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European Regional Development Fund

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Preston Area 1 & 2 Flood Risk Management Scheme

Preston Area 1 and 2 Construction Noise Report

November 2020

Environment Agency

In partnership with:

Lancashire County Council

North West Regional Flood & Coastal Committee

Environment Agency

European Union
European Regional Development Fund

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Preston & South Ribble Area 1 & 2 Flood Risk Management Scheme

Project No:	
Document Title:	Preston & South Ribble Flood Risk Management Scheme: Area 1 and 2 Construction Noise Report
Document No.:	ENV0000009C-JAC-ZZ-ZZ-TN-EN-0001
Revision:	02
Document Status:	Final
Date:	26th November 2020
Client Name:	Environment Agency
Client No:	ENV0000009
Project Manager:	Matt Waddicor
Author:	Ian Stanworth
File Name:	Preston Area 1 and 2 Construction Noise Report

Jacobs U.K. Limited

95 Bothwell Street
Glasgow, Scotland G2 7HX
United Kingdom
T +44 (0)141 243 8000
F +44 (0)141 226 3109
www.jacobs.com

Document history and status

Revision	Date	Description	Author	Checked	Reviewed	Approved
01	19/10/20	For issue	IS	RS	SK	SM
02	26/11/20	Final	IS	SK	SK	SM

Contents

Executive Summary

Jacobs, on behalf of the Environment Agency, have undertaken a construction noise and vibration assessment which covers the works proposed to be undertaken as Areas 1 & 2 of the Preston Flood Risk Management Scheme (FRMS).

The calculations for the works currently designed and programmed indicate that some activities may result in construction noise and vibration levels in excess of the construction noise trigger levels at nearby residential receptors.

There are locations where the calculated levels are in excess of the numerical trigger values for Noise Insulation or Temporary Re-Housing. Based on experience of such works however it is not considered likely that the works would be expected to exceed the temporal durations for these, and hence no action in relation to Noise Insulation or Temporary Re-Housing is required.

Nonetheless, mitigation in order to minimise noise and vibration impacts will be employed in order to reduce the impacts of the construction works as much as possible. Compliance measurements will be undertaken in the event of complaints being received to ensure that the construction noise and vibration levels remain acceptable.

1. Introduction

The Preston & South Ribble FRMS seeks to reduce the high level of flood risk to 4,778 properties including over 500 businesses along the Rivers Ribble and Darwen, to the south of Preston. The scheme is mainly a combination of concrete walls and earth embankments, and is split into five areas:

- Area 1 – Riversway and Broadgate;
- Area 2 - Lower Penwortham;
- Area 3 - Frenchwood;
- Area 4 - Walton-le-Dale; and
- Area 5 - Higher Walton.

It should be noted that this noise report refers only to the construction works proposed to be undertaken in Areas 1 and 2 (i.e. Riversway and Broadgate, and Lower Penwortham). The other areas noted above will be considered for subsequent construction noise assessments should these be required. The works proposed to be undertaken in each area are as follows:

1.1 Area 1: Riversway and Broadgate

Located on the right (north) bank of the River Ribble, to the south of the city centre. This area is approximately 1.2km long, extending from the West Coast Main Line (WCML), downstream to Liverpool Road Bridge. Proposed defences comprise:

- Replacement of the existing concrete wall, with a new concrete wall, between Liverpool Road bridge and Penwortham Old Bridge;
- Replacement of the existing concrete wall, with a new concrete wall with glass panels on top, along Riverside between Penwortham Old Bridge and Miller Gardens Apartments;
- A new flood gate located in front of Miller Gardens Apartments;
- A new concrete wall along the boundary of the BAC/EE Preston Social and Sports Association cricket pitch between Miller Gardens Apartments and Ribble Cottage;
- A new flood gate located close to Ribble Cottage;
- Replacement of the existing concrete wall, with a new concrete wall with glass panels on top, running on the river side of the road between Ribble Cottage and the railway viaduct;
- A concrete wall will be constructed along the boundary of the existing Preston City Council compound, with two flood gates tying into the abutments of the WCML viaduct.
- In addition, 3 lengths of the existing river bank from just downstream of Old Penwortham bridge to the WCML will be stabilised with a blockwork revetment.
- There will also be minor works around the Sea Cadets building (just downstream of Liverpool Road Bridge) where works will improve emergency access to the river.

1.2 Area 2: Lower Penwortham

Located on the left (south) bank of the River Ribble, to the south of the city centre. This area is approximately 0.8km long, extending from the West Coast Main Line (WCML), downstream to Penwortham Old Bridge, and turning inland to tie into the abandoned railway embankment. Proposed defences comprise:

- A new concrete wall along the boundary of the Penwortham Methodist Church between the church and the allotments. In order to maintain security of the allotments, fencing will be installed along the top of the new wall.
- A new ramp to raise existing road levels at the entrance to Penwortham Methodist Church and a up and over ramp along the Golden Way Footpath between the Penwortham Methodist Church and the disused railway embankment.
- Replacement of the existing concrete wall, with a new concrete wall with glass panels on top, along Riverside Road extending upstream from the Cadent Gas pipe bridge;
- A new concrete wall along the river front linking Riverside Road to Ribble Sidings. A blockwork retaining wall and inclined embankment will be constructed to stabilise the existing bank;
- An earth embankment along the river front of Ribble Sidings, replacing the existing embankment;
- In addition, there are two further isolated sections of defence:
- A short earth embankment in the gap in the abandoned railway embankment, at the access point to Penwortham Residential Park; and
- The partial filling in (to flood defence level) of a culvert under the WCML, some 500 metres inland from the River Ribble.

