noise Impact Assessment. LOAEL and SOAEL for each parameter has been agreed for the assessment in consultation with Liverpool City Council (LCC) and is set out in **Table A11.3.3**.

Table A11.3.3: Summary of Significance Levels for Noise and Vibration Impacts.

Parameter Assessed	LOAEL and SOAEL	Source Guidance
Construction Noise	LOAEL $L_{Aeq,T}$ 50dB (free field)	World Health Organisation guideline value for moderate annoyance in outdoor living areas.
	SOAEL $L_{Aeq,T}$ 65 dB (free field)	BS 5228-1 threshold for potential significance of daytime construction noise.
Construction Vibration	LOAEL peak particle velocity (PPV) 0.3mm/s	BS 5228-2 threshold at which vibration "might be just perceptible in residential environments".
	SOAEL PPV 1.0 mm/s	BS 5228 threshold at which vibration is likely to cause complaint within residential environments "but can be tolerated if prior warning and explanation has been given to residents".

Exceedance of SOAEL has not in itself been regarded to constitute to a significant adverse effect. The assessment of likely significant effects at sensitive receptors has considered the sensitivity of the receptor alongside the magnitude, duration and frequency of change. Significant effects have been determined through professional judgment.

Assessment of Construction Noise

Construction Activities and Plant Inventory

An inventory of likely construction plant and associated noise levels has been developed by Mott MacDonald based on the construction information presented in **Chapter 4,** using knowledge of projects such as construction of the LFC Main Stand and professional judgement.

Duration of the various construction activities has been determined from a preliminary construction programme which is presented in **Chapter 4**.

Reference noise levels from Annexes C and D of BS 5228–1 have been assigned to the plant. This information, broken down by construction activity, is presented in **Table A11.3.4**.

Each activity has been provided with a percentage operating time for any given hour of construction activity. In the absence of detailed contractor's information, professional judgement has been used in the assignment of this percentage.

Table A11.3.4: Construction inventory and Assumed Operating Durations

Construction Activity	Plant	Assumed BS5228 plant	BS5228 plant reference	Sound Pressure Level at 10m $L_{Aeq,T}$(dB)	Number of the Same/Similar Plant Items Operating Simultaneously on Site	Duration On time % (Typical % of a Construction Day that the Plant will be Operating)
Foundations and Substructure	Dumper	Distribution of material: Dump truck (tipping fill) C.2 #30	C.2 #30	79	1	50
	Wheeled Loader	Clearing site: Wheeled backhoe loader C.2 #8	C.2 #8	68	1	50
	Tracked excavator	Clearing site: Tracked excavator C.2 #2	C.2 #2	77	1	50
	Hydraulic Breaker Mounted on tracked excavator	Breaking up brick foundations: Breaker mounted on excavator C.1 #9	C.1 #9	90	1	50
	Tipper wagons	Distribution of materials: Wheeled backhoe loader C.4 #14	C.4 #14	67	1	50
	Vibratory Roller	Rolling and compaction: Vibratory roller C.5 #28	C.5 #28	77	1	50
	Dumper Truck	Distribution of material: Dump truck (tipping fill) C.2 #30	C.2 #30	79	1	50
	Mobile crane	Lifting: Mobile telescopic crane C.4 #39	C.4 #39	77	1	50

Construction Activity	Plant	Assumed BS5228 plant	BS5228 plant reference	Sound Pressure Level at 10m $L_{Aeq,T}$(dB)	Number of the Same/Similar Plant Items Operating Simultaneously on Site	Duration On time % (Typical % of a Construction Day that the Plant will be Operating)
	Tower Crane	Lifting: Tower crane C.4 #48	C.4 #48	76		50
	Ready mix concrete delivery lorry	Mixing concrete: Large lorry concrete mixer C.4 #21	C.4 #21	77	1	50
	Concrete pump	Pumping concrete: Concrete pump + cement mixer truck (discharging) C.4 #24	C.4 #24	67	1	50
	Handheld vibrating pokers	Concreting other: Poker vibrator C.4 #33	C.4 #33	78	1	50
	Mobile rock crusher	Crushing concrete/rubble: Tracked crusher C.1 #15	C.1 #15	84	1	50
Superstructure	Articulated low loader lorry	Loading lorries: Wheeled loader C.2 #26	C.2 #26	79	1	30
	Tower crane	Lifting: Tower crane C.4 #48	C.4 #48	76	2	50
	Mobile Crane	Lifting: Mobile telescopic crane C.4 #39	C.4 #39	77	1	50

