Calvert Noise and Vibration

Thursday 9th March 2023

Agenda

1. Noise
2. Vibration
3. Calvert Complaints Noise Data
4. School Hill Overbridge Assessment

Part 1: Noise

Basics – What is Sound?

- Sound is a minute change in air pressure which propagates through air in a wave form
- It's key properties relate to the wavelength (frequency, measured in Hz) and amplitude (loudness, measured in dB)
- Frequency corresponds to how low or high pitched a sound is
- Humans can hear sounds across a 20 – 20,000 Hz range and are most sensitive to 2000 – 5000 Hz sounds
- Humans can safely hear sounds across a 0 – 110 dB range (physical damage is likely around >85 dB where there is prolonged exposure, physical damage is likely around 120 dB where these is instantaneous exposure)
- Sound is measured in dB(A) – frequency weighting which approximates the response of the human ear, by applying a correction factor based on the sensitivity range of human hearing
- Low frequency sounds have longer wavelengths and travel further in air than high frequency sounds which have short wavelengths
- Sound decays with distance – it spreads out form the source and is reduced by soft ground/surfaces (i.e. grassy field), intervening objects (i.e. buildings) and atmospheric conditions (i.e. humid air)
- Noise is defined as unwanted sound

Basics – Sound Calculations

Logarithmic Scales

- Sound measurements are expressed and calculated on a logarithmic scale
- A logarithmic scale is one where each increase of 10 represents an increase of times 10 on a linear scale
- In noise terms this scale is the decibel scale in which:

  10dB = 10^1 = 10 on a linear scale, 20dB = 10^2 = 100 30dB = 10^3 = 1000 etc.
- The expression of a decibel in terms of its linear equivalent can be considered to equate to the sound energy associated with that sound level.
- Example, adding two equal sound levels together will result in a 3dB increase, such as, 50 dB + 50 dB = 53 dB

LAeq

- For most sound the sound level varies rapidly over time
- The LAeq measure takes all the sound energy in a set period and averages it out, thereby taking out the highs and lows.
- LAeq measurements are used in assessing noise impacts because the majority of studies quantifying human response to sound are based around the LAeq metric, or it's equivalents, and therefore there is a body of evidence available to suggest how people will respond to noise at a given level.

Basics – Human Response to Noise

The human ear is much more complex than any sound level meter – humans do not respond to sound in a linear way.

There is no simple relationship between noise measurements and human response – everyone will respond differently.

In general:

- Every 10 dB increase is double the subjective loudness
- A 1 dB increase / decrease is only perceptible under controlled conditions
- A 3 dB increase / decrease is the minimum perceptible change under normal conditions

INDOOR	NOISE LEVEL, dB(A)	OUTDOOR
Rock band	110	<1m from a chainsaw
Night club	100	1m from pneumatic road breaker
Food blender at 1m	90	1m from petrol lawnmower
Vacuum cleaner at 1m	80	City street pavement
Loud voice at 1m	70	Plane at height of 2000m
Normal voice at 1m	60	30m from petrol lawnmower
Open plan office	50	Rural area during the day
Fridge at 1m	40	Suburban area at night, no local traffic
Concert hall background noise	30	Country area at night, no local traffic
Extremely quiet room	20	Very remote rural area, no wind
Nearly silent	10	Wilderness at night, no wind
Audibility threshold	0	Audibility threshold

A familiar noise at the same loudness i.e. open plan office (50 dB) will not sound the same or result in the same response as an unfamiliar sound of the same loudness i.e. impact hammering 1km away (50 dB)

