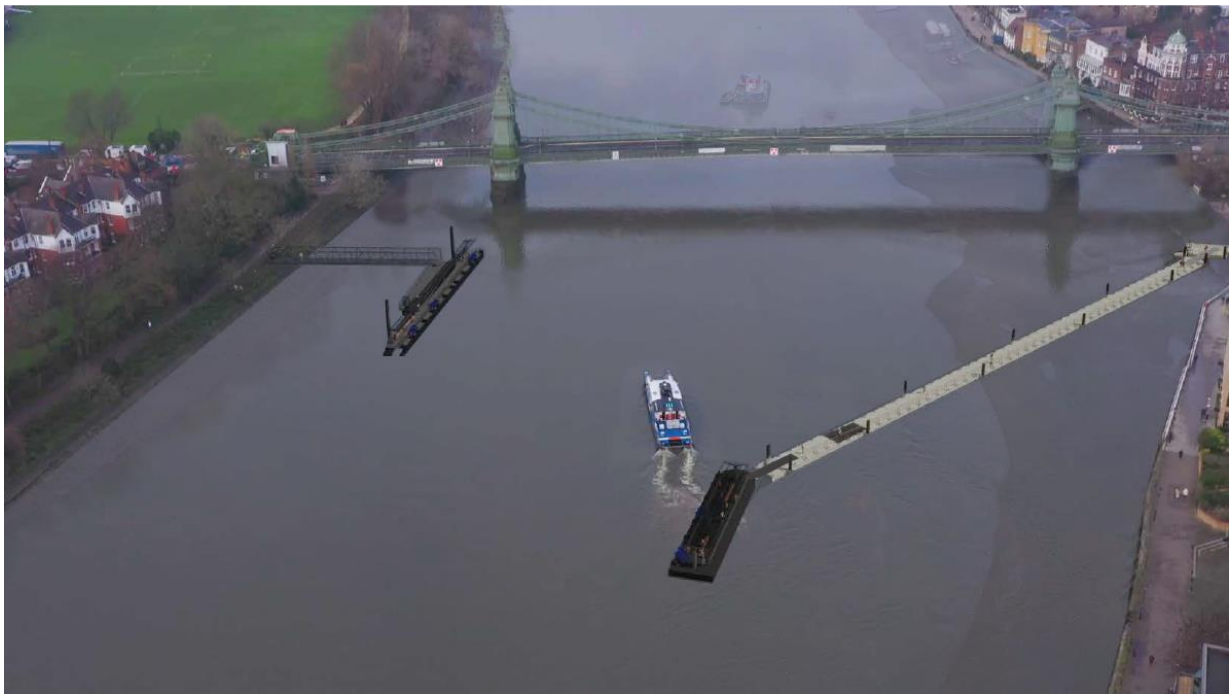
Transport for London

Hammersmith Temporary Ferry Service

Planning Application

Noise & Vibration Assessment



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List of Abbreviations

A-weighting	Frequency weighting applied to measured sound in order to account for the relative loudness perceived by the human ear.
Acoustic Environment	The sound emitted from all sources as modified by the environment.
Ambient sound	The totally encompassing sound in a given situation at a given time, usually composed of sound from many sources near and far.
Ambient Sound level	The $L_{Aeq,T}$, of the totally encompassing sound in a given situation at a given time, usually from many sources near and far, at the assessment location over a given time interval, T.
Background Sound Level	The underlying level of sound over a period, T, and is represented by $L_{A90,T}$.
Decibels (dB)	A measure of sound pressure level in decibels, as specified BS EN 61672-2:2003 Electroacoustics. Sound level meter.
dB(A)	A measure of sound pressure level, in decibels, with a frequency weighting (A-weighting) derived to take into account the fact that human response to sound is not equally sensitive to all frequencies.
Façade Level	A measurement that is undertaken within the acoustic influence of a reflective façade. BS 8233:2014 Guidance on sound insulation and noise reduction for buildings states that façade level measurement is typically 1 dB to 2 dB higher than corresponding free-field measurements because of the reflection from the façade.
Fast Time Weighting	A time interval of 125 milliseconds (ms) that the sound level meter records sound levels.
Free-field Level	A measurement that is undertaken away from the acoustic influence of a reflective façade.
Hertz (Hz)	The unit of measurement for frequency of a sound wave which measures the number of waves per second.
$L_{Aeq,T}$	A-weighted equivalent continuous sound level over a given time period. It is the sound level of a steady sound that has the same energy as a fluctuating sound over the same time period.

$L_{Aeq,1ohour}$	A-weighted equivalent continuous sound level over the period 0800-1800hrs. It is the sound level of a steady sound that has the same energy as a fluctuating sound over the same time period.
LBHF	London Borough of Hammersmith and Fulham
mms^{-1}	Mili-metres per second
Noise	A term used to describe "unwanted sound" or any sound that is undesired by the recipient.
PPV	Peak Particle Velocity (mms^{-1})
Sound	Any pressure variation that the human ear can detect. Depending on the medium, sound extends and affects a greater area (propagates) at different speeds. In air, sound propagates at a speed of approximately 343 m/s. In liquids and solids, the propagation velocity is greater - 1480 m/s in water and 5120 m/s in steel, for example.
Sound Level Meter (SLM)	The instrument used for acoustic (sound that travels through air) measurements. It is commonly a hand-held instrument with a microphone. The diaphragm of the microphone responds to changes in air pressure caused by sound waves.
Sound Power Level (L_w)	The total sound energy radiated by a source per unit of time.
Sound Pressure Level (L_p)	Sound pressure level is the RMS value of the Instantaneous Sound Pressures measured over a specified period of time, measured in decibels (dB) to a given reference pressure level.
TfL	Transport for London

1 Introduction

1.1 Introduction

1.1.1 This noise and vibration assessment report has been produced by Noise Consultants Limited ('NCL') on behalf of Thames Clippers for Transport for London (Tfl), in support of full planning applications for a temporary ferry service spanning the River Thames between Hammersmith (on the north) and Barnes (on the south). This temporary ferry service will be in service while the Grade II* listed Hammersmith Bridge, which is closed to road traffic, undergoes repairs.

1.1.2 Full planning permission is sought for the development of the scheme under the Town and Country Planning Act 1990 (as amended). The two piers are formed of similar structures which seek to respond to the immediate surroundings and their interaction with the respective land site environments.

1.1.3 The information in this report is set out in a format that could, where necessary, be used to support a Section 61 Application under the Control of Pollution Act (CoPA, 1974) (the 'S61 Application').

1.1.4 A brief summary of the proposed schemes is provided below. For additional detail please refer to the Design and Access Statement prepared by Beckett Rankine enclosed with this application.

Hammersmith and Fulham

1.1.5 The proposed Hammersmith Pier is to land on the slipway located at the end of Queen Caroline Street. The slipway is seldom used and is closed off with timber flood boards. Access to the pier is to be via a lightweight steel ramp which will span over the flood boards.