Construction Activity	Plant	Assumed BS5228 plant	BS5228 plant reference	Sound Pressure Level at 10m $L_{Aeq,T}$(dB)	Number of the Same/Similar Plant Items Operating Simultaneously on Site	Duration On time % (Typical % of a Construction Day that the Plant will be Operating)
	Spider Crane	Lifting: Wheeled mobile telescopic crane C.4 #38	C.4 #38	78	1	50
	MEWP	Lifting: Lifting platform C.4 #57	C.4 #57	67	1	30
	Ready mix concrete delivery lorry	Mixing concrete: Large lorry concrete mixer C.4 #21	C.4 #21	77	1	50
	Concrete pump	Pumping concrete: Concrete pump + cement mixer truck (discharging) C.4 #24	C.4 #24	67	1	50
	Handheld vibrating pokers	Concreting other: Poker vibrator C.4 #33	C.4 #33	78	1	50
	Access scaffold and staircases	Clearing site: Wheeled backhoe loader C.2 #8	C.2 #8	68	1	40
Roof	Articulated low loader lorry	Loading lorries: Wheeled loader C.2 #26	C.2 #26	79	1	50
	Tower crane	Lifting: Tower crane C.4 #48	C.4 #48	76	2	50

Construction Activity	Plant	Assumed BS5228 plant	BS5228 plant reference	Sound Pressure Level at 10m $L_{Aeq,T}$(dB)	Number of the Same/Similar Plant Items Operating Simultaneously on Site	Duration On time % (Typical % of a Construction Day that the Plant will be Operating)
	Mobile Crane	Lifting: Mobile telescopic crane C.4 #39	C.4 #39	77	1	50
	MEWP	Lifting: Lifting platform C.4 #57	C.4 #57	67	1	30
	Access scaffold	Clearing site: Wheeled backhoe loader C.2 #8	C.2 #8	68	1	40
Works to Anfield Road Stand including site preparation and steel frame erection	Mobile Crane	Lifting: Mobile telescopic crane C.4 #39	C.4 #39	77	1	50
	Dozer	Ground excavation/earthworks: Dozer C.2 #10	C.2 #10	80	1	50
	Tracked Excavator	Clearing site: Tracked excavator C.2 #2	C.2 #2	77	1	50
	Dumper Truck	Distribution of material: Dump truck (tipping fill) C.2 #30	C.2 #30	79	1	50
	Wheeled Loader	Clearing site: Wheeled backhoe loader C.2 #8	C.2 #8	68	1	50
	Tipper Wagons	Distribution of material: Dump truck (tipping fill) C.2 #30	C.2 #30	79	1	50
	Tower crane	Lifting: Tower crane C.4 #48	C.4 #48	76	2	50
	Mobile crane	Lifting: Mobile telescopic crane C.4 #39	C.4 #39	77	1	50