Basics – Weather Effects on Sound

Temperature

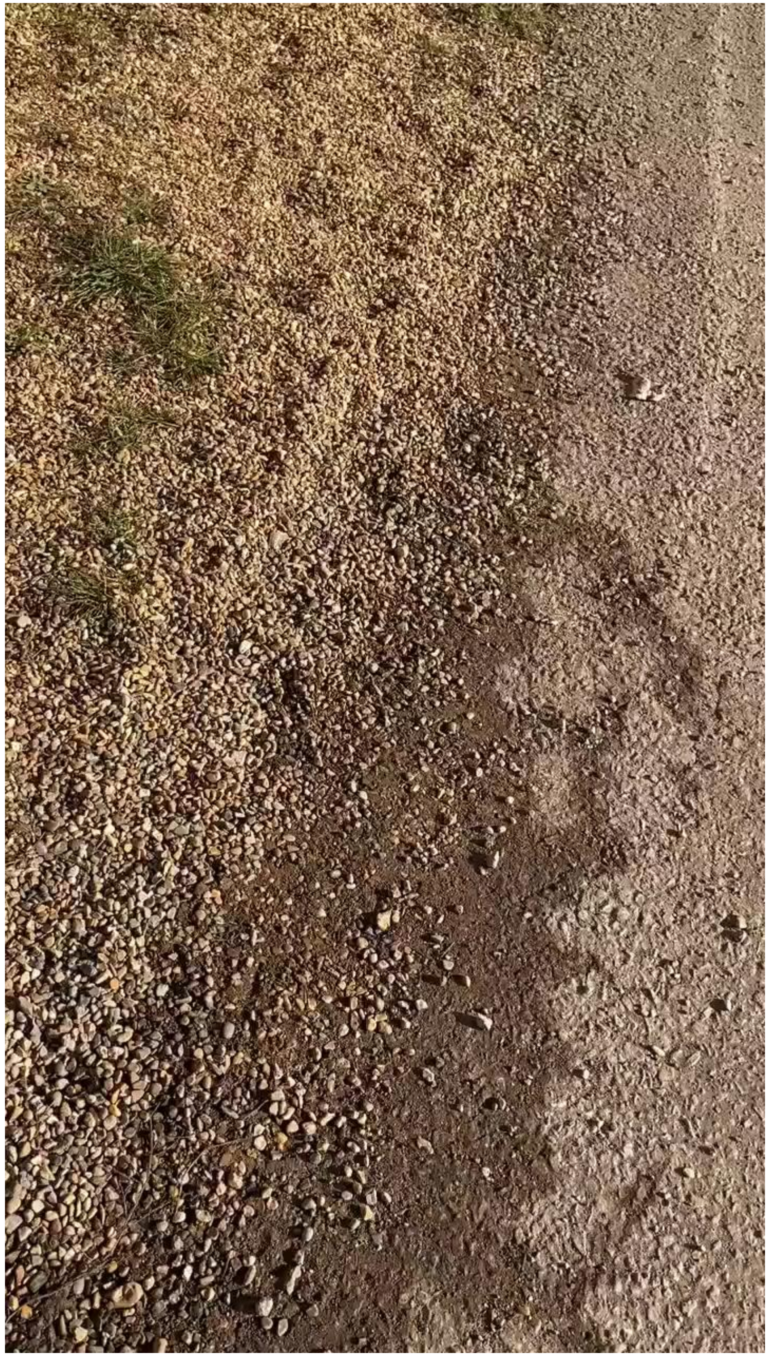
How: Sound moves more slowly in dense in cool air and faster in warm air i.e. sounds carryover longer distances when it is colder.

Why: When the temperature of the ground is very low and the air is still, this can lead to a temperature inversion forming in the atmosphere in the late afternoon/overnight. A temperature inversion is where cold air is trapped close to the ground by warm air above it. Sound waves cannot penetrate the boundary between the cold and warm air and are reflected back towards the ground. This can make distant sounds appear louder.

Wind

How: During high winds, sound can appear more dramatic, if you are downwind of the source. If you are upwind of the source, the sound could be indistinct. The difference between downwind and upwind conditions can result in a measured difference of 10 – 15 dB.

Why: Wind distorts sound energy causing sound waves to propagate more readily in the downwind direction; and high winds raise background noise levels i.e. tree rustling.



Basics – HS2 Noise Limits

If we predict or exceed SOAEL levels for more than 15 days a month we legally must have offered noise insultation.

Day	Time (hours)	Averaging Period T	Lowest Observed Adverse Effect Level $L_{pAeq,T}$ (dB)	Significant Observed Adverse Effect Level $L_{pAeq,T}$ (dB)
Mondays to Fridays	0700 - 0800 0800 - 1800 1800 - 1900 1900 – 2200	1 hour 10 hours 1 hour 1 hour	60 65 60 55	70 75 70 65
Saturdays	0700 - 0800 0800 - 1300 1300 - 1400 1400 – 2200	1 hour 5 hours 1 hour 1 hour	60 65 60 55	70 75 70 65
Sundays & Public Holidays	0700 – 2200	1 hour	55	65
Any night	2200 – 0700	1 hour	45	55

Predicted Noise Levels

Sound predictions are complicated logarithmic mathematical modelling scenarios which are impacted by many factors including:

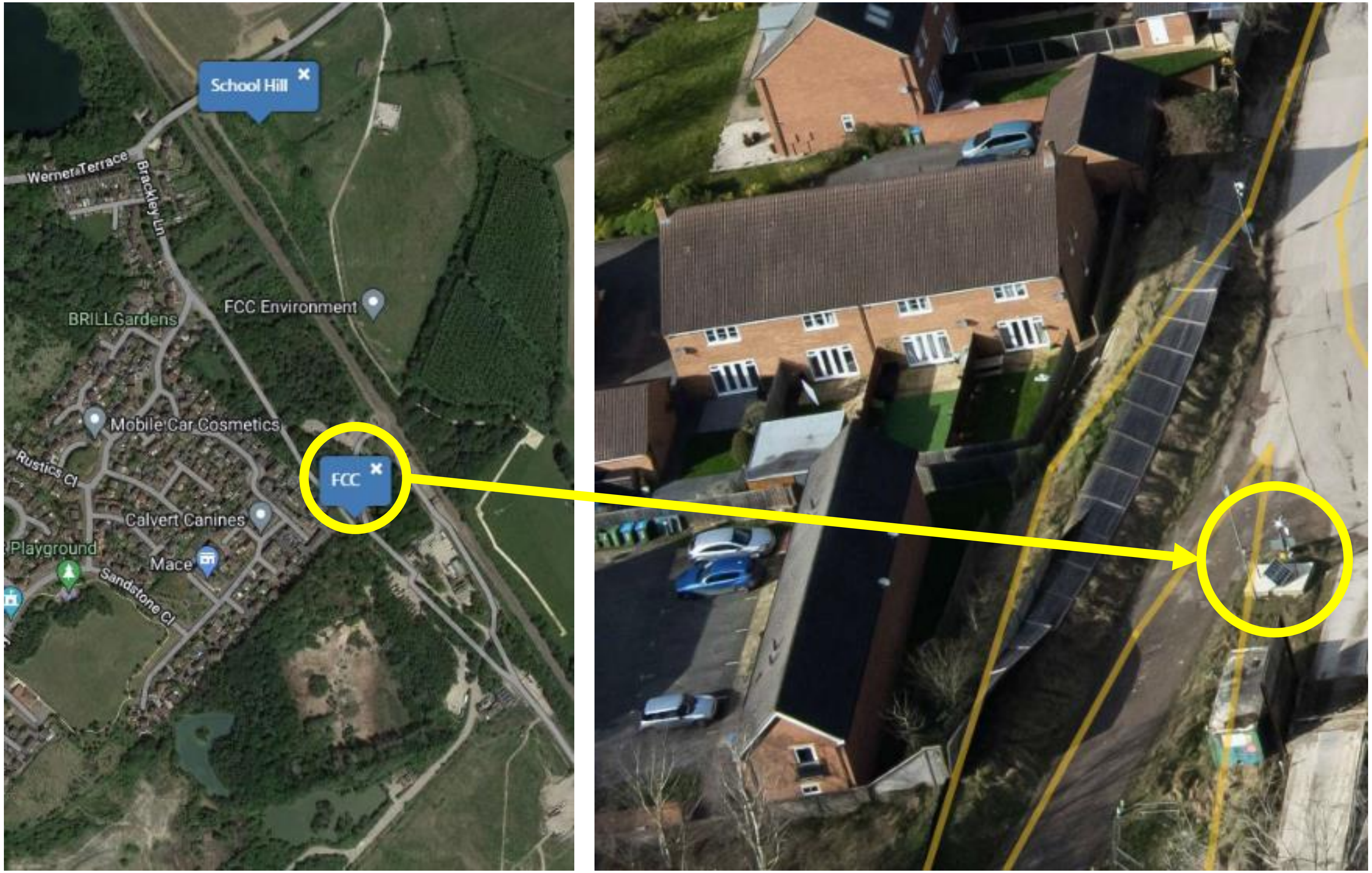
- Noise sources, their 'on-time' and location
- Baseline / background noise levels
- Other ongoing nearby works (HS2 or non-HS2 works)
- Type of ground i.e. hard ground (tarmac roads, grassy fields)
- Intervening objects i.e. reflective and absorptive surfaces (houses, fences)
- Atmospheric conditions (worse-case scenarios i.e. downwind is assumed)

Perceivable noise will not remain at predicted levels throughout the day, the levels will fluctuate and there may be periods of time where levels exceed the averaged predictions.

Noise travelling long distances is unlikely to increase the overall noise level (dB) of an area – lack of dB increase does not mean lack of perceivability, depending on if the sound is different or unusual.

If one sound source is 65 dB and a second sound source is 50 dB i.e. there is a difference of 10dB or more, the 50dB sound source will not lead to an overall increase of sound predictions or monitoring results. However, if the sound sources have different sound characteristics i.e. one is a high pitched constant hum (such as a generator) but the other is a loud intermittent low frequency rumble (such as drop hammer) the two different sources may be distinct and perceivable, despite the overall sound level not increasing in loudness.