1.1.6 A 125m long modular floating walkway (using units by EZ Dock) will span between the flood defence wall and a second-hand barge, modified for use as a pier. The walkway will be restrained by 12 tubular piles of up to 0.5m diameter. The required piling is to be minimised to avoid major impacts and disturbance of the river environment.

1.1.7 The barge will be restrained by a pair of spud legs – these have been selected given their temporary nature and lesser impact when compared to piles. The pier is skewed downstream to facilitate passage of large vessels beneath Hammersmith bridge (the bridge is open for occasional navigation when no works are in progress on the bridge).

1.1.8 The Description of Development for the London Borough of Hammersmith and Fulham is as follows:

1.1.9 *Erection of a new river pier, associated walkway and landing for a temporary period of up to three years for the purpose of providing a passenger and cyclist ferry service associated with the temporary closure of Hammersmith Bridge; the application also includes public realm works, including a new temporary pedestrian ramp for access, hard landscaping scheme, relocation of cycle parking and the reduction in height of the river wall.*

Richmond

1.1.10 The proposed Barnes Pier is formed from the old Savoy pier, itself a temporary structure, which will be repurposed for this development. The pontoon will be modified such that is restrained by a pair of spud legs rather than its current radial arms to minimise impact on the foreshore.

1.1.11 Access to the pier is by a 35m aluminium linkspan, with clear width 2.5m, connecting to the landside tow path.

1.1.12 The towpath is located beneath flood defence level and floods on large tides. As part of the works, a 45m lightweight steel frame walkway will be installed to allow dry access to the pier, the clear width of this structure will be a minimum of 2.5m to suit segregated pedestrian and cycle traffic.

1.1.13 The Description of Development for the London Borough of Richmond upon Thames is as follows:

1.1.14 *Erection of a new river pier, associated walkway and landing for a temporary period of up to three years for the purpose of providing a passenger and cyclist ferry service associated with the temporary closure of Hammersmith Bridge; the application also includes public realm works, including a new temporary pedestrian walkway and landscaping scheme.*

1.2 Scope of the Assessment

1.2.1 The construction of the piers for the ferry service has been designed to minimise cumulative effects with the adjoining Hammersmith Bridge works and impacts on the local community, however, there would remain the potential to generate noise emissions which may impact nearby residential properties.

1.2.2 The construction works may also lead to changes in vehicle flows on local roads, which may change noise levels at nearby residential properties.

1.2.3 The proposed ferry service will be provided for pedestrians, cyclists, wheelchairs and mobility scooters. It is assumed that there could potentially be some operational traffic associated with the ferry service, in terms of drop off and pick up. However, this number is expected to be significantly less than traffic that would have been associated with the open Hammersmith Bridge, and there is the potential for reduced vehicle movements more generally due to the provision of the ferry service. It is therefore assumed that the scheme will not significantly affect traffic flows on the local road network and thus during its operational life there are judged to be no significant noise impacts due to road traffic. As such, road traffic impacts during the operational phase are not considered further.

1.2.4 Access to the ferries will be via new piers reached by extended walkways into the river. Noise emissions from the ferries will, therefore, be at some distance from existing, sensitive receptors. The ferries are scheduled between 6:00-22:00 during weekdays at a frequency of 5-7 minutes and 8:00-22:00 during weekends leaving every 10-12 minutes. The ferries will therefore be alongside the piers for short periods of time. In addition, the pier layout has been designed to make use of the tide to reduce engine load and thus emissions.

1.2.5 The scope of the noise and vibration assessment includes consideration of:

- Construction road traffic noise – changes in road traffic noise on the surrounding road network associated with additional traffic required for the proposed scheme;
- Construction noise (fixed and mobile plant) – noise from fixed and mobile construction plant during the construction phasing;
- Construction vibration – emissions during construction activities with the potential to cause vibration induced adverse effects at sensitive receptors; and
- Operational noise – ferry engine noise emissions from during crossings.

1.2.6 Assessment assumptions are made with reference to the Hammersmith Temporary River Crossing Construction Environmental Management Plan (CEMP) Rev C3 25/05/21 and are based on discussions with the construction contractor. The final method and construction plant lists may change from those considered within this report subject to input from the appointed sub-contractors. Any diversions from the assumptions in this report which are likely to increase the predicted noise impact will be suitably reflected and addressed within the associated S61 Application.

1.2.7 Based on the information available at the time of the assessment, construction road traffic noise on the road network surrounding the proposed scheme has been considered qualitatively.

1.2.8 Noise impacts from construction traffic movements within the construction site boundary have been undertaken qualitatively, along with consideration of noise emissions from fixed sources, based on predicted construction phasing plant lists.

1.2.9 The prediction of vibration levels requires an understanding of the many factors which contribute to its propagation characteristics. These generally include an understanding of the source, intermediate ground structure, and receiving structure properties. Vibration levels to inform the assessment have been determined within reference to empirical formula.

1.2.10 The operational ferries will be powered by two John Deere PowerTechTM 9.0L Engine, Rated Power 317 kW, 425 hp (Model 6090SFM85), considered to be the main noise source. It is understood that a majority of the time the engines will be idling, or under low power. The associated engine performance sheets do not include noise emission data, therefore assumed noise emission data has been taken from BS 5228-1:2009 +A1:2014
'Code of practice for noise and vibration control on construction and open sites. Part 1: Noise and Vibration' (BS5228, 2014).

1.2.11 The adopted assessment methodology is supported by pertinent British Standards and Guidance, and the process outlined in Appendix A of the London Borough of Hammersmith and Fulham (LBHF) 'Procedure and Guidance Note for Applications for Prior Consent for Works with regard to noise on Construction Sites under Section 61 of the Control of Pollution Act' (the 'LBHF Guidance'). Requirements of the London Borough of Richmond upon Thames (LBRuT) specific to the management and mitigation of construction noise are consistent with those set out in London Borough of Richmond

upon Thames '*Supplementary Planning Document (SPD) Development Control for Noise Generating and Noise Sensitive Development'* (2018).

1.2.12 The information presented within this report is intended to meet the requirements of the LBHF Guidance technical appendices, and where necessary support a S61 Application. This primarily consists of the requirement to provide: a site layout plan; methods of working; plant and equipment; predicted noise levels; proposed steps to minimise noise and vibration; and monitoring regime.

1.2.13 This report has been prepared taking into account all relevant local and national guidance and regulations.

2 Legislation and Guidance

2.1 Control of Pollution Act (CoPA) 1974

2.1.1 The CoPA (1974) sets out two mechanisms for the management and control of construction noise and vibration on worksites. These are:

2.1.2 Section 60 – used by Local Authorities to place restrictions on how contractors can undertake construction works. Failure to comply with a Section 60 notice under CoPA can lead to prosecution in the Magistrates' Court and a fine; and

2.1.3 Section 61 – used by a contractor to apply for prior consent for noise producing works. The existence of a Section 61 prior consent will act as a formal defence on appeal of a Section 60 Notice if one is later served by the LBHF and LBRuT.

2.1.4 Where a S61 Application is required, it must be submitted to the LBHF for approval at least 28 days prior to the works taking place and should include details, such as the: construction programme; types of plant; and proposed mitigation measures.

