



SILVERTOWN TUNNEL

DOCUMENT TITLE:

Noise and Vibration Management Plan Royal Borough of Greenwich

DOCUMENT NUMBER:

ST150030-RLC-ZZZ-06-ZZ-PLN-EN-0002

PURPOSE OF ISSUE	For Acceptance	DOCUMENT SUITABILITY	S3 - For Review & Comment	TOTAL PAGES (Including this page)	22
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Prepared by	Checked by	Approved by	Date	Revision
 CJV Environmental Manager	 CJV Noise and Vibration Lead	 CJV Project Director	26/06/2020	P02

Issue and Revision Control

Document uncontrolled when printed.

Revision History			
Rev No	Date	Summary of Changes	Section & Number
P01	02/03/2020	First Issue	
P02	26/06/2020	Second Issue, general updates, addressing comments & updating approach to baseline noise monitoring.	1.1, 1.2, 3.1, 3.3, 3.4, 3.6, 3.7, 4.2, 4.3

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1. Overview

1.1 Introduction

The Silvertown Tunnel (STT) scheme involves the construction of a twin bore road tunnel providing a new connection between the A102 Blackwall Tunnel Approach on the Greenwich Peninsula (Royal Borough of Greenwich) and the Tidal Basin roundabout junction on the A1020 Lower Lea Crossing / Silvertown Way (London Borough of Newham). The project was formally granted development consent through a Development Consent Order (DCO) issued by the Department of Transport in May 2018. STT will be approximately 1.4 km long and able to accommodate large vehicles including double-decker buses. It will include a dedicated bus, coach and goods vehicle lane, enabling TfL to provide additional cross-river bus routes. The scheme also includes the introduction of free-flow user charging on both the Blackwall Tunnel (northern portal located in London Borough of Tower Hamlets) and the new Silvertown Tunnel.

Transport for London (TfL) have entered into a Project Agreement with the Project Company Riverlinx (Project Co) who are responsible for the detailed design, construction, financing and maintenance of the tunnel and supporting infrastructure. A 5 year period of design and construction will be followed by a further 25 years of operation and maintenance. The Project Co has appointed Riverlinx CJV as the Design and Construction (D&C) Contractor responsible for undertaking the detailed design and construction of the STT scheme all in accordance with the constraints and parameters of the DCO, TfL specifications and other commitments made by TfL to stakeholders. Riverlinx CJV is a joint venture formed between Ferrovial Agroman (UK) Ltd, BAM Nuttall and SK Engineering and Construction Co Ltd.

1.2 Purpose

The purpose of the Noise and Vibration Management Plan (NVMP) is to detail Riverlinx CJV's approach to managing works in relation to noise and vibration on the Silvertown Tunnel (STT) Project in the Royal Borough of Greenwich. This plan is to facilitate the avoidance and mitigation of any adverse effects generated from site activities during construction and shall set out measures to control and limit noise and vibration levels in the vicinity of the construction works. This NVMP has been prepared in consultation with the Royal Borough of Greenwich.

1.3 Project Details

The tunnel will require changes to the existing road network on both sides of the River Thames. On the south side of the river, on the Greenwich Peninsula, the following changes to the A102 Blackwall Tunnel approach will be needed; widening the A102 Blackwell Tunnel approach to create space for STT approach lanes, building a new flyover for the southbound traffic from the Blackwall Tunnel to cross above the Silvertown Tunnel approach lanes and introducing new signage to direct traffic. Appendix A shows the relevant Scheme area (order limits) within the Royal Borough of Greenwich.

2. Planning

2.1 Code of Construction Practice Requirements

In compliance with the Code of Construction Practice (CoCP) Riverlinx CJV will undertake the following;

- Pre-construction noise monitoring surveys to be agreed with the relevant planning authority to establish a pre-construction baseline for monitoring compliance with construction noise limits. Baseline monitoring will commence three months before construction works begin.
- Produce an updated construction noise assessment against the new baseline based on the detailed design and developed construction methodology in accordance with BS 5228. The construction noise assessments will also inform eligibility for noise insulation and temporary rehousing under the Construction Noise and Vibration Mitigation Scheme, as set out in Appendix G of the Code of Construction Practice.
- Riverlinx CJV will obtain consents, where appropriate, from the relevant Local Authority under Section 61 of the Control of Pollution Act 1974 for the proposed construction works. Any Section 61 consent that is obtained may contain site specific management and mitigation requirements for noise and vibration. The Section 61 process may not be appropriate in the case of some types of operations, including tunnelling.
- Best Practicable Means (BPM) as defined under Section 72 of the Control of Pollution Act 1974 will be employed during the construction phase and included in the NVMP.
- Riverlinx CJV will seek to minimise the noise and vibration from conveyor systems through the implementation of a maintenance programme which includes regular inspection of the conveyor equipment.
- Riverlinx CJV will notify the local residents of particularly noisy work prior to commencement. Effective communication will be established, keeping local residents informed of the type and timing of works involved, with attention to potential evening and night time works and activities which may occur in close proximity to receptors.
- During the construction phase, day time and night time noise and or vibration monitoring will be undertaken at key sensitive receptors to ensure that the mitigation measures suggested are working effectively. See Table 1 for the proposed locations and of the key sensitive receptors.

2.2 Environmental Statement

The STT Environmental Statement (ES) assessed the expected construction noise and vibration levels for all areas up to 300 m from the Order Limits for the duration of the construction period following the methodology found within BS 5228:2009+A1:2014 'Code of Practice for Noise and Vibration Control on Construction and Open Sites' Parts 1 and 2 (BS 5228). The following points have been extracted from the ES to provide context to the below items that will be covered within this NVMP;

- updating the construction noise and vibration assessments from Riverlinx CJV activities
- establishing noise and vibration monitoring regime
- determination of appropriate noise threshold levels
- developing an approach to Section 61 consent applications

The construction noise assessment was based on an estimated construction schedule and plant itinerary. Noise levels, generated during typical construction operations, will depend on the different construction plant being used, the percentage 'on-time' of this plant and types of activity being undertaken. Noise and vibration impacts from construction were assessed at 11 locations considered to be representative of all noise sensitive receptors within the immediate vicinity of the Scheme and are listed in Table 1 and mapped in Figure 1 below.