Monitoring – FCC



<u>Monitor Type</u>

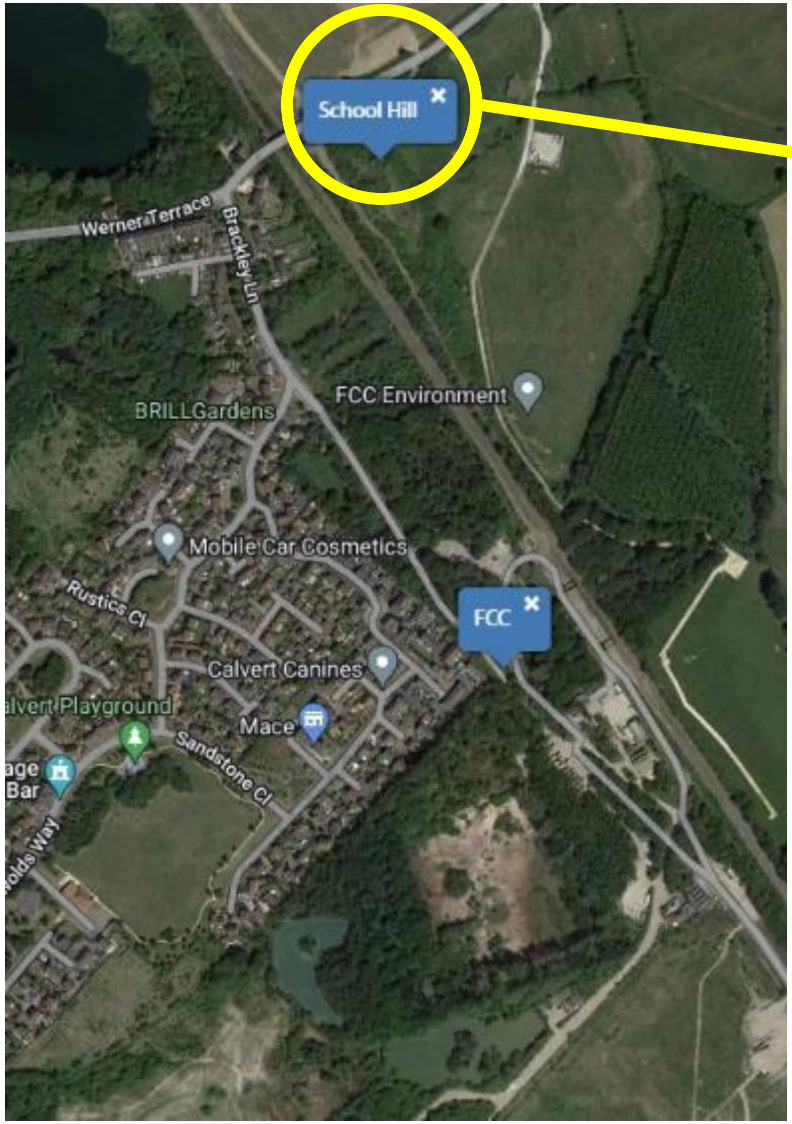
Dust

Noise

<u>Install date</u>

27/07/21

Monitoring – School Hill



Monitor Type

Dust

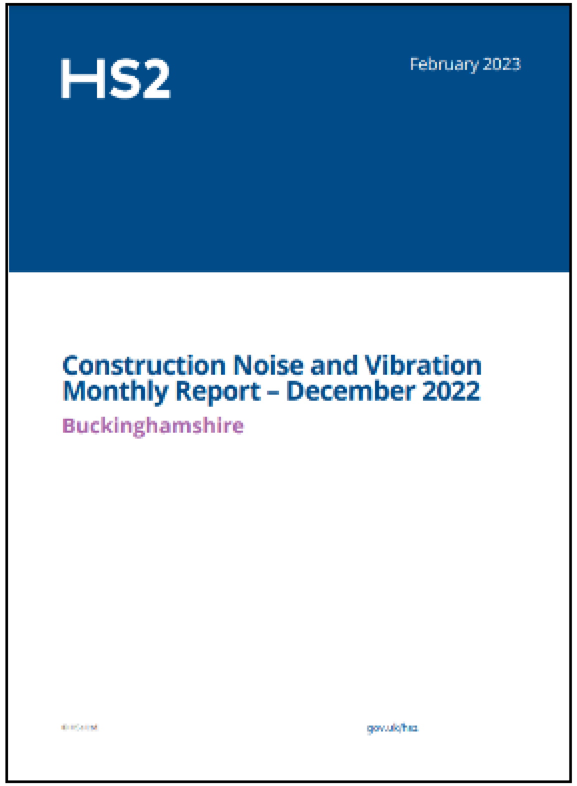
Noise

Install date

19/10/21

Monitoring – Results

- The noise meters upload the results instantaneously to an online cloud platform
- EKFB have access to this data at any time
- Trigger Alert levels are set for each monitor based on the predicted noise levels contained in the S61 Application
- When these levels are reached emails are sent to EKFB staff to advise them and take action if appropriate
- If a trigger alert is activated a 5 minute noise recording is captured


HS2

February 2023

Construction Noise and Vibration Monthly Report – December 2022

Buckinghamshire

gov.uk/hs2

- HS2 publish the raw data in 1hr LAeq's for all noise monitors. This data can be downloaded from the following https://www.data.gov.uk/dataset/24542ae7-dd44-444f-b259-871c4cc43b5e/environmental-monitoring-data
- Monthly noise reports are also published by HS2 and can be found at: https://www.gov.uk/government/collections/monitoring-the-environmental-effects-of-hs2-2022#monthly-noise-and-vibration-reports-

Noise Mitigation

- Hoarding (solid, plyboard) is to be erected across School Hill Road and behind Brackley Lane houses.
- Exclusion zone in place between ch.79+100 to 78+500 where no extended working outside of core hours, will be sought for earthworks.
- Location of receptors (houses and businesses) are taken into account when selecting plant and working methodology.
- Reduced speed limit on the mass haul road (used by dump trucks) to 10 mph between ch.79+100 to 78+500.
- Static generators are required to be super silent.
- Plant is well maintained in good condition.
- Noise training is delivered to site staff to raise awareness around behaviour.

Part 2: Vibration

Basics – What is Vibration?

- Vibration is caused by the input of energy which causes particles in an elastic body to oscillate.