2.1.5 A S61 Application is considered to be a pro-active approach to reducing environmental impact.

2.2 Design Manual for Roads and Bridges: Sustainability & Environment Appraisal LA 111 Noise and vibration (DMRB, 2020)

2.2.1 DMRB (2020) provides guidance on undertaking noise and vibration assessments on the impact of road projects. This includes assessing changes in traffic on existing roads, where it outlines the magnitude of impact in the short term and long term.

2.3 BS 5228-1:2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites. Part 1: Noise' (2014)

2.3.1 BS 5228-1:2009+A1:2014 provides recommendations for methods of noise control relating to construction sites that include activities such as demolition, site clearance, ground treatment or related civil engineering works.

2.3.2 It provides guidance on methods of measuring and assessing construction noise impacts, including those associated with construction vehicles travelling on haulage roads to and from the site.

2.3.3 BS 5228-1:2009+A1:2014 sets out a methodology for estimating noise from sites, which allows for typical noise levels to be calculated at locations representative of the assessed noise sensitive receptors. It sets example noise effect thresholds with regards to baseline levels of ambient noise at receptors (the 'ABC Method'), which can be used to assess the potential for significant effect at dwellings.

2.3.4 The ABC Method noise thresholds are reproduced in Table 1.

Table 1: BS 5228-1:2009+A1:2014 'ABC' Noise Impact Thresholds

Period	Category A	Category B	Category C
Day: T = 12 hrs, Weekdays 0700-1900 T = 6hrs, Saturday 0700-1300	>65 dB $L_{Aeq, T}$	>70 dB $L_{Aeq, T}$	>75 dB $L_{Aeq, T}$
Evenings and weekends: T = 1hrs Weekdays 1900-2300, Saturdays 1300-2300 Sundays 0700-2300	>55 dB $L_{Aeq, T}$	>60 dB $L_{Aeq, T}$	>65 dB $L_{Aeq, T}$
Night: T = 1hr, Every day 2300-0700	>45 dB $L_{Aeq, T}$	>50 dB $L_{Aeq, T}$	>55 dB $L_{Aeq, T}$
Notes: All sound levels are defined at the façade of the receptor: -Assessment Category A: impact criteria to use when baseline ambient sound levels (rounded to the nearest 5 dB) are less than these values; -Assessment Category B: impact criteria to use when baseline ambient sound levels (rounded to the nearest 5 dB) are the same as category A values; and -Assessment Category C: impact criteria to use when baseline ambient sound levels (rounded to the nearest 5 dB) are higher than category A values. If the ambient sound level exceeds the Assessment Category C threshold values given in the table (i.e. the ambient sound level is higher than the above values), then an impact is deemed to occur if the construction $L_{Aeq,T}$ sound level for the period is greater than the ambient noise level.			

2.4 BS 5228-1:2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites. Part 2: Vibration' (2014)

2.4.1 Provides recommendations for methods of vibration control relating to construction and open sites where activities have the potential to generate significant levels of vibration.

2.4.2 Where it is not possible to move the proposed construction activities or access traffic routes to a distance from the sensitive premises so as not to cause a complaint in a residential environment, BS 5228-2:2009+A1:2014 sets out vibration guideline values for the likely onset of human response to vibration. These effects are related to vibration in terms of Peak Particle Velocity (PPV mms-1), as summarised in Table 2.

Table 2: BS 5228-2:2009+A1:2014 Guidance on Effects of Vibration Levels

Vibration Limit PPV mms^{-1}	Effect
< 0.14	Vibration unlikely to be perceptible
0.14	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
0.30	Vibration might be just perceptible in residential environments
1.00	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 the residents
10.00	Vibration is likely to be intolerable for any more than a very brief exposure to these levels in most building environments

2.5 BS 8233:2014 'Guidance on Sound Insulation and Noise Reduction for Buildings' (BS 8233, 2014)

2.5.1 BS 8233 (2014) provides guidance for the control of noise in and around buildings. It is applicable to the design of new buildings, or refurbished buildings undergoing a change of use.

2.5.2 BS 8233 (2014) provides noise guidance for buildings of different uses, including a design range of noise criteria for domestic and commercial buildings.

2.5.3 BS 8233 (2014) sets indoor ambient noise criteria, which apply to steady noise sources, such as continuously running plant

2.5.4 For residential properties, indoor ambient noise levels for daytime (0700-2300) resting and sleeping are 35 dB LAeq, 16 hr, and during the night-time (2300-0700) 30 dB LAeq, 8 hr.

2.6 Noise and Vibration Sensitive Receptors

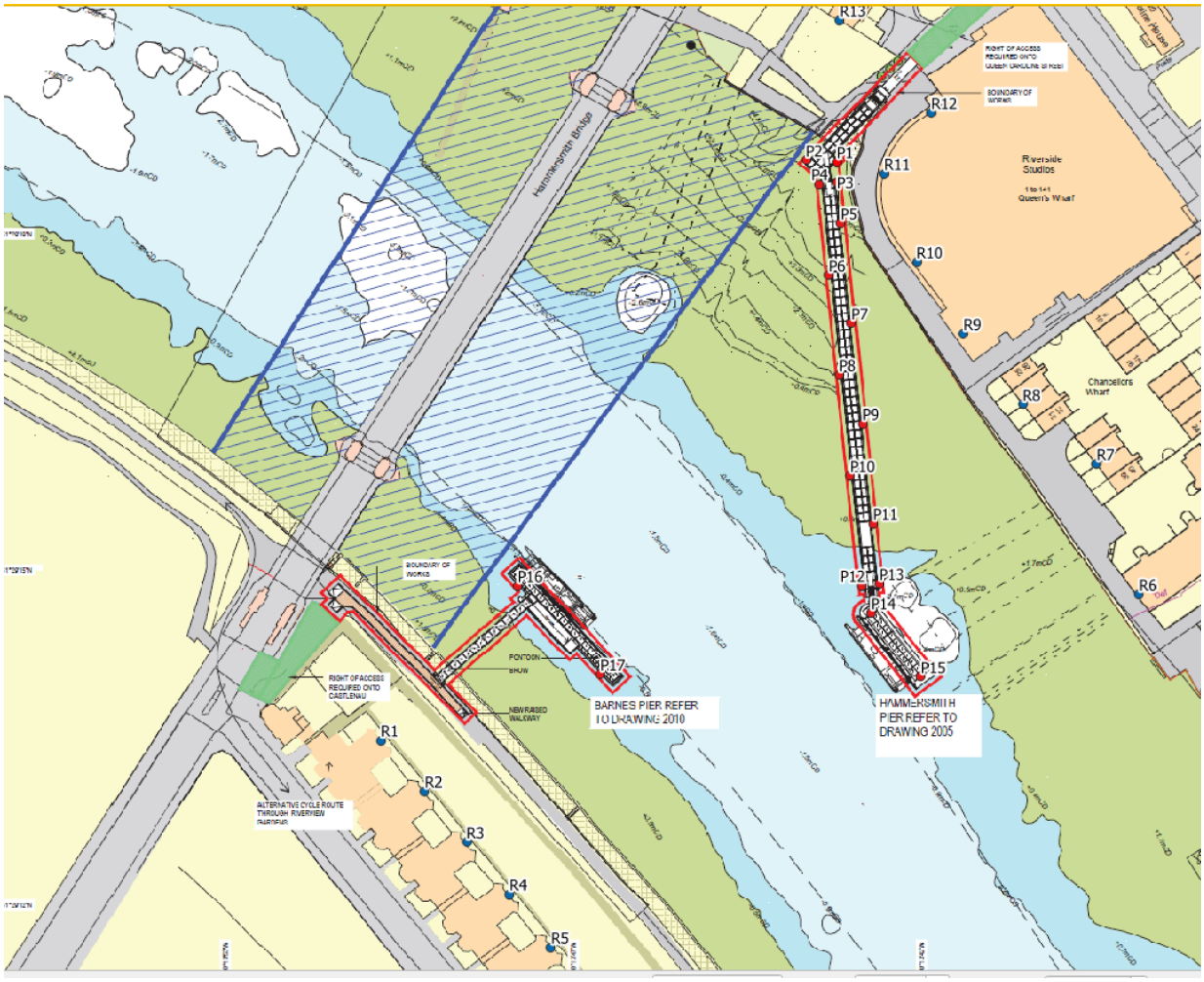
2.6.1 The noise and vibration assessment considered representative sensitive receptors are summarised in Table 3, and shown in Figure 1.