1.3 Construction Noise Assessment

In order to fully inform the stakeholders of the potential impacts of the proposed Preston Area 1 & 2 Flood Risk Management Scheme (FRMS), a detailed construction noise assessment has been undertaken.

The construction noise and vibration assessment has been based on information provided by the design team, together with the baseline noise levels inferred from the national noise modelling for England. Despite the current short-term reduction in traffic flows as a result of the current Covid-19 restrictions, from review of the noise modelling data it is unlikely that the change in traffic flows will have resulted in any change to the proposed construction noise limit.

Construction noise calculations have been undertaken utilising the methodology contained in British Standard (BS) 5228-1:2009 + A1:2014 'Code of practice for noise and vibration control on construction and open sites - Part 1 (Noise)', using either the noise data contained within Annex C of the Standard or Manufacturer's data. Vibration calculations, where this is possible,

have been undertaken using the methodology contained in BS 5228-2:2009 + A1:2014 'Code of practice for noise and vibration control on construction and open sites - Part 2 (Vibration)'.

The impact of the calculated noise and vibration levels at the nearest sensitive receptors has been compared against trigger values, and where required, mitigation measures have been proposed. As an element of good site practice, noise and vibration compliance measurements have also been proposed during the construction works.

It should be noted that there is no noise impact from the operation of the scheme as there are no active elements to the scheme, that is there are no pumps or powered operating equipment. As a consequence, only the potential construction noise and vibration impacts have been considered.

2. Baseline Noise Levels

The 'Extrium' noise map viewer has been utilised (www.extrium.co.uk/noiseviewer.html) to ascertain the modelled noise levels in the vicinity of the proposed works from the main current noise source, that being road traffic.

Whilst this is in part instructive, given the reduced levels of road traffic that are still being experienced, it is often not felt appropriate to utilise the information from noise modelling as a basis for the setting of construction noise limits.

In this instance however, the utilisation of the modelled noise levels from road or rail traffic in the area, even allowing for a reduction in road and rail movement would not alter the potential construction noise limit for the works, and as a consequence the usage of 'Extrium' modelling data can be seen to be robust.

Given that there is no measurement data reference cannot be made to current noise sources, but it is expected that most of the noise environment will emanate from road traffic noise, with some influence from aviation and railway noise. From the results reported on the 'Extrium' site it would appear that daytime noise levels are less than 55dB $L_{Aeq(16hr)}$ daytime or less and 50dB $L_{Aeq(8hr)}$ night-time or less. No evening noise levels are possible to define from 'Extrium' noise map viewer.

It is important to note that the 'Extrium' maps only include noise from major roads, and the noise level in a lot of areas would also contain a contribution from local roads. As a consequence, it is clear that the 55dB is a conservative level, and actual baseline noise levels could be higher. By utilising the 'Extrium' data however the assessment undertaken is worst case; real world impacts are likely to be less.

However, prior to the commencement of construction, a baseline noise survey will be undertaken to ensure that the baseline noise levels assumed in this report are indeed robust, and that as a consequence the mitigation measures proposed are appropriate and reasonable. Locations for this survey will be agreed with the appropriate Environmental Health Officers prior to the survey being undertaken.

The levels derived from the 'Extrium' noise map viewer above have been used to set the appropriate construction noise limits and the consequential Noise Insulation and Temporary Re-Housing triggers.

3. Derivation of Construction Noise Limits and Phases of Construction & Plant and Equipment Complements

Based on the baseline data outlined in Section 2, and experience of construction noise assessments, the below guidance is normally considered in the setting of noise limits for construction noise.

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

This code of practice provides guidance and recommendations on methods for the measurement of construction noise and assessing its impact on those exposed to it. It also refers to the legislative background to noise control on construction sites and gives recommendations for basic methods of noise control. Suitable methods are provided for the calculation of noise from construction activities, including basic information regarding noise levels from a range of construction equipment.

The Standard provides guidance for the identification of the significance of noise levels from surface construction activity. Significance can be considered in relation to fixed limits for noise and vibration, or alternatively in considering the potential change in the ambient noise level with the construction noise.

A significance criterion is developed from noise measurements of existing ambient noise levels at the nearest sensitive receptors to the site. Sensitive receptors are residential housing; hotels and hostels; buildings in religious use; buildings in educational use and buildings in health and/or community use.

The ambient noise levels, taken from the 'Extrium' noise model viewer in both Areas have been rounded to the nearest 5dB(A).

Section E.3.2 of BS 5228-1:2009 + A1:2014 provides an example of an appropriate significance methodology, based on an '*ABC*' methodology. This is an example indicating the threshold of potential significant effect at dwellings when the site noise level, rounded to the nearest decibel, exceeds the listed value.

The table, repeated within this report as Table 2, can be used as follows: for the appropriate period (night, evening/weekends or day), the ambient noise level is determined and rounded to the nearest 5dB. This is then compared with the site noise level. If the site noise level exceeds the appropriate category value, then a potential significant effect is indicated.

Any assessment then needs to consider other project-specific factors, such as the number of receptors affected and the duration and character of the impact, to determine if there is a significant effect.