- Vibration in soils decays rapidly with distance and is attenuated by energy absorption in the soil and by underground objects

- Vibration is mainly of interest in the frequency range 0.5 Hz to 250 Hz and is measured in PPV (peak particle velocity, mm/s) or VDV (vibration dose values, $m/s^{1.75}$)

- Vibration can give rise to audible sounds which is then measured in dB (termed as ground-borne sound)

- Like sound, vibration needs to be frequency weighted to match the response of the human tactile senses

- Like sound, human response to vibration is much more complex than can be measured with a meter

- Humans are very sensitive to vibration and will complain about vibration at levels far below those required to cause building damage

Basics – Vibration Limits (Building Damage)

The criteria used to assess the risk of building damage is taken from *Table 3 of the HS2 Code of Construction Practice (CoCP) Vibration trigger levels for building damage.* These criteria originate from *BS 7385:2 Evaluation and measurement for vibration in buildings.*

Building damage criteria is defined by the peak particle velocity (PPV) – PPV can be thought of as the maximum speed of a particles movement, measured in millimetres per second.

The CoCP gives maximum limits for both transient and continuous vibration above which damage could be caused – transient relates to singular and instantaneous events for a short duration (i.e. sheet piling), whilst continuous is a sustained vibration event occurring over an extended period (i.e. ground compaction with a vibratory roller).

The CoCP requires works to be controlled sufficiently so as not to exceed the below criteria at the building foundation.

Table 2 CoCP PPV vibration trigger levels

Category of Building	Impact Criteria (PPV at Building Foundation)	
	Transient Vibration	Continuous Vibration
Structurally sound buildings	≥12 mm/s	≥6 mm/s
Potentially vulnerable buildings	≥6 mm/s	≥3 mm/s

Basics – Vibration Limits (Human Response)

The impact criteria used to assess human response is taken from the *HS2 CoCP and HS2 Information Paper E23.*

The human response to vibration is defined by a vibration dose value (VDV) – VDV is a parameter that combines the magnitude of vibration and the time for which it occurs, as such, a longer period of medium intensity works could result in a higher VDV than high intensity works over a shorter period.

The LOAEL and SOAEL threshold for human response to vibration is defined in *Table 3 of the HS2 Information Paper E23: Control of Construction Noise & Vibration.*

The SOAEL is regarded as an upper limit, and if exceeded for two or more consecutive days or nights, the project is obliged to consider alternative measures.

Where works are likely to cause significant vibration, vibration risk assessments are completed.

Table 3 LOAEL and SOAEL from HS2 Information Paper E23

Vibration	Lowest Observed Adverse Effect Level	VDVday($m/s^{1.75}$)	0.2
		VDVnight($m/s^{1.75}$)	0.1
	Significant Observed Adverse Effect Level	VDVday($m/s^{1.75}$)	0.8
		VDVnight($m/s^{1.75}$)	0.4

Monitoring Locations – Brackley Lane

Monitor Type
Vibration

Install date
16/02/23

Monitoring – Results

Monitor has been set up to alert exceedances in-line with criteria for vulnerable buildings.

No exceedances have been recorded to date.

No vibratory activities ongoing in the area and results collected are helping to set a vibration baseline – this will help us identify future vibration issues when works are taking place and set representative exceedance limits.

Monitoring data has not undergone a full analysis, this information will be shared once available.

Part 3: Calvert Complaints Noise Data

BMS – Site Overview

Sheet piles are being installed along Sheephouse Wood between Ch. 76,750 and Ch.77+525 .

Sheet piles range between 12 – 20m in depth; sheet piled wall approx. 800m long.

Works are expected to be ongoing until end of April.

BMS – Works

Works involve:

- Step 1: Ground is pre-augered using an 'auger bore rig'
- Step 2: Sheet piles lifted into a vertical position using a 'leader rig'
- Step 3: Sheet piles are vibrated into place using a 'vibro hammer'
- Step 4: Pushing sheet piles to full depth using a 'impact hammer'