Sensitive Receptor (from ES)	Receptor ID	OS Coordinates
Ardennes House	SR1	539840, 180867
120 Victoria Dock Road	SR2	539885, 180848
Foster Court	SR3	539917, 180845
Hoola Development	SR4	539932, 180736
Alaska Apartments	SR5	540107, 180744
Western Beach Apartments	SR6	540086, 180453
Proposed New Developments with Residential Elements (Planning Applications 12/1708, 12/2819, 12/2841, 13/2823, 13/2822/F, 12/2840, 13/2874 AND 13/2865/F)	SR7	539602, 179503
River Way	SR8	539640, 179395
Holly Court	SR9	539730, 179164
Holiday Inn Express	SR10	539618, 178985
Proposed New Hotel (Planning Application Number 09/2796/F)	SR11	539466, 178980

Table 1 Location of Noise Sensitive Receptors

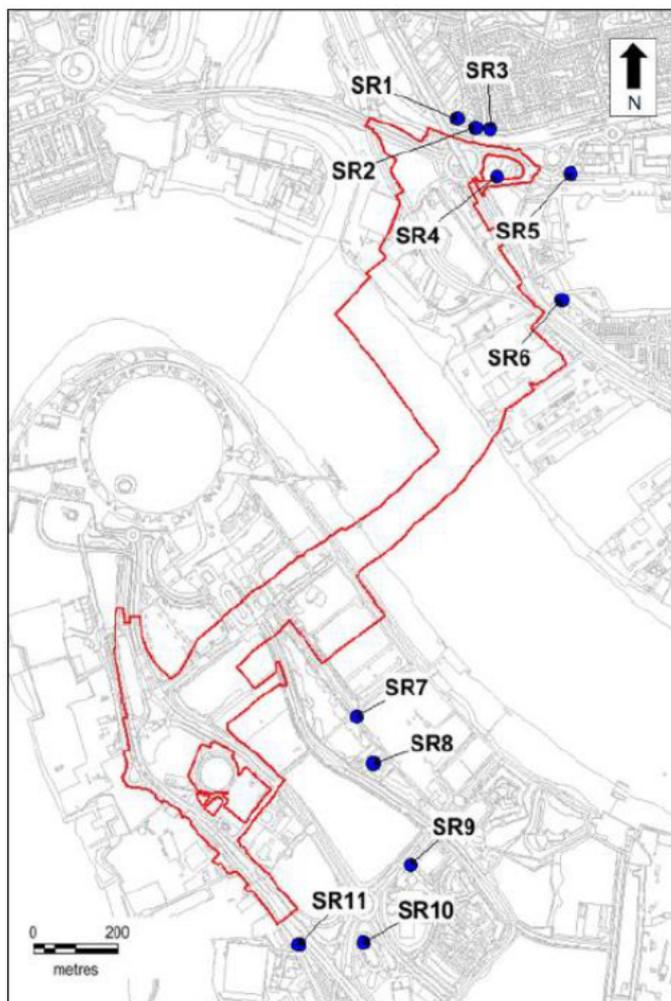


Figure 1 Location of Noise Sensitive Receptors

Construction Noise Impacts

The ES considered two approaches when defining appropriate noise thresholds for establishing potential noise impacts. Full details of these approaches are provided in Chapter 14 of the ES. The first approach utilised definitions from the Noise Policy Statement for England produced by DEFRA which sought to define the lowest

observable adverse effect level (LOAEL) and significant observable adverse effect level (SOAEL). The definition of LOAEL being “the level above which adverse effects on health and quality of life can be detected” and the definition of SOAEL being “the level above which significant adverse effects on health and quality of life occur”. Where the existing ambient noise level already exceeded the SOAEL, then a significant effect would be derived on the basis that construction noise should not increase the ambient noise climate by more than 3 dB. The SOAEL is therefore taken to be equivalent to the ambient noise level.

The second approach used the ‘ABC method’ derived from BS 5228 to establish noise significance thresholds based on ambient noise levels. A significant effect is deemed to occur if the construction activity L_{Aeq} noise level exceeds the threshold level for the category appropriate to the ambient noise level. If the ambient noise level exceeds the threshold value, then a significant effect is deemed to occur as the total L_{Aeq} noise level (ambient plus construction) for the period would increase by more than 3 dB due to the construction activity. In which case the threshold value is therefore taken to be equivalent to the ambient noise level. The ES predicted daytime construction noise levels at the closest receptors are in excess of the LOAEL at receptors SR1 to SR8, but they are below the SOAEL at all identified receptors. Notwithstanding the above, the predicted daytime construction noise levels are below the relevant threshold levels derived from the ‘ABC method’ at all identified receptors throughout the construction period. In accordance with BS 5228 daytime construction noise levels were therefore considered to result in a neutral significance of effect for the purpose of the ES.

The ES considered that only limited construction activities will occur during the night time period including tunnel boring and associated activities, and barge loading activities on the jetty. The predicted results assume all these activities occurring simultaneously. The predicted night time construction noise levels are below the threshold levels derived from the ‘ABC method’ for the time period at the closest façade of the closest receptors in Newham, where night works are anticipated. The predicted night time construction noise levels at all of the closest receptors in Newham are in excess of the LOAEL, but are below the SOAEL with the exception of SR6 (Western Beach Apartments). However the predicted construction noise level at SR6 is below the existing ambient noise level, therefore it has been concluded that all of the receptors considered for night time construction noise would be in agreement with the project definition of SOAEL, resulting in a neutral significance of effect for the purpose of the ES.

Construction Vibration Impacts from Piling

BS 5228 Part 2 provides guidance on effects of vibration levels on humans in terms of peak particle velocity (PPV). Using the guidance, a significance of effect in terms of PPV for piling operations was determined and presented in the ES. The significance of ground borne vibration levels from piling activities associated with the Scheme, and their potential for impacts upon buildings has been drawn from guidance provided in BS 5228-2. The limits for transient vibration, above which cosmetic damage could occur to a building assumed in the vibration assessment are presented in the ES in terms of PPV and are dependent on frequency. The ES asserts that general construction activities would not be expected to generate levels of ground borne vibration discernible outside of the Order Limits. However, within the scope of the construction activities required, ground stabilisation is necessary through both rotary and impact piling techniques. Ground borne vibration levels from these types of piling activity have been calculated in accordance with the prediction methodology of BS 5228 Part 2. Within the calculations undertaken, a worst case scenario of all receptors having a wooden floor has been assumed.