Table 2: Construction noise thresholds per APC categories, BS 5228-1:2009 + A1:2014 (Table E.1)

Assessment category & threshold value period	Threshold Value, in decibels (dB), $L_{Aeq,T}$		
	Category A[A)]	Category B[B)]	Category C[C)]
Night-time (2300 – 0700)	45	50	55
Evenings and weekends[D)]	55	60	65
Daytime (0700-1900) & Saturdays (0700-1300)	65	70	75
Note 1 A potential significant effect is indicated if the $L_{Aeq,T}$ noise level arising from the site exceeds the threshold level for the category appropriate to the ambient noise level			
Note 2 If the ambient noise level exceeds the Category C threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a potential significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3 dB due to site noise.			
Note 3 Applied to residential receptors only.			
[A)] Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values. [B)] Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values. [C)] Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values. [D)] 19.00–23.00 weekdays, 13.00–23.00 Saturdays and 07.00–23.00 Sundays.			

Given the above, and that the works would be expected to be undertaken during daytime hours only (assumed to be 0800 – 1600 Monday to Friday and 0800 – 1300 Saturdays, with no works Saturday afternoon, Sundays or Bank Holidays), construction noise triggers of **65dB** in the vicinity of the receptors in Areas 1 & 2 of the Preston FRMS are considered to be appropriate.

Table 3 reports the construction noise limits, together with the Noise Insulation and Temporary Re-Housing trigger levels. These are based on the guidance contained in Annex E.3.2 of BS 5228-1:2009+A1:2014, as reported in Table 2, together with the guidance contained in Annex E.4 in relation to Noise Insulation and Temporary Re-Housing.

Table 3: Construction noise, noise insulation and temporary re-housing trigger levels

Location	Average Baseline L_{Aeq}, dB	Construction Noise Limit (Annex E.3.2, BS 5228-1:2009+A1:2014), L_{Aeq}, dB	Noise Insulation Trigger, L_{Aeq}, dB	Temporary Re Housing Trigger, L_{Aeq} dB
Area 1	55 or less	65	75	80
Area 2		65		

These noise limits have been utilised throughout the calculations. The calculation points used in this assessment are based on the closest approach for each phase of the works to the nearest residential receptor as defined from review of the site plans and using Google Earth to measure the generic distance between source and receptor. As a result, the calculated noise levels can be considered to be worst case for each phase of works.

3.2 Construction Activities and Plant and Equipment Complements

From discussions with the construction engineers, the following construction activities are likely to be required in various locations across Areas 1 & 2:

- Service Diversion;
- Demolition of Existing Flood Walls;
- CFA Piling;
- Sheet Piling;
- Insitu Concrete;
- Installation of RC Wall;
- Excavation/Compaction;
- Concrete Fill;
- Redi-Rock Installation;
- Road/Footpath Construction & Surfacing;
- Flood Gate Installation; &,
- Handrail Installation.

Appendix B contains a full list of the construction activities and the plant and equipment associated with those works, together with their worst-case impact in each Area where they are proposed to take place. There is only an outline programme of works at present, but it is at present assumed that no two major activities will take place at the same time, in order that there are no cumulative impacts.

4. Calculation of Construction Noise Impacts

Calculations have been undertaken using the calculation method contained within Annex F of BS 5228-1:2009 + A1:2014, specifically the Sound Power Method. It should be noted that the calculations undertaken, the results of which are reported in the Table 4, are 'worst case'.

In this instance 'worst case' is defined as all plant and equipment for each construction activity operating as a cohesive unit, at the stated 'On-Times' for the full working period (in this case a full 10 hour day shift with half an hour each side of the working day for muster and departure from site, with 2 hours in the day for necessary work breaks), and that all plant is operating at the closest assumed point for those operations. It is considered therefore that some of these levels will be an over-estimation, or if they do occur, will take place for very short periods of time.

Table 4 indicates the maximum noise levels calculated to occur for each construction activity noted in Section 3.2. These do not consider the limitations of the calculation exercise noted above which consequently will have resulted in the calculated noise levels being an overestimate at certain locations. The calculated construction noise level is then combined with the baseline noise level of 55dB (from the 'Extrium' noise modelling) for the most appropriate baseline measurement receptor to produce the combined noise level in Table 4.

It should be noted that the baseline noise level has been derived from levels recorded on the 'Extrium' website. These may be found to be an under-estimation as this modelling only considers road noise on main thoroughfares and on railway lines. Local sources of noise may increase noise levels, but this will be ascertained prior to the commencement of construction.

Nonetheless it is considered that the calculation results are as accurate as possible given the complexities of construction site operations. If the construction noise trigger for the given receptor is exceeded, the levels in Table 4 in excess of this level are highlighted in **red**.

Where exceedances occur, mitigation measures will be considered later in the report (see Section 5). However, there is the possibility that some of the activities will still exceed the construction noise limit proposed, albeit for short periods of time, due to their proximity to the closest residential receptor.