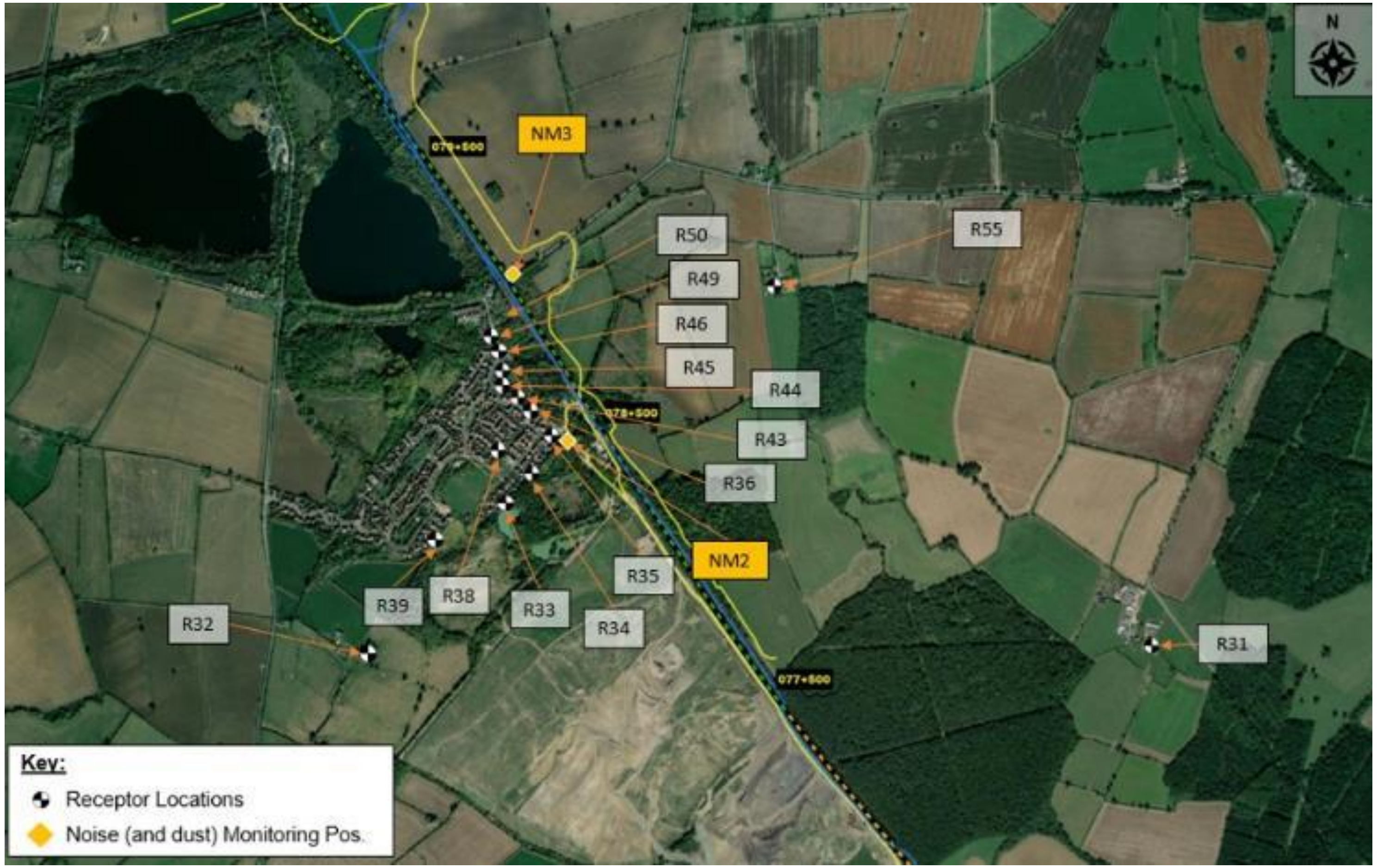
BMS – Site Photos

Step 1: Pre-augering


Step 4: Impact hammering


Installed sheet piles

BMS – Predicted Noise Levels (Activity)



Receptor I.D.	Receptor Address	Activity ID: 9.01 Activity: Bat Mitigation Structure : Phase 2 Sheet Piling
R31	Calvert Road, Middle Clayton	50
R32	Charndon, Bicester	<35
R33	Sandstone Close, Calvert	42
R34	Sandstone Close, Calvert	48
R35	9 Red Kite View	50
R36	Sandy Road, Calvert	35
R38	Heathers Close, Calvert	47
R39	Tudors Close, Calvert	40
R43	Brickhill Way, Calvert	41
R44	Brickhill Way, Calvert	39
R45	Cotswolds Way, Calvert	<35
R46	Cotswolds Way, Calvert	45
R49	Brackley Lane, Calvert	38
R50	12 Brackley Lane, Calvert	45
R55	Calvert Road, Steeple Clayton	45
NM2	NM – FCC Compound	44
NM3	NM – School Hill	39
NM7	NM – Woodlands	<35

Monitoring – Results (FCC)

08/02/23 - 23/02/23	
Day	Core Period LAeq (dB)
8.02	54.9
9.02	55.8
10.02	55.5
11.02 (5hr)	49.1
11.02 (10hr)	48.3
12.02 (10 hr)	47.8
13.02	54.8
14.02	55.4
15.02	55.9
16.02	58.3
17.02	55.3
20.02	57.6
21.02	55.7
22.02	60.3
23.02	60.5

Start time	1hr LAeq								
	8.02	14.02	15.02	16.02	17.02	20.02	21.02	22.02	23.02
08:00	55.4	55.5	57.9	58.6	56.9	55.8	56.6	58.4	61.5
09:00	58.1	56.0	56.6	59.8	56.8	54.1	55.6	63.5	63.2
10:00	54.0	54.8	55.2	56.6	55.8	54.0	55.4	60.8	62.4
11:00	55.6	54.5	57.7	57.5	55.8	57.2	56.4	59.5	62.6
12:00	56.7	55.6	57.7	59.2	56.9	64.8	59.0	62.3	61.0
13:00	56.1	55.6	54.3	59.7	55.2	52.6	52.6	60.1	57.6
14:00	53.7	55.8	54.8	59.7	56.3	56.7	58.1	62.0	60.3
15:00	52.5	56.2	55.1	57.7	53.9	54.2	55.2	60.4	59.0
16:00	51.7	55.6	55.9	57.6	50.2	54.1	50.4	53.5	53.8
17:00	49.8	54.3	47.6	52.1	45.0	51.5	46.8	52.3	52.6
10hr LAeq	**54.9**	**55.4**	**55.9**	**58.3**	**55.3**	**57.6**	**55.7**	**60.3**	**60.5**

11/02/23: Saturday 5hr LAeq = noise level during core working hours, 8am – 1pm; the noise level was 0.8 dB higher than the 10hr LAeq calculated between 8am – 6pm.