Construction Activity	Plant	Assumed BS5228 plant	BS5228 plant reference	Sound Pressure Level at 10m $L_{Aeq,T}$(dB)	Number of the Same/Similar Plant Items Operating Simultaneously on Site	Duration On time % (Typical % of a Construction Day that the Plant will be Operating)
	Lightweight Crane	Lifting: Wheeled mobile telescopic crane C.4 #38	C.4 #38	78	1	50
	Spider Crane	Lifting: Wheeled mobile telescopic crane C.4 #38	C.4 #38	78	1	50
	Hand Held Gas Cutter	Breaking up/cutting steel: Gas cutter C.1 #18	C.1 #18	79	2	40
	Articulated low loader lorry	Loading lorries: Wheeled loader C.2 #26	C.2 #26	79	1	50
	Tipper Wagon *	Distribution of materials: Wheeled backhoe loader C.4 #14	C.4 #14	67	1	50
Demolition of Anfield Road Stand Roof and Seating Tier	Tower crane	Lifting: Tower crane C.4 #48	C.4 #48	76	2	50
	Mobile crane	Lifting: Mobile telescopic crane C.4 #39	C.4 #39	77	1	50
	Lightweight Crane	Lifting: Wheeled mobile telescopic crane C.4 #38	C.4 #38	78	1	50
	Spider Crane	Lifting: Wheeled mobile telescopic crane C.4 #38	C.4 #38	78	1	50

Construction Activity	Plant	Assumed BS5228 plant	BS5228 plant reference	Sound Pressure Level at 10m $L_{Aeq,T}$(dB)	Number of the Same/Similar Plant Items Operating Simultaneously on Site	Duration On time % (Typical % of a Construction Day that the Plant will be Operating)
	Hand Held Gas Cutter	Breaking up/cutting steel: Gas cutter C.1 #18	C.1 #18	79	2	40
	Articulated low loader lorry	Loading lorries: Wheeled loader C.2 #26	C.2 #26	79	1	50
	Tipper Wagon *	Distribution of materials: Wheeled backhoe loader C.4 #14	C.4 #14	67	1	50
	MEWP	Lifting: Lifting platform C.4 #57	C.4 #57	67	1	30
Road Surfacing	Paving	Paving: Asphalt paver (+ tipper lorry) C.5 #31	C.5 #31	77	1	50
	General wheeled loader operations	wheeled loader	C.10 #9	75	1	50
	Rolling and compaction	Vibratory roller	C.5 #27	67	1	25
	Roller Bomag BW 24	Road Roller	D.8#30	73	1	25

Construction Activity	Plant	Assumed BS5228 plant	BS5228 plant reference	Sound Pressure Level at 10m $L_{Aeq,T}$(dB)	Number of the Same/Similar Plant Items Operating Simultaneously on Site	Duration On time % (Typical % of a Construction Day that the Plant will be Operating)
	Breaking road surface 1	Backhoe mounted hydraulic breaker	C.5 #1	88	1	60
	Road planing	Road planer	C.5 #7	82	1	60

The assessment of likely significant effects as a result of the Proposed Scheme has taken into account the durations for the construction activities shown in **Table A11.3.5** based upon the provisional construction programme.

Table A11.3.5 Duration of Construction Activities

Activity	Duration (months)	Description of works
Foundations and substructure	7	Construction of foundation pads and steel frame structure that will support the concrete floors in the stand.
Superstructure	12	Construction of core stairwells and concrete floors of stands.
Roof	9	Prefabricated roof structures delivered to site for bolting together. Roof structures lifted into place by cranes. Removal of existing upper tier once new grandstand is complete.
Works to Anfield Road Stand	3	Site clearance and steel frame erection.
Existing upper tier and roof demolition	3	The existing roof of the Anfield Road Stand will be subject to demolition as will the steel and concrete upper tier. Components would be dismantled by unbolting and using gas cutters and lowered by a crane onto a working platform and then cut up into smaller sections before being lowered to the ground and removed.
Road surfacing	3	Closure of Anfield road, construction of new road with automatic rising bollards along it's length.

The assessment of construction noise has taken into account the existing baseline noise environment. Representative baseline noise levels have been assigned to areas around the stand based on a series of environmental noise surveys undertaken at the site and surrounding area, a summary of which is presented in **Table A11.3.6:** Summary of Daytime Noise Levels at Residential Areas Surrounding the Proposed Scheme (refer to Appendix 11.2 for full details of noise surveys). Noise surveys focussed on the measurement of noise levels representative of residences away from the relatively noisy Walton Breck Road. In order to define the ambient noise levels for receptors exposed directly to traffic noise from Walton Breck Road, DEFRA noise mapping, accessed through the DEFRA data services platform[i] was consulted.