The assessment considered the potential vibration levels from rotary bore piling operations on the closest receptors and concluded the vibration levels as below human perception thresholds and would therefore have a neutral significance of effect at the closest receptors. Further consideration of the rotary piling generated vibration levels concludes the predicted levels to be significantly below any criteria for cosmetic damage to buildings, as defined in the ES. The vibration levels from percussive piling operations necessary for the installation of the temporary jetty were assessed at the closest residential receptors and the highest values predicted is 0.173 mm/s. This is only slightly above the significance criteria for neutral effects on humans, and it is therefore assessed as slight adverse as per the criteria defined in the ES. As such it is possible that this level of vibration may be just perceivable in residential environments however the percussive piling is only expected to occur for approximately 50 days in the entirety of the 4 year construction programme. Further consideration of the percussive hammer piling generated vibration levels concludes the predicted levels to be significantly below any criteria for cosmetic damage to buildings, as defined in the ES.

Noise and Vibration Impacts from the Tunnel Boring Machine

The significance of vibration levels from tunnelling activities in terms of vibration dose value (VDV) have been drawn from HS2 Information Paper E23 and the criteria thresholds for different levels of predicted vibration from the TBM are presented in the ES. An assessment of the vibration, ground borne and underwater sound from the tunnel boring machine (TBM) was undertaken. The predicted vibration levels indicate that vibration levels would be below the threshold level of human perception at the closest receptors, and as such considered to be negligible. The closest receptor (SR6) is approximately 170 m from the alignment of the TBM. The study has shown that the level of ground borne noise generated by the TBM at any of the nearby sensitive receptors would not exceed 35 dB L_{Amax} which is considered to represent the threshold of LOAEL and as such would be considered to have a negligible impact resulting in a neutral significance of effect.

Construction Vehicle Impacts

Construction vehicle noise impacts were calculated in accordance with the methodology for mobile plant, contained within BS 5228 along a defined Heavy Goods Vehicles (HGV) route.. The ES predicted change in noise level along each identified construction HGV route found that there would be no change greater than 1 dB. In the short term, a change of 1 dB is the smallest that is considered perceptible, and as such the magnitude of impact from HGV movements during the construction phase would be assessed as negligible, resulting in neutral significance of effect for the purpose of the ES.

2.3 Legislation

Riverlinx CJV are committed to complying fully with all legislation, regulations, industry best practice, and codes of practice relating to the environment, as an absolute minimum requirement. The relevant legislation, standards and other requirements for noise and vibration are found within the following;

- Control of Pollution Act 1974
- Environmental Protection Act 1990
- Development Consent Order (DCO)
- Code of Construction Practice (CoCP)
- BS EN ISO 8041:2005 Human response to vibration. Measuring instrumentation
- BS 5228-1:2009-A2014 Code of practice for noise and vibration control on construction and open sites. Noise
- BS 5228-2:2009-A2014 Code of practice for noise and vibration control on construction and open sites. Vibration
- BS EN 61672-1:2003 Electroacoustics sound level meters specifications
- BS EN 60942:2003 Electroacoustics sound calibrator.

2.4 Roles and Responsibilities

The Riverlinx CJV Project Director is responsible for the implementation of noise and vibration management during the construction of STT. Many members of the Riverlinx CJV also have responsibility for elements of noise and vibration management appropriate to their function, experience and seniority. The Riverlinx CJV Environmental Manager will lead on noise and vibration management and act as the key advisor on all related matters including compliance with the plan. The Environmental Manager will be supported by a noise and vibration specialist to lead on technical matters. Noise and vibration specialists shall be the following experience criteria shown in Table 2 below.

Environmental specialism	Specialist’s minimum qualifications and experience
Noise and vibration	A member of the Institute of Acoustics or equivalent with at least three years’ experience including expertise in tunnelling / ground-borne noise / vibration.

Table 2 Riverlinx CJV NVMP Roles and Responsibilities

Table 3 provides details of the personnel working on the project with specific responsibilities in relation to noise and vibration management.

Role Title	Responsibilities
Project Director	<ul style="list-style-type: none"> • Provide adequate environmental resources and support to effectively deliver the requirements of this plan.
Environmental Manager	<ul style="list-style-type: none"> • Develop and implement the NVMP. • Identify and maintain compliance with the requirements and principles of the NVMP during construction. • Assist lead auditors in auditing the NVMP • Identify, develop and provide environmental training as required specific to the NVMP. • Approve method statements and consider NVMP requirements. • Advise and instruct construction teams in the event of incidents and complaints. • Liaise/meet with external stakeholders.
Environmental Advisors	<ul style="list-style-type: none"> • Inspections on compliance with the NVMP requirements. • Brief NVMP requirements to relevant teams. • Advise and guide project team in the implementation of noise and vibration controls. • Identify ideas for improvement to environmental manager for consideration. • Report best practice across the project. • Assist in incident investigations and reporting. • Encourage near miss reporting and identify trends.
Noise and Vibration Specialist	<ul style="list-style-type: none"> • Provide technical support on noise and vibration issues. • Undertake baseline and construction phase noise monitoring. • Update the construction noise assessment. • Produce predictions to determine noise and vibration impacts of construction activities. • Assist in the investigation of any complaints or incidents as required.
Section Manager	<ul style="list-style-type: none"> • Provide information for Section 61 applications as requested by Noise & Vibration Specialist/environment team. • Work to ensure BPM is being integrated into all aspects of the construction works and detailed in method statements, and that compliance with the conditions of the relevant Section 61 consent is achieved. • Manage the investigation and response to complaints.
Community Construction Liaison Manager	<ul style="list-style-type: none"> • Liaise with the local community regarding any complaint or query. • Notify the Section Manager and environmental team of any complaints regarding noise and vibration. • Manage investigations into the complaints and provide the main point of contact with the helpline.
All Personnel	<ul style="list-style-type: none"> • Carry out the works in accordance with agreed methods and briefings. • Report anything that deviates from agreed processes. • Report all noise and vibration incidents and examples of best practice to section managers • Attend environmental training.