Table 4: Preston Phase 1 & 2 FRMS - Calculated construction noise levels

Construction Activity	Receptor Location				
	Broadgate				
	Range of Distance to Works (m)	Calculated Level, dB, L_{Aeq}	Noise Limit, dB L_{Aeq}	Combined Noise Level, dB L_{Aeq}	Excess of Limit, dB
Service Diversion	25 - 50	70.5 – 76.6	65	70.6 – 76.6	5.6 – 11.6
Demolition of Existing Walls	25 - 50	60.4 – 66.4	65	61.5 – 66.7	0 – 1.7
CFA Piling	25 - 50	65.6 – 71.7	65	65.8 – 71.8	0.8 – 6.8
Sheet Piling	30	73.8	65	73.9	8.9
Insitu Concrete	25 - 50	67.3 – 73.3	65	67.8 -73.4	2.8 – 8.4
Installation of RC Wall	25 - 50	61.5 – 67.6	65	62.4 – 67.8	0 – 2.8
Excavation/Compaction	25 - 50	61.2 – 67.2	65	62.1 – 67.5	0 – 2.5
Concrete Fill			65		
Redi-Rock Installation	25	67.4	65	67.6	2.6
Road/Footpath Construction & Surfacing	15	74.4	65	74.4	9.4
Handrail Installation			65		
Floodgate Installation			65		

Table 4: Continued

Construction Activity	Receptor Location				
	Riverside				
	Range of Distance to Works (m)	Calculated Level, dB, L_{Aeq}	Noise Limit, dB L_{Aeq}	Combined Noise Level, dB L_{Aeq}	Excess of Limit, dB
Service Diversion	10	84.5	65	84.5	19.5
Demolition of Existing Walls	10	74.4	65	74.4	9.4
CFA Piling	10 - 15	76.1 – 79.6	65	76.1 – 79.6	11.1 – 14.6
Sheet Piling	15 - 20	77.3 - 79.8	65	77.3 - 79.8	12.3 - 14.8
Insitu Concrete	10 - 15	77.8 – 81.3	65	77.8 – 81.3	12.8 – 16.3
Installation of RC Wall	10 - 15	72.0 – 75.5	65	72.1 – 75.5	7.1 – 10.5
Excavation/Compaction	10 - 15	71.7 – 75.2	65	71.8 – 75.2	6.8 – 10.2
Concrete Fill			65		
Redi-Rock Installation	15 - 20	69.3 – 71.8	65	69.5 – 71.9	4.5 – 6.9
Road/Footpath Construction & Surfacing	10 - 15	74.4 – 77.9	65	74.4 – 77.9	9.4 – 12.9
Handrail Installation			65		
Floodgate Installation	10	74.7	65	74.7	9.7

Table 4: Continued

Construction Activity	Receptor Location				
	Riverside Road				
	Range of Distance to Works (m)	Calculated Level, dB, L_{Aeq}	Noise Limit, dB L_{Aeq}	Combined Noise Level, dB L_{Aeq}	Excess of Limit, dB
Service Diversion	10 - 15	81.0 – 84.5	65	81.0 – 84.5	16.0 – 19.5
Demolition of Existing Walls	10 - 15	70.9 – 74.4	65	71.0 – 74.4	6.0 – 9.4
CFA Piling	10 - 15	76.1 – 79.6	65	76.1 – 79.6	11.1 – 14.6
Sheet Piling	20	77.3	65	77.3	12.3
Insitu Concrete	10 - 15	77.8 – 81.3	65	77.8 – 81.3	12.8 – 16.3
Installation of RC Wall	10 - 15	72.0 – 75.5	65	72.1 – 75.5	7.1 – 10.5
Excavation/Compaction	10	75.2	65	75.2	10.2
Concrete Fill			65		
Redi-Rock Installation	10 - 15	71.8 – 75.3	65	71.9 – 75.3	6.9 – 10.3
Road/Footpath Construction & Surfacing	15	74.4	65	74.4	9.4
Handrail Installation	15	70.0	65	70.1	5.1
Floodgate Installation			65		

Table 4: Continued

Construction Activity	Receptor Location				
	Leyland Road (B5254)				
	Range of Distance to Works (m)	Calculated Level, dB, L_{Aeq}	Noise Limit, dB L_{Aeq}	Combined Noise Level, dB L_{Aeq}	Excess of Limit, dB
Service Diversion	25	76.6	65	76.6	11.6
Demolition of Existing Walls			65		
CFA Piling			65		
Sheet Piling			65		
Insitu Concrete	25	73.3	65	73.4	8.4
Installation of RC Wall	25	67.6	65	67.8	2.8
Excavation/Compaction	25	67.2	65	67.5	2.5
Concrete Fill			65		
Redi-Rock Installation			65		
Road/Footpath Construction & Surfacing	25	69.9	65	70	5
Handrail Installation	25	65.5	65	65.8	0.8
Floodgate Installation			65		

Table 4: Continued

Construction Activity	Receptor Location				
	Penwortham Residential Park				
	Range of Distance to Works (m)	Calculated Level, dB, L_{Aeq}	Noise Limit, dB L_{Aeq}	Combined Noise Level, dB L_{Aeq}	Excess of Limit, dB
Service Diversion			65		
Demolition of Existing Walls			65		
CFA Piling			65		
Sheet Piling			65		
Insitu Concrete			65		
Installation of RC Wall			65		
Excavation/Compaction	10	75.2	65	75.2	10.2
Concrete Fill			65		
Redi-Rock Installation			65		
Road/Footpath Construction & Surfacing	10	77.9	65	77.9	12.9
Handrail Installation	10	73.5	65	73.6	8.6
Floodgate Installation			65		

Table 4: Continued

Construction Activity	Receptor Location				
	Margaret Road (for Ribble Sidings embankment)				
	Range of Distance to Works (m)	Calculated Level, dB, L_{Aeq}	Noise Limit, dB L_{Aeq}	Combined Noise Level, dB L_{Aeq}	Excess of Limit, dB
Service Diversion			65		
Demolition of Existing Walls			65		
CFA Piling			65		
Sheet Piling			65		
Insitu Concrete			65		
Installation of RC Wall			65		
Excavation/Compaction	100 - 150	51.7 – 55.2	65	**56.7 – 58.1**	**0**
Concrete Fill	125	50.4	65	**56.3**	**0**
Redi-Rock Installation			65		
Road/Footpath Construction & Surfacing			65		
Handrail Installation			65		
Floodgate Installation			65		

From the above it is clear that in the absence of any mitigation, most of the works will result in calculated noise levels above the construction noise limit, as a consequence of the separation distance between the works and the receptors, which are small, and the plant and equipment employed.