Table A11.3.6: Summary of Daytime Noise Levels at Residential Areas Surrounding the Proposed Scheme.

Representative Measurement Location	Description of Receptors	Ambient Noise Level $L_{Aeq,T}$ dB (daytime)
Noise Level Derived from DEFRA noise mapping	Receptors situated to the south of the stadium directly exposed to traffic noise from Walton Breck Road	73 $L_{Aeq,16hour}$
LT1	Receptors situated to the west of the stadium remote from Walton Breck Road including: Alroy Road, Gilman Street, Sibyl Street, Rockfield Road and Parts of Anfield Road.	55 $L_{Aeq,9hour\ (1400\text{-}23.00)}$
LT2	Receptors situated to the east of the Stadium remote from Walton Breck Road including Skerries Road, Arkles Lane, Wylva Road, Arkles Road and Parts of Anfield Road	53 $L_{Aeq,16hour}$

The study considered those sensitive receptors most likely to experience changes in levels of noise and vibration due to construction of the development. Those receptors lie principally within the network of residential streets immediately outside the red-line boundary of the development as shown in **Figure 1.1, Chapter 1.**

Using the methodology set out in Annex F of BS 5228-1 the radius from works at which construction noise will reduce to $L_{Aeq,T}$ 65 dB and $L_{Aeq,T}$ 75 dB has been determined for each activity. These are the threshold for potential significance of construction noise depending upon duration of works. This radius holds for receptors where there is direct, unobstructed line of sight to construction activity.

As receptors are predominantly situated to the west and east of the Proposed Scheme, the stand construction noise source location for receptors to the west has been assumed to be in line with the north western extent of the proposed stand. To the east the source location has been assumed to be the south eastern extent of the proposed stand. Predictions of construction noise have not assumed the source position to be the boundary of the construction site for the Proposed Scheme because this would result in overestimation of noise level. Hard acoustically reflective ground conditions were assumed for the distance correction used for the predictions.

Table A11.3.7 details the distances from the works for each activity at which the noise levels from construction are predicted to fall below $L_{Aeq,T}$ 75 dB façade and $L_{Aeq,T}$ 65dBA free field.

Table A11.3.7: Distance from construction activities at which noise levels fall below $L_{Aeq,T}$ 75dBA façade and 65dBA free field.

Activity	Foundations and Substructure	Superstructure	Roof	Works to Anfield Road Stand	Existing upper tier and roof demolition	Road surfacing
Distance (m) at which construction noise level falls to $L_{Aeq,T}$ 65 dB free field	175	81	62	122	91	136
Distance (m) at which construction noise level falls to $L_{Aeq,T}$ 75 dB facade	78	36	27	54	41	61

Noise sensitive receptors which fall within the radius of works presented in **Table A11.3.6** have been identified. Where it is judged that there is partial shielding afforded from the works, for example from intervening buildings, a -10dB shielding correction has been assumed when determining the construction noise level at the receptor. Where there is partial shielding afforded from works from intervening buildings, a -5dB shielding correction has been assumed. This means that not all residences which fall within the radii given in **Table A11.3.6** are subject to a potential significant effect.

During the demolition phase of the Anfield Road Stand some properties may have line of sight to the some of the works. However, it is anticipated that the demolition is likely to happen from the pitch side of the Stand and therefore surrounding properties may be afforded a level of shielding from the surrounding stands and the Anfield stand itself until demolition is complete. This has been assumed for prediction purposes.

Properties located near the junction of Anfield Road and Alroy or Skerries Roads and properties on Anfield Road are likely to have partial line of sight to the construction activities during the superstructure, roof and foundation construction phases. A -5dB shielding correction has been assumed for these receptors.