Table 3 Riverlinx CJV NVMP Roles and Responsibilities

2.5 Training and Awareness

The Riverlinx CJV Environmental Team will provide training to staff and operatives at all levels (and, when appropriate, to others involved in or affected by work activities) to achieve and maintain a high standard of environmental awareness and risk control. The construction team will be involved in the development of the NVMP and will be briefed on its requirements, the results of the baseline monitoring and the outcome of the construction noise assessment. They will be briefed and involved in developing the Riverlinx CJV application of best practicable means to reduce noise and vibration. Environmental information on noise and vibration management will be displayed in offices, site cabins and at sensitive locations to increase awareness of specific noise and vibration issues and consents.

All those working for Riverlinx CJV or on behalf of Riverlinx CJV shall undertake an induction that includes an introduction to the key aspects of environmental management on the project including information on the Noise and Vibration Management Plan. In addition, all Riverlinx CJV personnel will undertake the bespoke Environmental Awareness training session that will introduce personnel to how to manage site environment risks relevant to STT and provide practical guidance for specific topics including noise and vibration. The Environmental Team, the Noise and Vibration Specialist and the Riverlinx CJV construction team will deliver noise and vibration themed toolbox talks to site and office teams making use of best practice materials from parent companies and organisations such as CIRIA.

2.6 Communication

External communication on environmental matters will occur in a number of ways. The Riverlinx CJV Environmental Manager, Consents Manager and members of the Environmental Team will meet local authorities at appropriate and agreed intervals to discuss any noise and vibration management matters. The Riverlinx CJV Community Relations representative will seek to maintain dialogue with local communities and associations by various means including the Helpdesk. Should noise and vibration incidents occur due to construction activities, Riverlinx CJV will report details to relevant authorities.

Riverlinx CJV Helpdesk details are as follows:

Email: help@riverlinxcjv.co.uk

24/7 Helpdesk number: 079 079 7 84 86

3. Operational Control

3.1 Site Control Measures

The effective management of potential construction noise and vibration impacts on receptors will be accomplished by the adoption of Best Practicable Means (BPM) as defined under Section 72 of the Control of Pollution Act 1974. The Environment Team will work with the Construction Team and appointed subcontractors to include specific BPM controls within approved method statements. These will include, but not be limited to:

- installing appropriate fencing around the construction areas likely to generate noise;
- providing contact details for a site representative in the event that disturbance due to noise or vibration from the construction works occurs;
- ensuring that any complaints are dealt with pro-actively and that subsequent resolutions are communicated to the complainant;
- keeping site access routes in good condition and well maintained with no potholes or other significant surface irregularities;
- turning off plant machinery when not in use;
- maintaining all vehicles and mobile plant such that loose body fittings or exhausts do not rattle or vibrate;
- using silenced equipment where possible, in particular silenced power generators and pumps;
- using the most modern equipment available where possible and maintaining and operating equipment properly by trained staff;
- locating static noisy plant, including generators, as far away from noise sensitive receptors as is feasible for the particular activity;
- speed limits of to reduce the effect of construction traffic noise;
- regular condition assessments on site to inspect for defects such as pot holes which could cause an increase in noise levels. Indentations of greater than 20mm to be repaired when identified. Existing potholes would need to be considered by condition assessments prior to the commencement of works;
- ensuring that the quietest plant and equipment, techniques and working practices available are selected and used; and
- no music or radios would be played on site.
- the conveyor systems will be regularly inspected and maintained to ensure its efficient operation doesn't give rise to unwanted noise.

The Environment Team would brief site teams on the requirements of the NVMP and applying BPM controls when carrying out site activities through inductions, training briefs and toolbox talks. Riverlinx CJV would carry out regular site inspections and audits to cover specific checks on BPM. Noise and vibration monitoring will also be illustrative to any activities which are giving rise to noise levels higher than anticipated. In addition, specialist noise and vibration consultants will provide support in the development and implementation of BPM. Further specific mitigation measures may be developed as part of the Construction Noise Assessment (see Section 3.4. below) and these will be detailed within the Construction Noise Assessment report and Section 61 applications to the Royal Borough of Greenwich.

3.2 Construction Working Hours

Riverlinx CJV will carry out non-tunnelling construction activities inside of conventional core hours in line with standard good practice for major construction projects as much as practicable. Normal working hours for non-tunnel construction works will be from 08:00 to 18:00 Monday - Friday and 08:00 to 13:00 on Saturday with no work taking place on Sundays or bank/public holidays. To maximise productivity within the core hours, Riverlinx CJV will use a period of up to one hour before and up to one hour after core working hours for start-up and close down of activities. Start-up and close down activities can include, but are not limited to, preparation, deliveries (loading/unloading), maintenance, site briefings, inspections, meetings and training. Plant or machinery likely to cause a disturbance to local residents or businesses must not be operated during these start-up and close-down periods. These periods will not be considered an extension of core working hours.

Working Hours	Description
Monday to Friday 08:00 to 18:00 Saturday 08:00 to 13:00	Core Hours
Monday to Friday 07:00 to 08:00 Saturday 07:00 to 08:00	Start Up Activities
Monday to Friday 18:00 to 19:00 Saturday 13:00 to 14:00	Close Down Activities
Monday to Friday 19:00 to 23:00 Saturday 14:00 to 23:00 Sundays 07:00 to 23:00	Evening and Weekend Hours
All Week (23:00 to 07:00)	Night Hours

Table 4 Riverlinx CJV Working Hours Hierarchy

Where feasible, operations likely to cause disturbance and/or disruption would be limited to within the core working hours. However, some activities may be required outside these hours, e.g. delivery of abnormal loads. Except where activities are safety critical or in an emergency, any works outside these hours will be by agreement with the relevant local Environmental Health Officers (EHO). In the event of requiring additional working hours for discrete tasks evening and weekend hours as defined in Table 4 above will be considered prior to utilising night hours.

Some minor activities, such as changes in traffic management operations, may be required out of core working hours on a more frequent basis, but this would not be expected to have a significant impact in the context of the existing movements of traffic.