2.6.2 The receptors are considered to be representative of either single or a group of receptors.

Table 3: Assessment Noise and Vibration Sensitive Receptors

Receptor Reference	Receptor Name
R1	1-6 Riverview Gardens
R2	7-12 Riverview Gardens
R3	13-18 Riverview Gardens
R4	19-24 Riverview Gardens
R5	25-30 Riverview Gardens
R6	72 Chancellors Road
R7	35-36 Chancellors Wharf Properties
R8	27-28 Chancellors Wharf Properties
R9	Riverside Studios (river facing)
R10	Riverside Studios (river facing)
R11	Riverside Studios (river facing)
R12	Riverside Studios (Crisp Road facing)
R13	Alexandra House

Figure 1: Assessment Noise and Vibration Sensitive Receptors



3 Methods of Working

3.1.1 Construction is anticipated to begin in early June 2021 with offsite construction activities. Works on site will commence from July 2021 and be completed by the end of August 2021. These dates remain subject to attaining the relevant licensing and consents for the works.

3.1.2 The proposed methods of working are summarised in RED7MARINE 'Construction Environmental Management Plan (CEMP) (R7M-520038-EMP-001, 11/05/2021), and associated drawings.

3.1.3 The first activity on site will be the bathymetric and unexploded ordnance surveys.

3.1.4 The construction includes two temporary piers, one on either side of the river, including a floating walkway, fixed using piles driven into the riverbed. The typical pile locations are shown in Figure 1 (P1 – P17). All piles will be driven by a 160t crawler crane mounted on a spud leg barge. A jack-up barge will act as a piling gate where accessible. In the case of the four most northern piles (P1-P4), a landside excavator will act as the piling gate. Piles will be driven in the dry where possible, and in the minimum water level possible where not possible.

3.1.5 The construction phases and schedule are summarised in Table 4.

Table 4: Construction Phasing

Construction Phase Ref.	Construction Phase	Schedule	Main Noise Producing Activity
1	Site establishment, clearance and alterations	July 2021	Mobilisation
2	Piling – P1-P4	July-August 2021	Piling
3	Piling – P5-P17	July-August 2021	Piling
4	Walkway construction	July-August 2021	Construction

3.1.6 The main noise producing activities, as considered in the noise assessment, are associated with the piling activities (Construction Phase 2 and 3). Distances between the noise and vibration receptors and the typical piling locations shown in Figure 1, have been estimated using aerial photography in order to inform the assessment calculations.

3.1.7 The distances are summarised in Table 5, and are considered conservative as they assume the closest working area to the receptor.

Table 5: Receptors – Construction Phase Distances

Pile Ref	Distance between Pile and Receptor (m)												
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13
P1	213	218	225	233	242	153	115	89	62	37	14	31	41
P2	208	214	221	230	240	159	122	95	68	44	23	39	42
P3	209	213	219	227	237	148	111	84	57	33	14	34	47
P4	205	210	217	225	235	151	114	87	60	36	19	38	48
P5	200	204	210	217	226	138	102	74	48	25	19	41	59
P6	187	190	195	202	211	129	95	67	42	26	34	56	74
P7	182	183	187	193	201	114	82	55	33	26	44	65	88
P8	170	170	173	178	186	108	79	54	38	40	60	81	103
P9	167	165	167	170	177	94	69	47	39	49	73	92	117
P10	156	153	154	156	162	90	71	54	53	65	88	108	132
P11	155	151	149	150	154	80	67	55	61	77	102	120	146
P12	146	140	136	136	138	80	76	70	79	95	120	139	164

P13	151	144	141	140	142	75	72	66	76	94	119	137	164
P14	146	139	134	133	134	78	78	75	85	103	128	146	172
P15	157	147	140	135	133	67	80	84	100	120	146	164	192
P16	60	65	76	90	105	180	171	155	148	149	160	182	189
P17	66	61	62	69	80	157	156	145	144	150	167	189	202

3.1.8 A summary of the construction plant and operations likely to result in the greatest construction noise impacts associated with each phase is summarised in Table 6.

3.1.9 Where necessary, a conservative approach has been undertaken for the selection of assumed construction plant and operations in advance of the finalised methods and plant lists, which would be developed following sub-contractor appointment.

Table 6: Construction Phasing Plant List

Ref.	Phase	Construction Plant
2	Piling P1-P4	Tracked Excavator x 1 160t Crawler Crane x 1 Vibratory piling rig x 1
2	Piling P5-P17	Tracked Excavator (on 100t Jack-Up Barge) x 1 160t Crawler Crane x 1 Vibratory piling rig x 1

4 Assessment Approach

4.1 Construction Road Traffic Noise

Assessment Criteria

4.1.1 Additional road traffic generated by the proposed development has the potential to increase noise levels that will impact noise sensitive receptors, particularly on the local road networks.

4.1.2 The potential magnitude of impact from changes in road traffic noise can be determined using methodologies advocated within the Highways England 'Design Manual for Roads and Bridges' (DMRB, 2020). For construction road traffic noise, DMRB (2020) defines a study area as within 50m width from the kerb line of public roads with the potential for an increase in baseline noise level (BNL) of 1 dB(A) or more as a result of construction traffic to existing traffic levels.

Prediction Methodology

4.1.3 Guidance on the likely relationship between percentage (%) change in road traffic flows and change in noise levels is presented in the now superseded, Highways England

'Design Manual for Roads and Bridges' (DMRB, 2011). The guidance states a change in noise level of 1 dB(A) is equivalent to a 25% increase or 20% decrease in traffic flows.