Where noise sensitive receptors fall within the radius from works at which SOAEL of $L_{Aeq,T}$ 65 dB free field has been reached or exceeded, consideration has been given as to whether the total of construction noise added to baseline noise level results is an increase of at least 5 dB above baseline. If that is the case, and coincides where the construction activity is scheduled to last for one month or more, a significant adverse effect is considered to be likely. Note that at the time of writing, the construction programme indicates that all construction activities assessed with exceed a duration of one month. The noise sensitive receptors where a significant adverse effect is predicted are shown for each construction activity in Tables **A11.3.8 to A11.3.13.**

A “*” against the receptor location in the tables indicates the combination of construction noise level to exceed $L_{Aeq,T}$ 75 dB (façade), and therefore the potential for significant adverse effect, and activities to last for a shorter duration than one month.

Foundations and substructure **-** Construction of foundation pads and steel frame structure that will support the concrete floors in the stand.

Table A11.3.8: Calculation of Significance of Construction Noise due to Foundation and Substructure Works.

Representative baseline ambient noise measurement location	**Representative daytime baseline noise level $L_{Aeq,T}$(dB)**	**Construction noise level ≥ 65 dB**	**Total noise level with construction ≥ Baseline + 5dB**	**Duration of Effect ≥ 1 month**	**Properties experiencing significant adverse effect**
LT1	55	Yes	Yes	Yes	2-24 Alroy Rd, 128-144 Anfield Rd, 33-45 Anfield Rd
LT2	53	Yes	Yes	Yes	73-75 Anfield Rd*, 77-85 Anfield Rd, 250-252 Anfield Rd*, 254-268 Anfield Rd, 1-29 Skerries Rd, 31-39 Skerries Rd*

** Properties falling in the 75dBA (façade) noise radius.*

Superstructure - Construction of core stairwells and concrete floors of stands.

Table A11.3.9: Calculation of Significance of Construction Noise due Superstructure Works.

Representative baseline ambient noise measurement location	Representative daytime baseline noise level $L_{Aeq,T}$(dB)	Construction noise level ≥ 65 dB	Total noise level with construction ≥ Baseline + 5dB	Duration of Effect ≥ 1 month	Properties experiencing significant adverse effect
LT2	53	Yes	Yes	Yes	75 Anfield Rd, 250-252 Anfield Rd, 31-39 Skerries Rd, 73 Anfield Rd*

** Properties falling in the 75dBA (façade) noise radius.*

Roof - Prefabricated roof structures delivered to site for bolting together. Roof structures lifted into place by cranes. Removal of existing upper tier once new grandstand is complete.

Table A11.3.10: Calculation of Significance of Construction Noise due Roof Works.

Representative baseline ambient noise measurement location	Representative daytime baseline noise level $L_{Aeq,T}$(dB)	Construction noise level ≥ 65 dB	Total noise level with construction ≥ Baseline + 5dB	Duration of Effect ≥ 1 month	Properties experiencing significant adverse effect
LT2	53	Yes	Yes	Yes	73-75 Anfield Rd, 37-39 Skerries Rd

** Properties falling in the 75dBA (façade) noise radius.*

Works to Anfield Road Stand – Including site clearance and steel frame erection.

Table A11.3.11: Calculation of Significance of Construction Noise due Works to Anfield Road Stand.

Representative baseline ambient noise measurement location	**Representative daytime baseline noise level $L_{Aeq,T}$(dB)**	**Construction noise level ≥ 65 dB**	**Total noise level with construction ≥ Baseline + 5dB**	**Duration of Effect ≥ 1 month**	**Properties experiencing significant adverse effect**
LT1	55	Yes	Yes	Yes	45 Anfield Rd, 140-144 Anfield Rd, 2-12 Alroy Rd
LT2	53	Yes	Yes	Yes	17-37 Skerries Rd, 75 Anfield Rd, 250-260 Anfield Rd, 73 Anfield Rd*, 39 Skerries Rd*

** Properties falling in the 75dBA (façade) noise radius.*

Existing upper tier and roof demolition - The existing roof of the Anfield Road Stand will be subject to demolition as will the steel and concrete upper tier. Components would be dismantled by unbolting and using gas cutters and lowered by a crane onto a working platform and then cut up into smaller sections before being lowered to the ground and removed.