Tunnel boring works and associated supporting activities will need to be undertaken on a 24 hour, seven days per week basis due to the safety critical nature of the activities. Associated supporting activities will include any below ground works as well as above ground works which may include, but are not limited to; lifting operations into and out of the TBM launch/reception chambers, movement and manufacture/fabrication of materials required for tunnelling (including segments) on site, movement of tunnel spoil using conveyors, HGVs and barges, production/treatment and transportation of concrete and slurry for use in the tunnels, dewatering activities, and any other works required to ensure the continued safe operation of the tunnelling works.

3.3 Baseline Noise Monitoring

Noise monitoring was undertaken between January 2019 and February 2020 at the locations shown in Table 5 and Figure 2 below. Upon consultation with David Trew, Environmental Protection Team Manager for the Royal Borough of Greenwich the data captured from this period of monitoring in the vicinity of STT will be used as the baseline for the area and taken forward in the production of the Construction Noise Assessment. This data will be used in lieu of any further baseline monitoring, in mid-2020, as the effects of the coronavirus lockdown in England during this period would likely provide an inaccurate representation of baseline noise conditions.

Noise Monitoring Location	Name
Millennium Primary School, 50 John Harrison Way	NML04
The Pilot, 68 River Way	NML05
Ravensbourne College, 6 Penrose Way	NML06

Table 5 Noise Monitoring Locations 2019/20

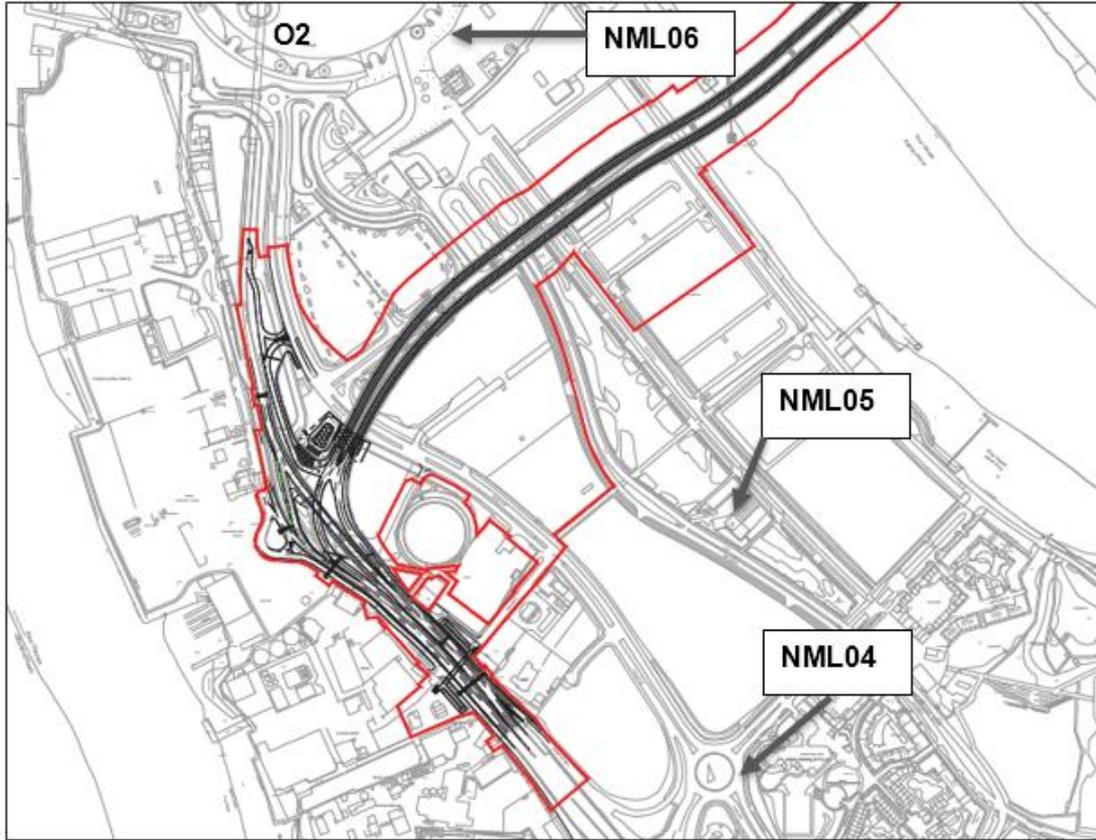


Figure 2 Map showing locations of noise monitoring (2019/20)

3.4 Construction Noise Assessment

Riverlinx CJV are developing a construction noise assessment against the 2019/20 baseline, described in Section 3.3 above, and will complete this prior to the commencement of main works construction and in accordance with BS 5228 based on the latest design and construction methodology. This assessment will be used to inform and develop specific mitigation measures to demonstrate the application of Best Practicable Means (BPM) as defined under Section 72 of the Control of Pollution Act 1974 and these specific mitigation measures will be detailed within forthcoming Section 61 applications and the Construction Noise Assessment report. In addition, the assessment will also identify any property eligible for the STT Construction Noise and Vibration Mitigation Scheme. The results of the Construction Noise Assessment will be shared with the Royal Borough of Greenwich, the first iteration of which is due to be finalised in July/August 2020.

3.5 Section 61 Applications

The Construction Noise Assessment will provide an overview of predicted noise levels during the construction phase. This will provide detail on what phases of work and specific activities are liable to give rise to high levels of noise for the receptors that surround the scheme. Further noise predictions will be run during the construction phase to ensure the anticipated noise levels are as accurate as possible and Riverlinx CJV are best placed to implement appropriate BPM mitigation to reduce noise and vibration from site activities. The results of any future assessments will be used as relevant within the Section 61 applications submitted to the Local Authority. Riverlinx CJV will seek to obtain consents under Section 61 of the Control of Pollution Act 1974 for construction activities likely to give rise to higher noise levels for which Riverlinx CJV will propose means to mitigate the impact upon surrounding receptors, adopting BPM as an underlying principle. Figure 3 below provides an indicative high-level programme which illustrates when key construction activities are programmed to take place.