4.1.4 Baseline road traffic flow information for the road network surrounding the proposed scheme was not available for this assessment, and the trip generation during the construction of the temporary ferry service is not yet finalised, therefore a quantitative understanding of the likely percentage change in road traffic flows could not be undertaken.

4.1.5 However, as the daily number of vehicles is expected to be approximately one per day over the 3-month construction phase, the associated noise impact is predicted to be low.

Proposed Management and Control Measures

4.1.6 No mitigation requirements have been identified by the construction road traffic noise assessment.

4.2 Construction Noise (fixed and mobile plant)

Assessment Criteria

4.2.1 The assessment criteria adopted is in reference to the BS 5228-1:2009+A1:2014 'ABC Method' noise threshold criteria, as shown in Table 1. In the absence of ambient noise information for the areas surrounding the site, given the urban location of the works, Category C criteria has been considered as a 'upper threshold'. The noise assessment criteria, derived in relation to the ABC Method are:

Upper threshold - 75 dB LAeq, T (façade);

Design range - 70 – 75 dB LAeq, T (façade);

Lower design range - 65 – 70 dB LAeq, T (façade).

4.2.2 For construction activities where predicted noise levels are likely to be less than 65 dB LAeq, T during the daytime period, potential significant noise effects at dwellings are unlikely to occur.

4.2.3 For construction activities where predicted noise levels fall into the 'lower design range', potential significant noise effects at dwellings are unlikely to occur assuming on-site contractors adopt BPM and adhere to the requirements of the Construction Plan.

4.2.4 For construction activities where predicted noise levels fall into the 'design range', further consideration is given to likely construction noise impacts in addition to the conservative construction noise impacts which are based on the closest approach between receptor and source.

4.2.5 For construction activities shown to exceed the 'upper threshold' noise criterion, the likely construction noise levels are presented, and where necessary, construction phase or activity specific noise mitigation measures are recommended.

Prediction Methodology

4.2.6 Noise predictions have been undertaken using a spreadsheet noise model adopting calculation methodologies advocated within BS 5228-1:2009+A1:2014. The noise model allows for consideration of the likely effectiveness of noise mitigation and noise reductions from any proposed changes to the working methods.

4.2.7 The noise model considers factors such as:

- the sound power outputs of the processes and plant;
- the periods of operation of processes and plant;
- the distances from sources to receivers;
- the presence of screening by barriers;
- The reflection of sound; and
- ground attenuation.

4.2.8 As a conservative approach, the prediction methodology has assumed all construction plant considered for each construction phase is operating at or near to the closest approach to the considered receptor. The influence of any screening or presence of acoustic barriers is also not considered, and 'hard' ground cover has been assumed.

4.2.9 The associated sound power level information as required for the noise predictions have been taken from those detailed within BS 5228-1:2009+A1:2014, and the assumptions are summarised in Table 7. The operational on-time assumptions are based on correspondence with the construction contractor team.

Table 7: Construction Plant Sound Emission Data

Construction Plant	BS5228 (2014) Proxy	BS5228 (2014) Reference	Assumed % On-Time	Sound Power Level, L_{WA}, dB
Tracked Excavator	Tracked Excavator	C.3 23	33	96
160t Crawler Crane	110t Tracked Mobile Crane	C.3 28	16	95
Vibratory Piling Rig	Vibratory Piling Rig	C.3 8	16	116

Assessment

4.2.10 Conservative estimations of the likely noise impacts from the construction phases referenced in Table 4 and plant assumptions shown Table 6, adopting the noise impact assumptions summarised in Table 7, are summarised for each of the piling locations in Table 8.

Table 8: Receptors – Construction Noise Levels

Pile Ref	Sound Pressure Levels at Receptors, $L_{Aeq, T}$, dB												
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13
P1	<65	<65	<65	<65	<65	<65	65	67	70	75	83	76	74
P2	<65	<65	<65	<65	<65	<65	<65	67	70	73	79	74	74
P3	<65	<65	<65	<65	<65	<65	65	68	71	76	83	76	73
P4	<65	<65	<65	<65	<65	<65	65	67	71	75	81	75	73
P5	<65	<65	<65	<65	<65	<65	66	69	73	78	81	74	71
P6	<65	<65	<65	<65	<65	<65	67	70	74	78	76	71	69
P7	<65	<65	<65	<65	<65	65	68	71	76	78	73	70	67
P8	<65	<65	<65	<65	<65	66	68	71	75	74	71	68	66
P9	<65	<65	<65	<65	<65	67	69	73	74	72	69	67	65
P10	<65	<65	<65	<65	<65	67	69	72	72	70	67	66	<65
P11	<65	<65	<65	<65	<65	68	70	71	70	68	66	65	<65
P12	<65	<65	<65	<65	<65	68	69	69	68	67	65	<65	<65
P13	<65	<65	<65	<65	<65	69	69	70	69	67	65	<65	<65
P14	<65	<65	<65	<65	<65	68	68	69	68	66	<65	<65	<65
P15	<65	<65	<65	<65	<65	70	68	68	66	65	<65	<65	<65
P16	71	70	69	67	66	<65	<65	<65	<65	<65	<65	<65	<65
P17	70	70	70	69	68	<65	<65	<65	<65	<65	<65	<65	<65

> Upper threshold

Design range

Lower design range

< Lower design range

4.2.11 As shown in Table 8, noise levels associated with a majority of the construction phases at considered receptors fall into or below the 'design range', and therefore potential significant noise effects at R1 – R8 and R13, are unlikely to occur assuming on-site

contractors adopt best practicable means (BPM) and adhere to the requirements of the CEMP.

4.2.12 The highest noise levels from piling activities are shown to occur at R9 – R12, particularly where separation distances are less than 40m. Proposed noise management and control measures in relation to these receptors are discussed further in the 'Proposed Management and Control Measures' section.

Proposed Management and Control Measures

4.2.13 For those receptors shown to likely experience construction noise levels in the 'design range' or below, potential significant noise effects are unlikely to occur where on-site contractors adopt BPM and adhere to the measures of the CEMP.

4.2.14 General BPM measures detailed in Section 5.2.4 of the CEMP, are expanded upon in Section 5 Mitigation Measures.

Receptor Specific Noise Management and Control Measures

4.2.15 This section considers noise management and control measures for those receptors identified as likely experiencing noise levels exceeding the 'upper threshold' design criterion, namely Receptors R9 – R12.

4.2.16 The noise levels summarised Table 8 assume works are being undertaken at the piling position. The highest noise levels at R9 – R12 occur during the piling works at P1-P8. Works at these positions should be undertaken as efficiently and quickly as reasonably practicable.

4.2.17 The noise predictions are conservative as they do not include provision for the likely noise level reductions afforded by the river embankment. As advocated in BS 5228-1:2009+A1:2014, if there is a barrier or topographic feature between the source and receptor, a 5 dB attenuation can be assumed if the plant is 'just visible' to the receiver, and 10 dB attenuation when the noise source is completely screened.