12/02/23: Sunday 10hr LAeq = noise levels representative of areas baseline noise level (minus weekday traffic noise); on day of complaints (8th and 14th February) 10hr LAeq not significantly higher than baseline (+7.1 dB and +7.6 dB)

Monitoring – Results (8th February 2023)

8th February: Piling Noise witnessed at Werner Terrace 9am to 12 mid day

- Complaint indicated noise was constant – data doesn't indicate elevated noise levels in the morning when the complaint was made.
- Between 9 – 10am noise levels increase by 3dB – caused by a spike of noise between 9:25 and 9:35 when noise increased by 6dB.
- The 10 hour LAeq for the working day was 54.9dB – marginally lower than the average day for a 4 month period last summer (55.1 dB).
- Data does not suggest any unusual activity or significant noise issue from the piling works and is well below the daytime LOAEL for construction works of 65dB.
- The average day predicted noise levels in the S61 application for this area were between 60 and 61 dB, so the actual was also well within this.

Monitoring – Results (14th February 2023)

14th February: Noise at 11:00am location/ duration unknown

- Complaint made at 11am – Noise from the FCC and School Hill monitor have been reviewed.

- FCC monitor didn't show any rise in noise at 11:00am – the hourly LAeq fell slightly.

- The FCC 10 hour LAeq for the working day was 55.4dB – slightly higher than the 08/02/23 (54.9) and 4 month average during summer 2022 (55.1 dB). Levels at the FCC were well below the LOAEL and the predicted noise level.

- The hourly LAeq at 11am fell slightly from 54.8dB to 54.5dB – School Hill monitor largely records compound noise and noise from the compound dominates the sound field.

- At 10:59 noise levels went up by approx. 9dB above the morning average – a sharp increase in noise of 9dB suggest the noise source was close by.

- The noise increase at 10.59 a short lived event – it's possible the source could have been from the housing estate, or something occurring immediately adjacent in the compound, road, or railway trace; increase cannot be attributed to sheet piling (no noise increase was detected at this time at the FCC monitor, which is closer to the worksite).

- The School Hill 10 hour LAeq for the working day was 55.4db – slightly higher the 4 month average during summer 2022 (51.8 dB) but below the maximum recorded LAeq (61.1dB). Levels at School Hill were well below the LOAEL and the predicted noise level.

Part 4: School Hill Overbridge Assessment

SHO – Site Overview

School Hill Overbridge is due to be demolished and replaced with a new overbridge.

Worksite is located at ch.79+050

OSGR = SP 68835 24749

In total there are 118 support piles to be constructed which a maximum depth of 36.1m and diameter of 1200mm.

Boreholes will be supported with bentonite during construction – bentonite is added during the drilling process, to add weight and, prevent the bore from collapsing and groundwater entering the pile.

Piles will be cast in-situ rotary bored piles .

SHO – Works

Rotary bored piling will construct School Hill Overbridge concrete support piles.

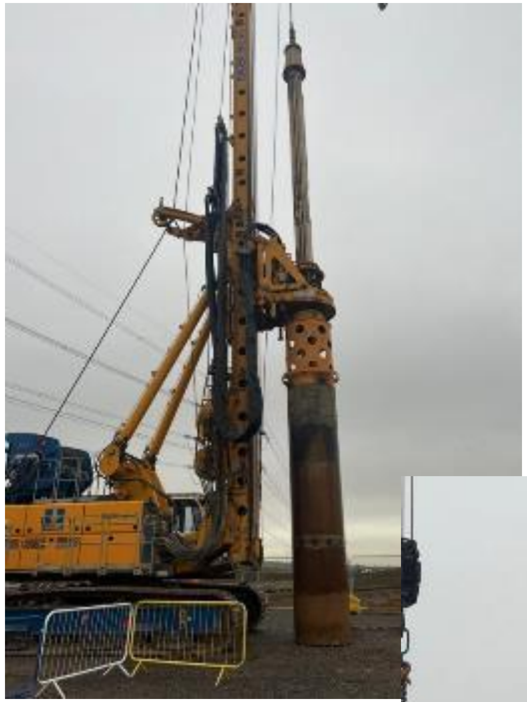
Works involve:

- Step 1: Excavation of pile using a ‘rotary bored piling rig’
- Step 2: Periodically, during the excavation process, the drill head will be removed from the excavation hole to ‘spin off’ excavated material
- Step 3: Installation of rebar reinforcement cages using a ‘crawler crane’
- Step 4: Concreting of pile using a ‘concrete wagon’

PERRY HILL OB SITE

SHO – Example Works

EDGCOTT ROAD OB SITE



SHO – Programme

Existing School Hill Overbridge is due to be demolished in April 2023.