From discussions with engineers and previous experience it is probable that most of the construction activities will be of a short to medium term duration;

It should also be noted that the calculations for all construction works have been undertaken at the closest approach of the works to the receptor and consequently the potential calculated impacts have been made when the impacts are at their highest.

The reported levels noted above are therefore worst case, nonetheless, mitigation measures should be considered to minimise the potential noise impacts.

5. Noise Mitigation and Control Measures

Most of the construction noise calculations indicate a significant number of activities resulting in exceedances of the construction noise limits, and as a consequence temporary construction mitigation measures will be beneficial in the control of construction works. These should be employed throughout the works but especially so where calculated noise levels exceed the construction noise limit. There will be some natural screening for example where works are taking place on rivers edge, several metres below and away from the top of the riverbank.

For static operations, temporary barriers consisting of Heras fencing panels covered with acoustic blankets will be employed. However, much of the work is dynamic, and moves a considerable distance in a shift, such that such static noise control measures are not practicable. In accordance with good site practice, the following measures should be implemented. Generic measures to assist in the reduction of noise levels generated from the site at residential receptors could include, but are not limited to the following:

- Noise and vibration control at source: e.g. selection of quiet and low vibration equipment, location of equipment on site, control of working hours and the provision of acoustic enclosures; and,
- Screening: e.g. local screening of equipment or perimeter hoarding.

The measures to be addressed for each activity could include, but are not limited to the following:

- Careful selection of equipment by consideration of the EC Directive to ensure that the quietest available equipment is specified;
- Specification of the quietest methods or use of the programme to ensure that noise levels are minimised;
- Use of hoarding or specific noise barriers where this is possible and practicable. No equipment is expected to operate at night, but any that does (such as pumps and generators) will be shielded from surrounding residential uses. All noisy hand-held equipment such as 'Stihl' saws shall be shielded using temporary barriers such a Heras fencing fitted with acoustic shielding panels (similar to 'Blok N Mesh');
- Site layout to locate noise sources as far away from residential properties as possible, although given the site constraints for some activities this will be difficult;
- Provision of lined and sealed acoustic covers for all suitable equipment;
- Regular maintenance of all equipment;
- Operation of equipment in the mode of operation that minimises noise;
- Shutting down equipment when not in use;
- No waiting or queuing on the public highway with engines running;
- Construction of temporary infrastructure to minimise noise and vibration;
- Handling all materials in a manner which minimises noise; and

- Audible warning systems designed to minimise noise.

Experience of the use of these forms of mitigation on other sites has shown that combined they have the potential to reduce construction noise levels by 5-10dB. Nonetheless there remains the potential that some of the proposed activities will still result in noise levels above the construction noise trigger.

In this instance, given the nature of the works, proactive community relations are key to let residents know when works are taking place, that they might be noisier than they would expect, the duration of those works, and the benefit to them once the works are complete.

6. Noise Insulation and Temporary Re-Housing Assessment

There is the potential for some of the construction activities in Areas 1 & 2 to generate noise levels in excess of the construction noise trigger values. Given that it is possible that the mitigation measures noted in Section 5 will not result in a reduction in noise levels to below the construction noise triggers, consideration of the potential requirement for Noise Insulation or Temporary Re-Housing needs to be undertaken.

BS 5228-1:2009 + A1:2014 Annex E.4 defines the temporal elements for construction works; if these durations are not exceeded by the works then Noise Insulation (or Temporary Re-Housing) will not be required:

- A period of ten or more days of working in any fifteen consecutive days; or,
- A total number of days exceeding forty in any six consecutive months.

From a review of the calculated noise levels, and an understanding of the potential programme. The works which are calculated to exceed the construction noise triggers at any particular receptor, are not likely to take any more than forty days in any six month period, and the work can be programmed not to exceed ten working days out of any fifteen consecutive days.

Therefore, from the works currently programmed, and for which calculations have been undertaken, none of the works will require Noise Insulation or Temporary Re-Housing measures, based on an understanding of the required operations.

7. Construction Vibration

In order to understand the full impact of the works it is also necessary to consider the potential vibration impacts of the proposed works. From the works description in its apparent that the main vibration generating activities will be piling and compaction. The assessment of these impacts is therefore required.

The following guidance is useful in understanding the methods of calculation, and guidance on the potential impact of vibration levels from construction operations on nearby residential receptors.

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

BS 5228 2009 + A1:2014, Part 2: Vibration provides guidance in relation to the effects of construction vibration upon the surroundings. Vibration, even of a very low magnitude, can be perceptible to people.

Vibration nuisance is frequently associated with the assumption that, if vibration can be felt, then damage is inevitable. However, considerably greater levels of vibration are required to cause damage to buildings and structures. In any neighbourhood, some individuals will be more sensitive to vibration than others.