4.2.18 During the closest piling works, particularly piling locations P1-P8, where receptors are not afforded an obstructed view of the piling activities due to the location of the embankment, additional screening should be provided in the form of site hoarding, screens or bunds.

4.2.19 On this basis, it is reasonable to assume that noise levels would be at least 5 dB lower than stated. At R11, where the noise levels would exceed the 'upper threshold' during P1, and P3-P5 piling operations, even with the introduction of a partial barrier screening, further noise management measures would be required, including consideration of attended noise monitoring, the use of nylon packs on the pile gate to eliminate steel on steel between gate and pile, and community engagement measures. These are discussed further in Section 5 Mitigation Measures.

4.3 Construction Vibration

Assessment Criteria

4.3.1 Construction activities, such as vibratory piling, have the potential to cause vibration induced adverse effects at residential receptors.

4.3.2 The effect of human exposure to vibration from sources other than blasting is covered in BS 6472-1:2008 Guide to evaluation of human exposure to vibration in buildings: 1-Vibration sources other than blasting 2-Blast-induced vibration, (BS 6472:2008). The standard provides guidance for predicting human response to vibration in buildings over the frequency range of 0.5 Hz to 80 Hz. It presents frequency-weighting curves for humans exposed to whole-body vibration, advice on measurement methods and methods for assessing continuous, intermittent and impulsive vibrations.

4.3.3 BS 6472:2008 uses the vibration dose value (VDV ms-1.75) to determine the effect of vibration on human receptors within the buildings, as "[p]resent knowledge shows that this type of vibration is best evaluated with the vibration dose value (VDV)." As noted in BS 5228-2:2009:A1:2014, for construction it is considered more appropriate to consider effects of vibration levels in terms of Peak Particle Velocity (PPV mms-1).

4.3.4 The use of the PPV metric is also consistent with the guidance within BS 7385-2:1993 'Evaluation and measurement for vibration in buildings. Guide to damage levels from ground borne vibration' (BS 7385-2, 1993), which presents assessment criteria to be applied for the likelihood of cosmetic damage to buildings.

4.3.5 Table 2 presents a summary of the assessment criteria given in terms of human building response, derived based on guidance within BS 5228-2:2009:A1:2014 and BS 7385:1993.

Prediction Methodology

4.3.6 The prediction of vibration levels requires an understanding of the many factors which contribute to its propagation characteristics. These generally include an understanding of the source, intermediate ground structure, and receiving structure properties.

4.3.7 The spatial extents of the construction vibration assessment are set at 100m, as at greater distances the levels of vibration from construction activities are unlikely to exceed the assessment thresholds.

4.3.8 As shown in Table 5, the closest receptors to the piling works are R9 – R12. The closest receptor is R11, which is 14m at the closest approach. R9, R10 and R12 are at least 25m from all the pile locations.

4.3.9 The construction plant with the greatest potential for adverse vibration levels will be during the use of the vibratory piling. In addition, the use of the tracked excavator as the piling gate, either on the shore or on the jack-up barge.

4.3.10 Vibration magnitudes can be estimated with reference to historic case history data presented in BS 5228-2:2009:A1:2014. Measured vibration levels associated with vibratory pile drivers are included in Table D.10 of BS 5228-2:2009:A1:2014. Measurement data from locations, considered to be similar, in London include:

- Ref. C49. 1972 London EC4 (Sand and gravel over London clay). Driving pile – 0.55mms-1 at 10m

- Ref. C54. 1980 London N1 (Gravel over London clay). Driving casing – 2.0 mms-1 at 40m

4.3.11 The theoretical energy per blow for both Ref. C49 and C54 is the same, however the measured vibration levels for Ref. C54 are much greater. Whilst vibration levels are unlikely to exceed the 1.00 mms-1 vibration limit, as summarised in Table 2, at the closest receptors, it is recommended that attended vibration monitoring is undertaken during piling activities at the closest approach.

Assessment

4.3.12 As shown in Table 5, the closest receptors to the piling works are R9 – R12. The closest receptor is R11, which is 14m at the closest approach. R9, R10 and R12 are at least 25m from all the pile locations. With reference to the historic case history data presented in BS 5228-2:2009:A1:2014, there is the potential for vibration levels to exceed the 1.00 mms-1 vibration limit, at the closest receptors.

4.3.13 When vibratory piling is undertaken at closest approach (less than 40m), and in reference to guidance summarised in Table 2 there is the potential for vibration levels to cause complaint, unless 'prior warning and explanation has been given to the residents'.

Proposed Management and Control Measures

4.3.14 For the majority of construction activities vibration specific mitigation will not be required.

4.3.15 It is recommended that attended vibration monitoring is undertaken during the initial piling activities, namely those at closest approach to the receptors. The measured vibration levels will be used to inform appropriate mitigation measures, including BPM.

4.4 Operational Noise - Ferry Emissions

4.4.1 Access to the ferries will be via new piers reached by extended walkways into the river. These walkways maximise the distance between the ferries and sensitive receptors, so that noise emissions from the ferries will be at some distance from existing, sensitive receptors, and only at the piers for short periods of time. Proposed operation information provided:

4.4.2 Vessel Type: FBM Hydrocat (Sky, Star and Storm). Engine type: 2 x 317kW @ 2300 RPM, John Deere 6090SFM85

Scheduling & Frequency:

- 06:00 – 22:00 on weekdays and 08:00 – 22:00 at weekends

Peak times (weekday only TBC)

- 06:00 – 10:00 and 15:00 – 19:00

Frequency (from each pier): every 5-7 minutes, 2 vessels (18 – 24 crossings per hour)

Off Peak times (weekday and weekend)

- 10:00 – 15:00 and 19:00 – 22:00

Frequency (from each pier): every 10 -12 minutes, 1 vessel (2nd vessel layby at Barnes Pier) (10 – 12 crossings per hour)

4.4.3 The piers will be more than 67m from any sensitive receptors. On the Barnes side, the nearest property (R1) to a pier is 67 m, and on the Hammersmith side the closest residential property (R5) is 74 m from the pier.

Assessment Criteria

4.4.4 There is no specific guidance for the assessment of noise from ferry movements. However, BS 8233 (2014) provides guidance with respect to continuous noise sources, such as idling engines. The assessment therefore references the recommended indoor ambient noise levels for daytime (0700-2300) and night-time (2300-0700) periods with respect to calculated noise emissions from the ferry engines.

4.4.5 The scheduling of the ferries include movements during the night-time, i.e. 0600-0700, therefore the assessment criteria will be:

- 0600-0700 – internal noise level 30 dB LAeq, T
- 0700-2200 – internal noise level 35 dB LAeq, T

4.4.6 Development specific baseline noise monitoring has not been undertaken, but for context, reference will also be made to baseline noise measurements undertaken in support of the Riverside Studios development, the 'RBA Report'1. The RBA Report included measurements at a riverside position, 'Measurement Position 4'. These are summarised in Table 7 below, and are considered representative of the assessed sensitive receptors.