Table A11.3.12: Calculation of Significance of Construction Noise due to Existing Upper Tier and Roof Demolition Works.

Representative baseline ambient noise measurement location	**Representative daytime baseline noise level $L_{Aeq,T}$(dB)**	**Construction noise level ≥ 65 dB**	**Total noise level with construction ≥ Baseline + 5dB**	**Duration of Effect ≥ 1 month**	**Properties experiencing significant adverse effect**
LT2	53	Yes	Yes	Yes	75 Anfield Rd, 250-254 Anfield Rd, 27-39 Skerries Rd, 73 Anfield Rd*

** Properties falling in the 75dBA (façade) noise radius.*

Construction of new Anfield Road Alignment **-** Closure of Anfield road, construction of new road with automatic rising bollards along it's length.

Table A11.3.13: Calculation of Significance of Construction Noise due to Road Surfacing Works.

Representative baseline ambient noise measurement location	**Representative daytime baseline noise level $L_{Aeq,T}$(dB)**	**Construction noise level ≥ 65 dB**	**Total noise level with construction ≥ Baseline + 5dB**	**Duration of Effect ≥ 1 month**	**Properties experiencing significant adverse effect**
LT1	55	Yes	Yes	Yes	41-45 Anfield Rd, 136-144 Anfield Rd, 2-8 Alroy Rd
LT2	53	Yes	Yes	Yes	77-81 Anfield Rd, 256-266 Anfield Rd, 5-27 Skerries Rd, 29-39 Skerries Rd*, 73-75 Anfield Rd*, 250-254 Anfield Rd*

** Properties falling in the 75dBA (façade) noise radius.*

Mitigation for construction noise

Limits for normal working hours will be agreed in advance with LCC and incorporated into the contract specification for the development. The contract will also include a clause requiring that the best practicable means for noise control be applied at all times.

Application of Best Practicable Means (BPM) as defined in Section 72 of the Control of Pollution Act 1974 can be implemented through a Construction Environmental Management Plan (CEMP), based on good industry practice. Construction activities will be limited to daytime only.

As a minimum requirement, best practical means should be applied to manage noise emissions from construction works. Typical means by which noise may be controlled include the following:

- Selecting quiet equipment;
- Use of mains electrics instead of generators;
- Ensure equipment is maintained, in good working order, and is used in accordance with the manufacturer's instructions;
- Members of the construction team should be trained and advised on quiet working methods;
- Equipment should not be left running unnecessarily;
- Equipment should be fitted with silencers or mufflers;
- Use plant enclosures whenever feasible;
- Use temporary acoustic screens around small works where feasible;
- Careful orientation of plant with directional features away from sensitive receptors;
- Materials should be lowered instead of dropped from height;
- Inform nearby noise sensitive receptors in advance of construction activities and keep them up to date with progress and changes to works. A letter drop to residents will be made in this instance; and
- Give nearby noise sensitive receptors a site contact telephone number; the contact should liaise with residents and maintain good rapport prior to and during construction works.

Consideration of Noise Effects of Construction Compound

The main construction compound to be located at the rear of the club parking directly opposite the stand on Anfield Road, within the boundary of Stanley Park. This location is remote from noise sensitive receptors.

Detailed information on plant and usage of the compound is not anticipated to be available until the detailed design stage of the scheme. It is likely that equipment such as heavy vehicles, cranes and forklift trucks will access the compound, which will generate noise on an intermittent basis. The compound is likely to have welfare facilities which may require the use of a generator.

Likely noise mitigation will include:

- Acoustic enclosure of external plant such as generators;
- Temporary noise barriers where there are sensitive receptors close by;

- Restrictions on delivery times; and
- Appropriate location of ingress and egress point.