To assess the likelihood of building damage from vibration, measurements are usually taken of maximum Peak Particle Velocity (PPV). This parameter has been found to be the most suitable single descriptor when assessing risk of structural damage and human reaction to vibration.

Whilst there are no defined assessment criteria for construction vibration impacts, BS 5228-2:2009 + A1:2014 provides useful indications as to how the effects can been defined (Table 5):

Table 5: Proposed vibration magnitude (based on human response)

Calculated Vibration Level	Effect
0 – 0.14 mm/s	No effect
0.14 – 0.29 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3 - 0.99 mm/s	Vibration might just be perceptible in residential environments.
1.0 – 9.99 mm/s	It is likely that vibration of this level in residential environments will cause complaint but can be tolerated if prior warning and explanation has been given to residents.
10 mm/s +	Vibration is likely to be intolerable for any more than a very brief exposure of this level.

Document LA111 (which concerns noise and vibration from the construction and operation of road schemes) suggests that a significant effect can occur above 1mm/s PPV.

However, this is subject to the same temporal scope as noise mentioned in Section 7. If this level is considered to be the trigger for the onset of complaints, then any vibratory impacts above this would be considered to require some form of mitigation.

From the construction activities noted above, it is considered that the only elements of the construction work where calculation of the potential impacts is possible is compaction and piling works. Whilst there are other potential vibration activities taking place during the construction works, none of them are capable of calculation based on the current published calculation methodologies.

The potential vibration impacts of vibratory compaction operations, either from earthworks or compaction works required during surfacing works have been calculated using the methods contained in BS 5228-2: 2009 + A1:2014 . Table 6 records the calculated vibration levels for a 3t twin drum vibro compaction roller and an 18t single drum vibro compaction roller:

Table 6: Calculated vibration levels from vibro compaction using method from BS 5228-2:2009 + A1:2014

Receptor Distance (m)	3t Twin Drum Roller - Vibro-Compaction, mm/s PPV		18t Single Drum Roller – Vibro-Compaction mm/s PPV	
	Start Up & Run Down	Steady State	Start Up & Run Down	Steady State
	Probability of Calculated Level Being Exceeded (%)			
	50%	50%	50%	50%
5	3.0	2.4	11.2	8.7
10	1.4	1.0	5.6	3.9
20	0.6	0.4	2.6	1.6
30	0.4	0.2	1.6	0.9
40	0.3	0.1	1.1	0.6
50	0.2	0.1	0.8	0.4

Previous experience indicates that of the levels recorded from the calculation above, those representing a 50% probability of the calculated level being exceeded most accurately reflect real world measurements, although it is considered that measurement during the works should be undertaken to ensure that this is the case.

From Table 6, and assuming the 50% probability of the calculated level being exceeded, at distances in excess of 20m for the 3t roller and at distances in excess of 50m for the 18t roller the vibration generated will be less than 1mm/s PPV.

Some of the works may take place within 15-20m of residential receptors, at which distance compaction works using the 3t roller should not give rise to vibration levels likely to give rise to residential complaint. If a larger machine is required for some of the earthworks the distance at which complaints are likely to occur will increase to 50m.

In some areas vibratory or hammer piling will be required. It is accepted that auger piling is required throughout large parts of the scheme in order to create foundations, but these are generally a low vibration generating activity for which there is no method of calculating the impacts.

Given this, Table 7 reports the calculated potential impacts for sheet piling, inserted by either vibratory or hammer methods, again assuming a 50% probability of the calculated level being exceeded, which in our experience most closely reflects real world measurement.

Table 7: Calculated vibration levels for hammer and vibro piling using methods contained in BS 5228-2:2009 + A1:2014

Receptor Distance (m)	Vibro-Piling	Hammer Piling	
	All Operations	Piling through Medium Dense Granular Soils	Piles at Refusal
	Probability of Calculated Level Being Exceeded (%)		
	50%		
5	7.4	1.1	2.8
10	3.0	0.6	1.8
20	1.2	0.3	0.9
30	0.7	0.2	0.5
40	0.5	0.1	0.4
50	0.4	0.1	0.3

For all activities, the calculated vibration levels reported in Table 7 indicate that at distances greater than 20m for hammer piling and 23m for vibratory piling would not be likely to give rise to a significant effect.

Nonetheless, prior communication with the residents where vibro or hammer piling are required within 20m will be key to inform them of the type of works taking place, that the works have the potential to generate vibration, that will be felt, but will not cause any structural damage to their property.

7.2 Vibration mitigation and control measures

Control of vibration is perhaps less simple to define than noise mitigation given that the potential impacts are currently less well understood. Minimisation of compaction works, elongation of compaction runs to maximise the distance between the closest receptors and the activity wherever possible, together with the reduction of site speed limits to reduce the potential for vibration generation and 'body-slap' from HGVs and Dumpers will assist. Such an approach will also reduce noise and potentially dust generation from the passage of these vehicles.

No indication can be given of the amount of reduction in construction generated vibration these measures will provide. However, such measures will minimise the potential for vibration generation.

8. Compliance Measurement

From the results reported above there is a risk of the suggested construction noise limits being exceeded throughout large parts of the Area 1 & 2 construction works. It would therefore be appropriate that compliance noise and vibration measurements be undertaken as a matter of course.