Table 9: RBA Report – Baseline Monitoring

Measurement Period, T	RBA Measurement Position	Lowest L_{A90}, dB	Average $L_{Aeq, T}$ dB
Daytime (0700-1900)	4	51.3	60.5
Evening (1900-2300)	4	48.1	56.9
Night-time (2300-0700)	4	34.5	54.6

4.4.7 The RBA Report baseline noise monitoring will be used to inform an assessment of the impact from the change in noise levels, adopting methodologies advocated in IEMA: Guidelines for Environmental Noise Impact Assessment (IEMA, 2014).

4.4.8 The change in noise level criteria are consistent with those adopted for UK infrastructure projects, including High Speed Two (HS2), as summarised in Table 8.

[1] RBA Acoustics 'Queens Wharf and Riverside Studios London W6, Acoustic Assessment' (Report 5713/AAR, September 2013)

Table 10: Impact from Change in Noise Levels

Impact Classification	Noise Level Change, $L_{Aeq, T}$ dB
Negligible	≥ 0 dB and < 3 dB
Minor	≥ 3 dB and < 5 dB
Moderate	≥ 5 dB and < 10 dB
Major	≥ 10 dB

Prediction Methodology

4.4.9 The propagation of sound levels arising from the operation of the ferries has been determined through spreadsheet based noise modelling, using calculation methodologies advocated in ISO 9613 'Acoustics — Attenuation of sound during propagation outdoors' Parts 1 and 2, with minimal assumed corrections for air absorption and an assumed ground attenuation of G = 0.

4.4.10 The operational ferries will be powered by two John Deere PowerTechTM 9.0L Engine, Rated Power 317 kW, 425 hp (Model 6090SFM85), considered to be the main noise source. These engine types are also commonly used in tractors, such as the John Deere 8R Series tractors. It is understood that a majority of the time the engines will be idling, or under low power. The associated engine performance sheets do not include noise emission data, therefore assumed noise emission data has been taken from BS 5228-1:2009+A1:2014, namely that shown in Table D.9 Ref 50 'Tractor (idling)' 71 dB LAeq, T sound pressure level at 10m (sound power level, LWA 99 dB).

4.4.11 The predicted ferry engine noise levels at each of the receptors is summarised in Table 11.

Table 11: Ferry Engine Noise Levels at Receptors

Receptor	Predicted Noise Level, L_{Aeq}, dB	Receptor	Predicted Noise Level, L_{Aeq}, dB	Receptor	Predicted Noise Level, L_{Aeq}, dB
R1	57.5	R6	56.4	R11	51.0
R2	57.0	R7	55.6	R12	50.0
R3	56.2	R8	55.5	R13	48.7
R4	55.0	R9	54.3	-	
R5	56.6	R10	52.8	-	

Assessment

4.4.12 BS 8233 (2014) sets out recommended indoor ambient noise levels for residential dwellings. In order to convert the predicted external noise levels, as summarised in

Table 11, to internal noise levels, consideration is required of the acoustic performance of the building façade.

4.4.13 A 26 dB outdoor to indoor noise level difference is a conservative expectation of standard structures with a masonry construction, standard thermal double-glazed windows (closed) with open non-acoustic trickle vents. This correction has been applied to the noise levels in Table 11, and the associated indoor noise levels are summarised in Table 12.

Table 12: Ferry Engine Noise Levels at Receptors (Internal Noise Levels)

Receptor	Predicted Internal Noise Level, L_{Aeq}, dB	Receptor	Predicted Internal Noise Level, L_{Aeq}, dB	Receptor	Predicted Internal Noise Level, L_{Aeq}, dB
R1	31.5	R6	30.4	R11	25.0
R2	31.0	R7	29.6	R12	24.0
R3	30.2	R8	29.5	R13	22.7
R4	29.0	R9	28.3	-	
R5	30.6	R10	26.8	-	

4.4.14 As shown in Table 12, internal noise levels do not exceed the BS 8233 (2014) daytime indoor ambient noise criteria, 35 dB LAeq, 16 hr, at any of the assessed receptors.

4.4.15 During the night-time period, which applies to early morning ferry movements (0600-0700) there are exceedances of the BS 8233 (2014) indoor ambient noise criteria of 30 dB LAeq, 8 hr at R1 (1.5 dB exceedance), R2 (1.0 dB exceedance), R3 (0.2 dB exceedance), R5 (0.6 dB exceedance) and R6 (0.4 dB exceedance).

4.4.16 Whilst there are exceedances of up to 1.5 dB, it is noted that these would only occur for 1-hour at the end of the night-time period (0600-0700). It is also noted that BS 8233 (2014) states that 'the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved'. The associated noise impacts are therefore considered acceptable.

4.4.17 An additional consideration of likely noise impacts has been based on the change in noise level criteria, summarised in Table 8. The 'before' scenario is based on baseline noise monitoring in the RBA Report, as summarised in Table 7. The 'after' scenario is the cumulative level of the baseline noise levels and the predicted ferry noise levels. This is shown in Table 12.

Table 13: Ferry Noise Impact – Change in Noise Levels

Receptor	Daytime (Before) LAeq, T	Evening (Before) LAeq, T	Night-time (Before) LAeq, T	Daytime (After) LAeq, T	Evening (After) LAeq, T	Night-time (After) LAeq, T	Daytime Change, dB	Evening Change, dB	Night-time Change, dB
R1	60.5	56.9	54.6	62.3	60.2	59.3	1.8	3.3	4.7
R2	60.5	56.9	54.6	62.1	59.9	59.0	1.6	3.0	4.4
R3	60.5	56.9	54.6	61.9	59.6	58.5	1.4	2.7	3.9
R4	60.5	56.9	54.6	61.6	59.1	57.8	1.1	2.2	3.2
R5	60.5	56.9	54.6	62.0	59.8	58.7	1.5	2.9	4.1
R6	60.5	56.9	54.6	61.9	59.7	58.6	1.4	2.8	4.0
R7	60.5	56.9	54.6	61.7	59.3	58.1	1.2	2.4	3.5
R8	60.5	56.9	54.6	61.7	59.3	58.1	1.2	2.4	3.5
R9	60.5	56.9	54.6	61.4	58.8	57.4	0.9	1.9	2.8
R10	60.5	56.9	54.6	61.2	58.3	56.8	0.7	1.4	2.2
R11	60.5	56.9	54.6	61.0	57.9	56.2	0.5	1.0	1.6
R12	60.5	56.9	54.6	60.9	57.7	55.9	0.4	0.8	1.3
R13	60.5	56.9	54.6	60.8	57.5	55.6	0.3	0.6	1.0

	Negligible	≥ 0 dB and < 3 dB
	Minor	≥ 3 dB and < 5 dB
	Moderate	≥ 5 dB and < 10 dB
	Major	≥ 10 dB

4.4.18 As shown in Table 12, the impacts associated with the change in noise levels during the daytime is 'negligible'. During the evening and night-time periods, the impacts are 'minor'.