Activity	Start	Finish	2019	2020	2021	2022	2023	2024	2025
Contract Award	Q4 2019		◆						
Design	Q3 2019	Q4 2021		█					
TBM Launch Chamber (Prior to TBM Launch)	Q1 2021	Q2 2022			█				
River Wall in Silvertown	Q4 2020	Q1 2024			█				
TBM Tunnel Southbound	Q2 2022	Q3 2022				█			
Turn TBM	Q3 2022	Q4 2022				█			
TBM Tunnel Northbound	Q4 2022	Q2 2023					█		
TBM Rotation Chamber (Prior to TBM Arrival)	Q2 2021	Q3 2022			█				
Silvertown Cut & Cover	Q1 2021	Q4 2023			█				
Greenwich Cut & Cover	Q1 2021	Q3 2023			█				
M&E and T&C	Q4 2023	Q4 2024						█	
Permit to Use	-	Q1 2025							◆

Figure 3 – Indicative Programme Dates

Applications shall incorporate the following steps;

- Noise and vibration calculations necessary to support a Section 61 application
- Submission of draft Section 61 application (where beneficial for complex applications)
- Submission of formal final Section 61 application to the Local Authority, where possible, at least four weeks prior to the planned commencement date of the activities outlined.
- Any queries or comments made during the determination of the formal Section 61 application will be address and amendments made (if required) as soon as practicable to assist the Local Authority in their determination

Upon approval of a Section 61 consent, Riverlinx CJV will distribute the Local Authority consent and any conditions (if imposed) to Riverlinx CJV’s site management team for dissemination to all site staff. Section 61 consent conditions will be adhered to and on-site inspections and noise and vibration monitoring will be undertaken to demonstrate compliance. Should working methods, hours of work, plant usage or locations of work change, a dispensation or variation will be applied for if requested by the Local Authority. In the event of an overrun of works, work required in response to an emergency, or work which if not completed would be unsafe or harmful to the permanent works, the Local Authority will be informed as soon as possible of the reasons for and the likely duration of the works in accordance with the procedure agreed through the Section 61 process.

3.6 Noise Predictions

Noise predictions will be run during the construction phase to assess the potential noise levels at the nearest relevant receptors. The noise predictions will be undertaken in accordance with BS 5228. Noise predictions will cover all periods of planned work; both day time activities and those activities that are required to occur overnight, such as the tunnel boring works and associated supporting activities. Riverlinx CJV will seek to control the effects of construction noise and vibration using the BPM measures described above; however, there may be circumstances where noise predictions inform that construction activities could, even after applying BPM, trigger a need to provide noise insulation or temporary rehousing to affected receptors as per the Construction Noise and Vibration Mitigation Scheme found in Appendix G of the CoCP.

3.7 Construction Noise and Vibration Mitigation Scheme

Riverlinx CJV will adhere to the Construction Noise and Vibration Mitigation Scheme appended to the CoCP in the event of that the construction noise assessment or later noise predictions identify noise levels that exceed the

qualifying criteria for noise insulation and or temporary rehousing, that cannot be mitigated through on-site mitigation (e.g. alternative plant, acoustic barriers). In such a scenario, Riverlinx CJV will look to offer to either provide and install free of charge, or provide grant aid for a claimant to install, noise insulation. In certain cases where the level of noise created by construction activity is predicted to exceed the qualifying criteria, Riverlinx CJV will contact potential claimants to try to arrange temporary rehousing or help claimants to arrange it for themselves and provide grant aid for the costs. Construction noise insulation and temporary rehousing arrangements apply to dwellings and other buildings lawfully used for residential purposes. All noise insulation or temporary housing provisions will be in place prior to the period of construction activity identified to exceed the qualifying criteria except where a claimant chooses not to accept the mitigation offer or does not respond within the timeframe detailed in the scheme. In these cases, works will continue as programmed. To be eligible, a claimant must own or occupy a private dwelling and the dwelling must be one in which the predicted or actual construction noise exceeds the relevant 'noise trigger level' in Table 6 for one or more of the following:

- a period of 10 or more days of working in any 15 consecutive days;
- a period of 3 or more nights of working in any 7 consecutive nights; or
- for a total of 40 days or more in any 6 consecutive months.

The rooms to which this scheme applies, eligible rooms, are defined as living rooms or bedrooms having a qualifying door or a qualifying window in any eligible building. The trigger values shown below in Table 6 do not apply where the ambient noise level is greater than the noise insulation trigger value. In which case, the ambient noise level is taken as the noise insulation trigger level for noise insulation, and the ambient noise level plus 10 dB is taken as the trigger level for temporary rehousing. The above temporal requirements still apply. Additionally, some buildings and/or their occupants will be treated as special cases and will be considered on a case by case basis. These include:

- night workers;
- those needing a particularly quiet home environment to work in; or
- those that have a medical condition which will be seriously aggravated by construction noise

Day	Work Between These Hours	Period for L_{Aeq} (Hours)	Noise Insulation Trigger Levels dB $L_{Aeq,T}$	Temporary Rehousing Trigger Level dB $L_{Aeq,T}$
Monday to Friday	07:00 – 08:00	1 hr	70	80
	08:00 – 18:00	10 hr	75	85
	18:00 – 19:00	1 hr	70	80
	19:00 – 22:00	3 hr	65	75
	22:00 – 07:00	1 hr	55	65
Saturdays	07:00 – 08:00	1 hr	70	80
	08:00 – 13:00	5 hr	75	85
	13:00 – 14:00	1 hr	70	80
	14:00 – 22:00	3 hr	65	75
	22:00 – 07:00	1 hr	55	65
Sundays & Bank Holidays	07:00 – 22:00	1 hr	65	75
	22:00 – 07:00	1 hr	55	65

Table 6 Noise Insulation and Temporary Rehousing Thresholds

Further information on the process of eligible properties is found within the Construction Noise and Vibration Mitigation Scheme document appended to the CoCP.

3.8 Vibration

Peak Particle Velocity (PPV) magnitudes in excess of 1.0 mm/s predicted/measured external to a building will be used as an indicator of vibration levels in residential environments that will be likely to cause complaints but can be tolerated if prior warning and explanation has been given to residents as per the guidance in BS 5228 Part 2. Cosmetic building damage could potentially arise if vibration levels external to a building exceed the vibration levels

described in Table 7 below, as per the guidance in BS 5228 Part 2. Riverlinx CJV will use BPM to control vibration levels so that the PPV is kept beneath these levels. Where possible, vibration predictions for all piling operations will be performed in accordance with the calculation methodology detailed in BS 5228 Part 2 and methodologies considered to minimise vibration levels as far as practicable.