No significant adverse noise and vibration effects are anticipated due to operation of the compound.

Consideration of Noise Effects of Construction Traffic

The movement of construction workers has been considered. It is anticipated that the majority of these would drive to the vicinity of the site and make use of Stanley Park car park. The intensity of construction workers on site will be finalised within the CEMP, together with details of any shift working or private transport provisions (such as shuttle buses).

A prediction of change in basic noise level (BNL) has been undertaken based upon projected construction traffic flows compared with baseline traffic flows provided by Mott MacDonald transportation engineers. The prediction was undertaken using the methodology set out in Calculation of Road Traffic Noise (CRTN)[ii] The roads considered were Priory Road, Arkles Lane and Anfield Road which are the likely access routes for construction traffic. The results of the prediction are set out in **Table A11.3.14.**

Table A11.3.14: Predictions of Change in BNL Due to Construction Traffic Flows

Road	BNL Do Minimum (dB)	BNL With Construction Traffic (dB)	BNL Change (dB)
Anfield Road	61.8	62.1	+0.4
Priory Road	64.1	64.4	+0.3
Arkles Lane	64.9	65.1	+0.2

Predicted changes in noise level were less than $L_{A10,T}$ +1 dB.

Reference to Design Manual for Roads and Bridges (DMRB) Volume LA111, Noise and vibration Rev 0[iii] which defines a scale of impact for traffic noise change (See Chapter 11 Table 11.5) indicates that the predicted temporary changes should be considered of negligible impact.

No significant adverse noise effects are anticipated due to construction traffic.

Consideration of Noise Effects of Diverted Traffic During Construction

Anfield road will be closed to through traffic during construction of the Proposed Scheme and through traffic diverted. Mott MacDonald transportation engineers have provided predictions of changes in traffic flow along potential diversion routes which include Walton Lane, Arkles Lane, Priory Road and Walton Breck Road Conservative predictions of change in BNL based upon projected flows of diverted traffic compared with baseline traffic flows have been undertaken. The prediction was undertaken using the methodology set out in Calculation of Road Traffic Noise (CRTN). Predicted changes in noise level were less than $L_{A10,T}$ +3 dB. This is considered to represent a minor impact.

The results of the prediction are set out in **Table A11.3.15.**

Table A11.3.15: Predictions of Change in BNL Due to Traffic Diverted from Anfield Road

Road	BNL Do Minimum (dB)	BNL With Diverted Traffic (dB)	BNL Change (dB)
Priory Road	64.1	65.4	1.3
Arkles Lane	64.9	66.1	1.2
Walton Lane	69.6	70.1	0.5
Arkles Road	59.0	60.9	1.9
Wylva Road	59.1	61.3	2.2
Walton Breck Road	63.9	65.8	1.9

Predicted changes in noise level were less than $L_{A10,T}$ +1 dB.

Reference to Design Manual for Roads and Bridges (DMRB) Volume LA111, Noise and vibration Rev 0[iv] which defines a scale of impact for traffic noise change (See Chapter 11 Table 11.5) indicates that the predicted temporary changes should be considered of negligible or minor impact.