Proposed Management and Control Measures

4.4.19 Specific mitigation for the control of operational noise emissions is not required. However, reductions in noise impacts maybe achieved through the implementation of best practice measures. These include:

- Ensuring ferry engine use is limited as far as reasonably practicable;

- Ferry engines are used during operational hours only, for instance, not left to idle before and after periods of operation;
- Noise from public address systems should be avoided, or reduced as far as reasonably practicable;
- Noise from waiting passengers should be managed.

5 Mitigation Measures

General Steps to Minimise Construction Noise Impacts

5.1.1 The working methods that informed the noise predictions have been developed in consultation with the construction contractor. Where necessary, further noise reductions can be achieved by considering the noise reduction considerations advocated within BS 5228-1:2009+A1:2014, including:

- Substitution – where practicable, one or more of the proposed construction plant items are substituted for a quieter option;
- Equipment siting - where practicable, construction plant items will be located away from noise sensitive areas. Noise reductions are achieved by setting plant specific setback distances; and
- Working methods – where practicable, adjust working methods so that the number of concurrent construction and demolition activities being undertaken is reduced.

5.1.2 Additionally, general provisions for the control of noise and vibration during the construction of the Proposed Scheme, such as management and monitoring processes, are required to ensure best practicable means (BPM) are planned and employed, as defined in Section 72 of the Control of Pollution Act 1974 and Section 79 of the Environmental Protection Act 1990.

5.1.3 General steps, including BPM, to minimise noise levels, in addition to any specific mitigation, as required for any of the considered construction phases, require construction contractors to undertake the following, as a minimum:

- integration of noise control into the preparation of method statements, including, where necessary, the use of effective silencers;
- proactive links between noise management activities and community relations activities;
- preparation of details of site hoardings, screens or bunds that will be put in place to provide acoustic screening during construction, together with an inspection and maintenance schedule for such features;
- preparation of risk assessments to inform structural surveys of buildings and structures that may be affected by vibration from construction;
- preparation of risk assessments to inform structural surveys of buildings and structures that may be affected by vibration from construction;

- development of a noise and vibration monitoring protocol, including a schedule of noise and vibration monitoring locations and stages during construction of the Scheme when monitoring will be undertaken;
- preparation of and submitting Section 61 consent applications, where appropriate;
- the undertaking and publication of all monitoring required to ensure compliance with all acoustic commitments and consents; and
- implementation of management processes to ensure ongoing compliance, improvement and rapid corrective actions to avoid any potential noncompliance.

Steps to Minimise Noise Impacts at Receptors Identified within the 'Design Range' Noise Criterion

5.1.4 At receptors where predicted noise impacts have been identified in the 'Design Range' noise criterion, suitable noise reductions in addition to BPM measures, are likely to include:

- construction plant that is intermittently used should be shut down in the intervening periods between work or throttled down to a minimum;
- appointment of a site contact to whom complaints/queries about construction activity can be directed - any complaints should be investigated, and action taken where appropriate.
- local residents should be kept informed of periods of likely intensive construction, including working hours;
- all reasonable steps should be taken to limit the number of vehicles waiting to deliver materials to the Site;
- construction at the Site boundary (which would be closest to nearby residential receptors), should be undertaken as efficiently and quickly as reasonably possible; and
- with the exception of generators, pumps and electric plant, all plant and equipment should be shut down when not in use.

Steps to Minimise Noise Impacts at Receptors Identified Exceeding 'Upper Threshold'

5.1.5 At receptors where predicted noise levels have been identified as likely exceeding the 'upper threshold' noise criterion, noise reduction measures are required.

5.1.6 With reference to the BPM measures and the advice outlined in 'Steps to Minimise Noise Impacts at Receptors Identified within the 'Design Range' Noise Criterion', specific consideration and management of the following measures is required in relation to these receptors:

- Preparation of details of site hoarding, screens or bunds that will be put in place to provide acoustic screening during construction;
- preparation of and submitting Section 61 consent applications;

- the undertaking and publication of all monitoring required to ensure compliance with all acoustic commitments and consents;
- local residents should be kept informed of periods of likely intensive construction, including working hours; and
- construction at the Site boundary (which would be closest to nearby residential receptors), should be undertaken as efficiently and quickly as reasonably possible.

5.1.7 In addition, to eliminate the noise emissions associated with steel on steel between gate and pile, the piling operations will use nylon packs on the pile gate.

General Steps to Minimise Construction Vibration Impacts

5.1.8 During vibration activities, BPM should be undertaken, including limiting work activities at the closest approach to receptors.

5.1.9 When vibration piling is undertaken at the closest approach (distances less than 40m), it is recommended that attended vibration monitoring is undertaken. The measured vibration levels will be used to inform appropriate mitigation measures, including BPM.

6 Conclusions

6.1.1 This report is intended to support a full planning application for a temporary ferry service spanning the River Thames between Hammersmith (on the north) and Barnes (on the south). This temporary ferry service will be in service while the Grade II* listed Hammersmith Bridge, which is closed to road traffic, undergoes repairs.

6.1.2 The information in this report is presented in format suitable for supporting a Section 61 Application under the Control of Pollution Act (CoPA, 1974) (the 'S61 Application'), where required.

6.1.3 The scope and methodology adopted has been developed in consultation between LBHF, LBRuT and TfL, and associated supplementary guidance, and the construction working methods have been developed in consultation with the construction contractor.

6.1.4 Construction road traffic noise impacts are likely to be low, given the daily number of vehicles is expected to be approximately one per day over the 3-month construction phase.

6.1.5 With respect to construction noise, the predicted noise levels associated with each phase have been assessed against noise criterion. The assessment demonstrated that there is the potential for exceedance of the 'upper threshold' noise criterion at receptors without consideration of noise mitigation measures. General noise mitigation measures are presented in Section 5: Mitigation Measures, with measures set out for those receptors where noise levels are likely to be in the 'design range' noise criterion. For those receptors with the potential for noise levels to exceed the 'upper threshold', specific mitigation is given. This includes a requirement for provision of site hoarding to provide acoustic screening, liaison with residents throughout the construction process, and ensuring activities with the greater noise emissions are located at the greatest distance possible from the receptor.

6.1.6 The likely greatest potential for adverse vibration levels will be during the use of the vibratory piling. Vibration magnitudes were estimated with reference to historic case history data presented in BS 5228-2:2009:A1:2014, and indicated the potential for vibration levels to cause complaint during works at the closest approach. It is recommended that attended vibration monitoring is undertaken during the initial piling activities, namely those at closest approach to the receptors. The measured vibration levels will be used to inform appropriate mitigation measures, including BPM.

6.1.7 Operational noise impacts have been considered with reference to recommended internal ambient noise levels set out in BS 8233 (2014) and impact from change in noise levels criteria, as advocated in IEMA (2014). During the daytime period, noise emissions from the ferries are shown to meet the most stringent BS 8233 (2014) internal noise criterion. During the night-time period, the noise levels exceed the stringent noise criteria by up to 1.5 dB, but meet the 'relaxed' noise criterion. The noise level changes are negligible or minor at all assessed receptors.