Type of Building	Peak component particle velocity in frequency range of predominant pulse (PPV)	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	50 mm/s at 4 Hz and above
Unreinforced or light framed structures Residential or light commercial buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above
NOTE 1 Values referred to are at the base of the building		
NOTE 2 At frequencies below 4 Hz, a maximum displacement of 0.6mm (zero to peak) is not to be exceeded		

Table 7 Transient Vibration Levels (PPV) for Cosmetic Damage to Buildings

3.9 Notifications

Riverlinx CJV will provide newsletters within potentially affected surrounding areas to provide work updates and keep the local community informed. The newsletters will include details of construction activities that are expected to take place and their timings, paying particular attention to any evening and night time works. As part of Riverlinx CJV's commitment to ensuring its operations do not significantly impact local residents, a community contact number will be provided on the site hoardings and publicly distributed material. This will allow local residents to contact the project helpline 24 hours a day should they feel the need to. Any complaints or enquiries received from local residents will be investigated and dealt with in a timely manner.

3.10 Underwater Noise and Vibration

The ES assessed the potential noise and vibration impacts of specific construction activities on marine life. Elevated underwater noise and vibration levels during marine construction work and dredging can potentially disturb fish by causing physiological damage and/or inducing adverse behavioural reactions. In order to inform the assessment of underwater noise effects on fish, noise impacts associated with the new temporary jetty construction, dredging and tunnelling works were considered. The ES considered that the risk of harm could be mitigated by the following a number of mitigation measures including controls on piling and applying seasonal restrictions to avoid migratory periods. Methodologies for in-river works will be developed and appropriate noise and vibration mitigations included. The tunnelling works have the potential to generate noise and vibration that will impact on fish; however, the levels are anticipated to be barely audible for fish against existing ambient levels. The anticipated levels are also well below the thresholds considered to cause injury with only very localised and mild behavioural responses within a few metres of the river bed. Method statements will be developed that integrate appropriate mitigation measures and explore additional measures if deemed necessary by Riverlinx CJV ecologists. In addition, in-river working methods will be developed in consultation with the river regulators as part of the consenting process.

4. Checking

4.1 Compliance Checks

During the construction phase Riverlinx CJV will monitor the effectiveness of the NVMP. This will be undertaken by the Environmental Team and Section Managers and will include inspections and audits to confirm compliance with the plan. Any non-conformances will be addressed and further action will be taken where deemed appropriate. Riverlinx CJV's noise and vibration specialist will undertake checks on compliance including attended monitoring exercises where thought helpful to assess the effectiveness of BPM.

4.2 Noise and Vibration Monitoring

Noise monitoring will be undertaken for the duration of the main construction works and will principally comprise of unattended (semi-permanent) noise monitoring and will be supplemented with attended monitoring for discreet tasks. Vibration monitoring will be undertaken following receipt of a valid complaint, or upon the reasonable request of the Local Authority, and may comprise unattended (semi-permanent) or attended monitoring. The proposals for construction phase monitoring are presented below based on the following understanding of noise sensitive receptors and pre-existing noise sources.

The nearest residential receptors to the main worksite area are considered the Upper Riverside No. 5 building (to the northeast), however during site visits in February and March 2020 the building did not appear to be occupied. This building along with its neighbouring residential receptors at Upper Riverside No. 1 to 4 buildings are all likely to be occupied, if not already occupied, during the STT works. The next nearest residential receptors are in the area understood to be called Lower Riverside (to the east) and include the Waterman, Lighterman, Aperture, and Cable & Roper buildings all overlooking Chandlers Avenue and Pilots Walk. No commercial properties were considered noise sensitive in the ES, however, construction works are concluding on new commercial buildings within an area understood to be called the Design District. These buildings once occupied are likely to be the closest to the main works area and could give rise to complaints, particularly as this district is being marketed as a "new creative destination" for "bringing together ideas in design, art, tech, food, craft and music" (info: <https://designdistrict.co.uk/>). Two schools (St Mary Magdalene C of E School and Millennium Primary School) are located southeast of the main works area. The schools are further from the main works than the residential receptors, are within lower rise buildings, and are closer to the main sources of road traffic noise, the A102 and Millennium Way. All buildings to the west of the main works area appear to be of a commercial industrial nature and are therefore not considered to be noise sensitive, particularly due to their proximity to major road traffic using the A102 (Blackwall Tunnel Southern Approach). This is supported by the ES which did not identify any receptors to the west of the Order Limits. Other noise sensitive receptors identified in the ES are significantly further from the main works area than those discussed above and are of no greater noise sensitivity. During the aforementioned site visits, the noise environment around the nearest receptors was dominated by continuous distant road traffic (including those using the A102 and Millennium Way) and on occasions by aircraft from the London City Airport. The cable car wheel was audible outside Upper Riverside No. 5. Occasional noise from vehicles including buses using the local road network was also present, which we would anticipate would increase substantially during major events at the nearby O2 arena. Based on the above understanding, the following three locations are proposed for the construction phase monitoring in Greenwich. These locations will be subject to review and will be in place prior to mains works construction due to commence in December 2020.

Location A – Mace Site Compound

The noise monitoring location is proposed within the site compound currently occupied by Mace as shown in Figure 4 below and Appendix A. The site cabins are approximately in line with the facades of the Upper Riverside No. 1 to 5 buildings. The ideal position is currently considered to be on the roof or high up on the side of the existing site cabins for security reasons, such as the staircases, provided they do not have a high footfall. If this is not possible, or practicable, then a location within the compound grounds should be acceptable, such as on the lower rise structures or lamp posts visible in the parking area. This location should be representative of the noise environment in the area of the nearest residential properties at Upper Riverside No. 1 to 5.



Figure 4 Location A – Mace Site Compound

Location B – The O2 Car Parking Office

This noise monitoring location is proposed on the roof of The O2 Car Parking Office which is a single storey building located adjacent to the roundabout on Edmund Halley Way as shown in Figure 5 below. The parking office building is south of the Design District on the opposite side of the roundabout as shown in Appendix A. This location should be representative of the noise environment at the new commercial properties adjacent to Edmund Halley Way which form part of the Design District development. However, construction works are still on going at this development and may influence the noise levels during certain periods of the day. As construction works develop it may be necessary to relocate this monitoring location to the site hoarding nearest to the Design District, as this parking office building may be removed or be encompassed by the worksite.