In the event of complaints being received, noise or vibration measurement will be undertaken to ensure that the complaint is thoroughly investigated, and remedial actions are implemented as required.

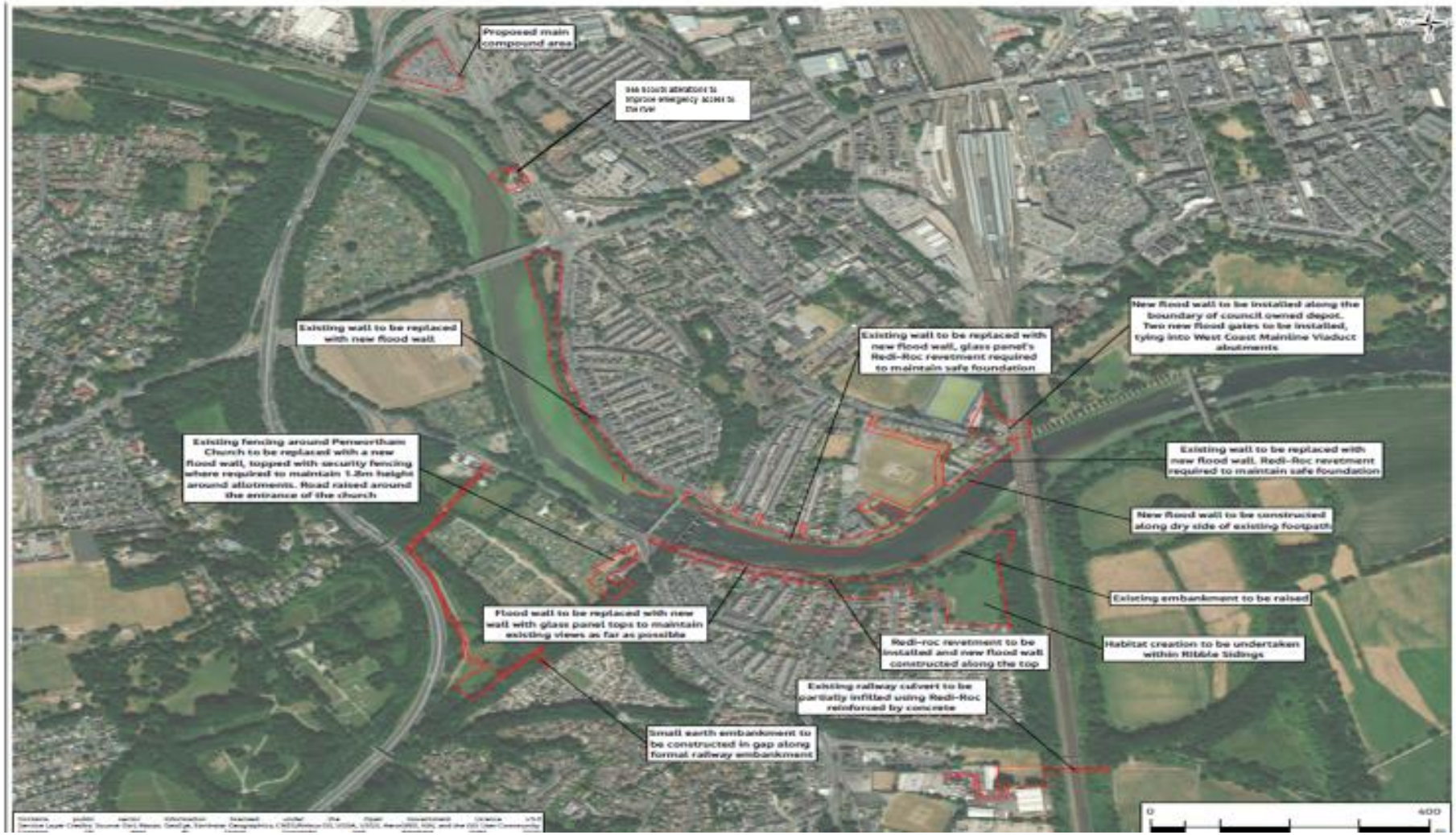
Noise measurements will be taken whilst site operations are active during the stated working hours and will be recorded on the measurement sheet shown below. The sound level meter used for compliance noise survey work shall comply and be capable of operating as Type 1 integrating sound level meter, complying with IEC 61672.

The sound level meter and calibrator will have been calibrated in a United Kingdom Accreditation Service (UKAS) or National Physical Laboratory (NPL) accredited laboratory within the past year and the details should be reported on the measurement sheet. The sound level meter should be calibrated both before and after the survey. Any drift that is detected between the calibration events shall be recorded on the measurement sheet.

Should vibration measurements be required, which should only happen if complaints are received as the calculations indicate that complaints are unlikely, vibration monitoring equipment will be installed at the complainant's property and left to run for several days or for the rest of the duration of the activities which have caused the complaint. The vibration equipment should be downloaded, and the results examined daily in order to understand the vibration generated by the works. This will ascertain vibration levels generated from the construction activities, and vibration levels experienced outside the construction periods.

All results from noise and vibration measurements undertaken in response to complaints will be shared with the complainant and the Local Authority if requested but will remain on file for the duration of the project.