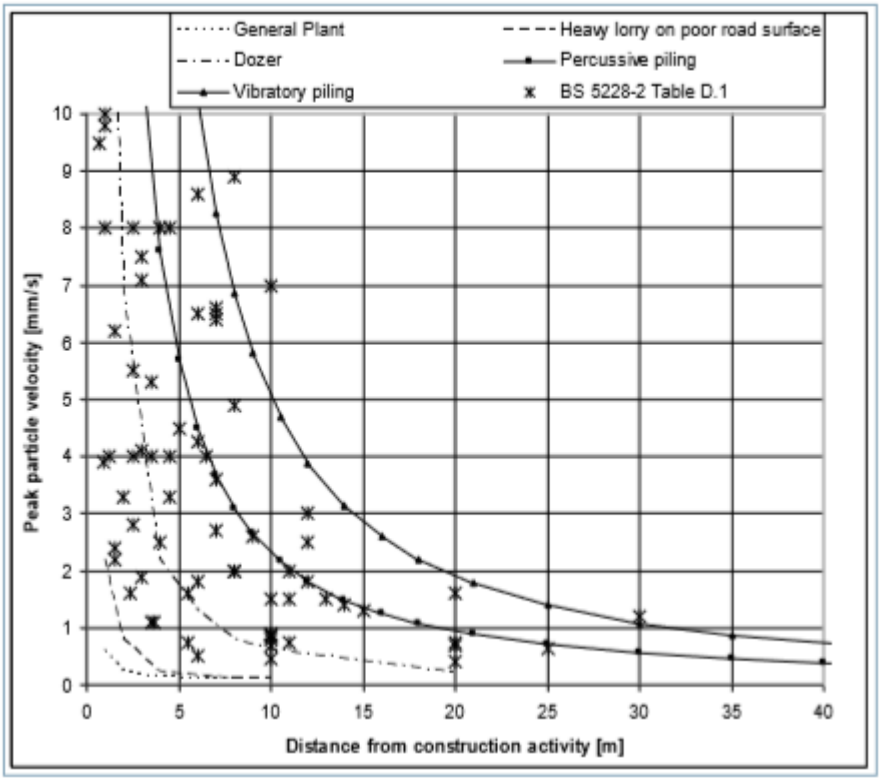
No significant adverse noise effects are anticipated due to diverted traffic during construction.

Vibration

Assessment of vibration effects has assumed the red line boundary as the closest potential location for vibration producing activities, such as passage of construction plant.

BS 5228 –2 provides empirical relationships between various construction operations and vibration PPV as a function of distance. Some of these values and those from TRL Report 53[v] have been plotted – see **Chart A11.3.1.**

Chart A11.3.1 Vibration levels for Construction Plant using Data in BS5228-2 and TRL Report 53.



No piling work is anticipated during the construction of the Proposed Scheme. Reference to Chart A11.3.1 indicates that for general construction plant and vehicle movements exceedance of SOAEL of PPV 1.0 mm/s would only be anticipated at vibration sensitive receptors within 2m of the plant.

Generally, sensitive receptors are located at a distance of more than 8m from the works. The façade of one property lies along the red line boundary of the Proposed Scheme: 39 Skerries Road. This property has the potential to experience a significant adverse effect from construction vibration, should works involving heavy plant approach the boundary. It should be noted however that any vibration impacts from construction would be transient, for example the passage of an excavator, crawler crane or other construction vehicle, and unlikely to occur for one hour or more, further reducing the likelihood of significant adverse effects. Construction vibration is likely to be lower than the PPVs of 7mm/s (refer to BS6472[vi]) or more which would have the potential to cause cosmetic damage to properties.

Mitigation for Vibration Generated by Construction

Secondary mitigation to limit the adverse effects of construction vibration should include:

- Minimising operation of heavy plant within 8m of vibration sensitive receptors; and
- Avoid approach of heavy plant to within 2m of vibration sensitive receptors if reasonably practicable.

Post application of the suggested mitigation, no significant adverse effects are anticipated due to construction vibration.

[i] https://environment.data.gov.uk/spatialdata/road-noise-laeq-16h-england-round-3/wms
[ii] DoT, 1988. Calculation of Road Traffic Noise (CRTN)
[iii] Highways England, 2019. Design Manual for Roads and Bridges (DMRB) Volume LA111, Noise and vibration Rev 0
[iv] Highways England, 2019. Design Manual for Roads and Bridges (DMRB) Volume LA111, Noise and vibration Rev 0
[v] TRANSPORT RESEARCH LABORATORY, 1986. Ground vibration caused by civil engineering works (Research report 53)
[vi] BSI,2008. British Standard BS 6472 Guide to evaluation of human exposure to vibration in buildings Part1: Vibration sources other than blasting