Figure 5 Location B – The O2 Car Parking Office

Location C – Ardmore Site Compound

This noise monitoring location is proposed within the site compound currently occupied by Ardmore as shown in Figure 6 below. The ideal position within the compound is currently considered to be on the roof of the entrance

security cabin. If this is not possible, then a location within the compound grounds would be chosen. This location should be representative of the noise environment in the area of the existing residential properties at Lower Riverside (on Chandlers Avenue and Pilots Walk) which are highlighted in Appendix A.

This location is in the approximate position of ES receptor SR7 (“proposed new developments with residential elements” which is understood to represent the Lower Riverside development). It is unclear at this stage when the construction of all the Lower Riverside buildings will be started and finished, and if the properties will become occupied during STT works. During the aforementioned site visit there was no indication of any significant construction activities in the immediate vicinity of the site compound, or in the neighbouring hoarded off areas. Although there are clearly plans for significant future development. If construction works do take place for these future developments during the STT construction programme, or the Ardmore site compound is removed at some point, this monitor may need to be relocated or abandoned entirely, as a secure location may no longer be practicable or the location may experience significant noise interference from closer construction sites not related to the STT scheme.



Figure 6: Location C – Ardmore Site Compound

Note: This image was taken from Google Street View from March 2018.

The microphones of the noise monitors will be installed approximately 1 metre from the nearest reflecting surface where this is possible.

All monitoring locations may be subject to change based on the progress of the STT scheme, specific noise concerns that may develop, and changes to sensitive receptors. All changes will be discussed and agreed with the Royal Borough of Greenwich.

For attended noise and vibration measurements, Riverlinx CJV will log/produce the following;

- Date and time taken
- Duration
- Calibration levels at the beginning and end of the measurement period
- Equipment used, including make, model, serial number and calibration details
- Plan showing location of measurement points
- Whether they are free field or at one metre from a building façade
- Relevant comments relating to the works
- Ambient noise or noisy intrusions including other events not related to the works causing high levels of noise and/or vibration
- Name and designation of the person taking the readings
- Construction activities taking place at the time of the readings
- Method of fixation of transducer (geophones) used for vibration monitoring

- Noise and vibration indices being measured
- Response time of the meter
- Additional information during vibration monitoring including the:
 - Condition of the building
 - Construction activities which may give rise to significant vibration
 - Other extraneous vibration inducing activities
 - Indicative ambient vibration levels, including transient event peaks
- Mitigation measurements in place

All sound level meters will comply with BS EN 61672-1:2003 Electroacoustics sound level meters specifications and be calibrated in accordance with BS EN 60942:2003 Electroacoustics sound calibrators. All meters will be set to record on a 'fast' time response and as a minimum the following indices will be measured and reported:

- L_{Aeq} , the A-weighted equivalent continuous noise level for the duration of the measurement time interval
- L_{Amax} , the maximum A-weighted noise level for the duration of the measurement time interval, measured with the meter set to fast response
- L_{A10} , the A-weighted sound pressure level exceeded for 10% of the measurement time interval
- L_{A90} , the A-weighted sound pressure level exceeded for 90% of the measurement time interval

Unattended (semi-permanent) noise monitors will be provided with the capacity to send text and or email alerts to nominated Riverlinx CJV personnel. If the highest predicted monthly construction noise levels are exceeded by more than 3 dB than the monitoring system will raise a Red alert. The cause of the alert is then investigated and, if caused by Riverlinx CJV works, then compliance with the S61 consent and BPM will be checked and works/mitigation amended as necessary. An Amber Alert will be raised where the monitoring system forward-predicts that a Red Alert could be triggered within the monitoring period based on the last 15-minute reading. In these instances, the system also provides details of the amount of time remaining before a Red Alert is raised if works continued at the current noise level. This enables the site team to amend the current works, if practicable, to avoid a Red Alert. Remote monitors will be laboratory calibrated every 24 months, and acoustic field calibrators will be laboratory calibrated every 12 months.

The ES predicted that ground borne noise arising from tunnel boring works would not exceed LOAEL of 35 dB L_{Amax} at any of the nearby sensitive receptors and as such there are no proposals to monitor for ground borne noise. Attended noise monitoring will be undertaken as required to assist with complex complaints and validate noise measurements during the early stages of potentially heavy or intrusive works, particularly those occurring at sensitive times.

The ES predicted that rotary bore piling and tunnel boring works would not give rise to vibrations perceptible to the sensitive receptors and as such there are no proposals to monitor for vibration for these activities. Vibration monitoring will therefore only be carried out following receipt of a valid complaint or upon the reasonable request of the Royal Borough of Greenwich.

4.3 Reporting

Noise and vibration data will be reported as part of periodic reporting to TfL. This data will be subjected to a verification check by the noise and vibration specialist to confirm that it is valid. In addition, the noise data reports will be made available to the Royal Borough of Greenwich. The periodic reporting will include:

- Describe noise monitoring equipment including serial numbers and dates of last calibration
- Include dates and results of field calibration checks within the reporting period
- Report relevant period levels for weekday, Saturday, Sunday and night time
- Include data provided in a graph format where possible
- Identify any Red Alerts, investigation findings and actions taken.
- Noise or vibration related complaints and details of the investigation.

In the event of a noise complaint, Riverlinx CJV will undertake an investigation to review the noise monitoring data to determine whether elevated noise levels were captured by one of the unattended monitors and were caused by site activities. The investigation will include an assessment into whether appropriate BPM measures were in place. Riverlinx CJV will report back on findings to the complainant and provide this information to the Royal Borough of Greenwich.

4.4 Review

The Environmental Manager will meet with senior team members, including the Project Director, Quality Manager, and Engineering Manager for formal management reviews. The review will include specific focus on the Noise and Vibration Management Plan. At the management reviews, improvement plans and related actions will be developed if required. The Environmental Manager will issue all review attendees with a report including the following items before the meeting:

- Adequacy of environmental resourcing
- Training undertaken and planned
- Analysis of site inspections, audits, incidents and non-conformities
- Analysis of monitoring
- Recurring issues and time taken to complete actions
- Follow-up actions from previous management review
- Recommendations for improvement.

Appendix A