Appendix A. Site Layout Plan


Proposed main compound area
Existing wall to be replaced with new flood wall
Existing wall to be replaced with new flood wall, glass panel's Redi-Roc revetment required to maintain safe foundation
New flood wall to be installed along the boundary of council owned depot. Two new flood gates to be installed, tying into West Coast Mainline Viaduct abutments
Existing fencing around Penwortham Church to be replaced with a new flood wall, topped with security fencing where required to maintain 1.2m height around allotments. Road raised around the entrance of the church
Existing wall to be replaced with new flood wall. Redi-Roc revetment required to maintain safe foundation
New flood wall to be constructed along dry side of existing footpath
Existing embankment to be raised
Flood wall to be replaced with new wall with glass panel tops to maintain existing views as far as possible
Redi-roc revetment to be installed and new flood wall constructed along the top
Habitat creation to be undertaken within Ribble Sidings
Existing railway culvert to be partially infilled using Redi-Roc reinforced by concrete
Small earth embankment to be constructed in gap along formal railway embankment
0
400

Appendix B. Plant and Equipment to be used and Calculated Construction Noise Levels at Generic Distances

Proposed Indicative Plant and Equipment List, Preston & South Ribble FRMS - Areas 1 & 2												
Activity	Plant Description	No	% On-Time	Shift Duration (hrs)	Duration of Activity (hrs)	Total L_w dB	Construction Noise Levels, L_{Aeq} dB at Generic Distances (m)					
							10m	15m	20m	25m	30m	50m
Service Diversion	Dynapac Floor Saw	1	30%	10	8	118.2	84.5	81.0	78.5	76.6	75.0	70.5
	Vibratory roller 4t	1	15%	10	8	102.0						
	Wheeled backhoe loader 8t	1	20%	10	8	97.0						
	Mini tracked excavator – 5t	1	40%	10	8	102.0						
	Diesel generator 7.5kW	1	50%	10	8	93.0						
	Lorry with lifting boom 6t	1	15%	10	8	105.0						
	Dumper 6t	1	20%	10	8	107.0						
CFA Piling	Tracked excavator 22t	1	20%	10	8	99.0	79.6	76.1	73.6	71.7	70.0	65.5
	Large rotary bored piling rig 110t	1	45%	10	8	111.0						
	Concrete pump + mixer truck	1	40%	10	8	95.0						
	Lorry (4-axle wagon)	1	20%	10	8	108.0						
Sheet Piling	Vibratory piling rig 52t	1	40%	10	8	116.0	83.3	79.8	77.3	75.4	73.8	69.3
	Tractor (towing trailer)	1	20%	10	8	107.0						
Insitu Concrete	Concrete pump + mixer truck	1	40%	10	8	95.0	81.3	77.8	75.3	73.3	71.7	67.3
	Tracked excavator 22t	1	20%	10	8	99.0						
	Paslode Nail Gun	1	10%	10	8	120.0						
	Circular Saw	1	10%	10	8	104.0						
	Poker vibrator 2.2kW	1	15%	10	8	97.0						
Installation of RC Wall	Lorry (4-axle wagon)	1	30%	10	8	108.0	75.5	72.0	69.5	67.6	66.0	61.5
	Lorry with lifting boom 6t	1	15%	10	8	105.0						
	Tracked excavator 22t	1	20%	10	8	99.0						
	Mobile telescopic crane 100t	1	35%	10	8	99.0						
Excavation/Compaction	Tracked excavator 22t	1	20%	10	8	99.0	75.2	71.7	69.2	67.2	65.4	61.2

Proposed Indicative Plant and Equipment List, Preston & South Ribble FRMS - Areas 1 & 2												
Activity	Plant Description	No	% On-Time	Shift Duration (hrs)	Duration of Activity (hrs)	Total L_w dB	Construction Noise Levels, L_{Aeq} dB at Generic Distances (m)					
							10m	15m	20m	25m	30m	50m
	Dumper 6t	1	20%	10	8	107.0						
	Roller 18t	1	15%	10	8	101.0						
	Lorry (4-axle wagon)	1	20%	10	8	108.0						
Concrete Fill	Tracked excavator 22t	1	25%	10	8	99.0						
	Large concrete mixer 26t	1	40%	10	8	104.0	72.3	68.8	66.3	64.4	62.8	58.4
	Poker vibrator 2.2kW	1	30%	10	8	97.0						
Redi-Rock Installation	Tracked excavator 22t	1	30%	10	8	99.0						
	Vibratory roller 4t	1	25%	10	8	102.0						
	Lorry with lifting boom 6t	1	15%	10	8	105.0	75.3	71.8	69.3	67.4	65.8	61.3
	Lorry (4-axle wagon)	1	25%	10	8	108.0						
Road/Footpath Construction & Surfacing	Tracked excavator 22t	1	20%	10	8	99.0						
	Mini tracked excavator – 5t	1	40%	10	8	102.0						
	Lorry (4-axle wagon)	1	20%	10	8	108.0						
	Dumper 6t	1	30%	10	8	107.0	77.9	74.4	71.9	69.9	68.3	63.9
	Asphalt paver (+ tipper lorry)	1	35%	10	8	103.0						
	Vibratory roller 4t	1	25%	10	8	102.0						
	Roller 18t	1	15%	10	8	101.0						
Handrail Installation	Diesel generator 7.5kW	1	50%	10	8	93.0						
	Hammer Drill Under Load	1	35%	10	8	101.0						
	Mini tracked excavator – 5t	1	30%	10	8	102.0	73.5	70.0	67.5	65.5	64.0	59.5
	Tractor (towing trailer)	1	15%	10	8	107.0						