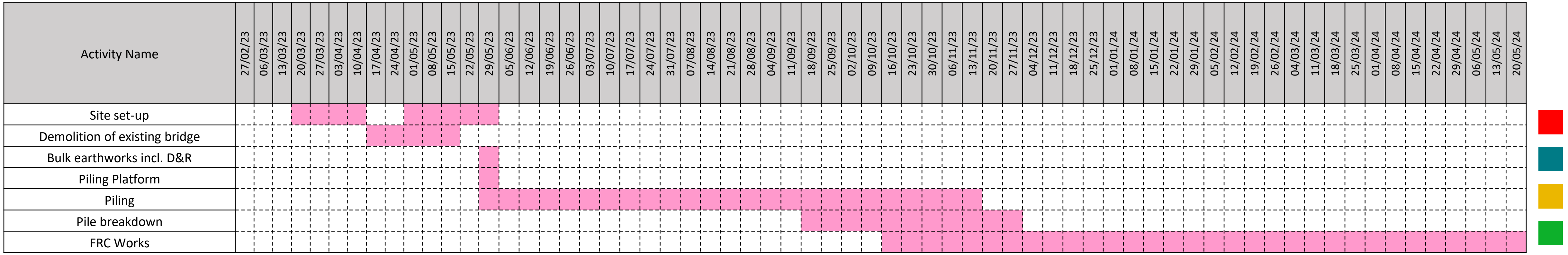
Earthworks for School Hill Overbridge due to start and finish in May / June 2023.

Piling works due to start May 2023 and finish November 2023.

Pile breakdown due to start September 2023 and finish November 2023.

FRC (formwork reinforced concrete) works due to start October 2023 and will be ongoing throughout 2024.

Note: programme subject to change and governed by road closures in the area



SHO – Predicted Noise Levels (Activity)

Receptor I.D.	Receptor Address	Activity ID:	6.01	6.02	6.03	6.04	6.05
			School Hill Overbridge				
		Activity:	Site Setup	Demolition of existing bridge	Bulk excavation incl. topsoil strip and D&R	Piling Platform incl. drainage system	Piling
R1	Cotswolds Way - Cotswolds Way, Calvert		<35	<35	<35	<35	<35
R2	284303 - Tudors Close, Calvert		36	42	39	40	39
R3	284685 - Sandstone Close, Calvert		<35	36	<35	35	<35
R4	283758 - Cotswolds Way, Calvert		<35	41	38	39	38
R5	284026 - Kiln Close, Calvert		36	43	39	40	39
R6	284336 - Cotswolds Way, Calvert		37	43	40	42	40
R7	Grebe Cl - Grebe Close, Calvert		36	42	39	40	39
R8	285709 - Heathers Close, Calvert		38	44	42	43	42
R9	Red Kite View - Red Kite View, Calvert		<35	39	37	38	37
R10	284438 - Kiln Close, Calvert		38	45	42	43	41
R11	Kiln Close - Kiln Close, Calvert		38	44	41	42	41
R12	285332 - Rustics Close, Calvert		42	49	45	46	45
R13	284834 - Sandy Road, Calvert		43	50	46	47	46
R14	285533 - Cotswolds Way, Calvert		46	53	49	50	49
R15	286928 - Sandy Road, Calvert		49	56	51	52	51
R16	285268 - Brindles Close, Calvert		43	49	46	47	46
R17	285731 - Cotswolds Way, Calvert		47	53	50	51	51
R18	286466 - Werner Terrace, Calvert		47	53	51	52	52
R19	286631 - Brackley Lane, Calvert		62	70	65	66	66
R20	286608 - Brackley Lane Calvert		62	69	64	65	65
R21	Itter Lane - Itter Lane, Calvert		42	48	45	46	46
R22	Grebe Close - Grebe Close, Calvert		42	49	45	46	46
R23	Brickhill Way - Brickhill Way, Calvert		43	50	46	47	47
R24	285186 - Sandy Road, Calvert		44	51	47	48	48
R25	285447 - Cotswolds Way, Calvert		43	49	46	47	47
R26	285464 - Brickhill Way, Calvert		44	51	48	49	49
R27	285737 - Cotswolds Way, Calvert		55	62	57	58	58
R28	286585 - Brackley Lane, Calvert		52	59	55	56	56
R29	286616 - Brackley Lane, Calvert		65	73	68	69	69
R30	286506 - Werner Terrace, Calvert		64	71	66	67	67

Vibration Risk Assessments – SHO

Vibration risk assessment (VRA) has been completed for School Hill Overbridge piling activities.

Assessment Factors

- Considered 10 properties along Werner Terrace and Brackley Lane.
- Considered building damage risk and human response.
- Taken 12 / 13 Brackley Lane to be the closest sensitive receptor (46m)
- Considered the operation of 2 x rotary bored piling rigs
- Considered vibration from ‘augering’, ‘auger hitting base of hole’ and ‘auger spinning off’
- Applied measured plant values and completed vibration calculations outlined in British Standard documents
- Assumed plant % on times based on site experience.

Vibration Risk Assessments – SHO

Receptor		Works Activity			Vibration Generating Plant					PPV Predicted, mms^{-1}			VDV Predicted, $ms^{-1.75}$				
Receptor ID	Receptor Name	Activity ID	Activity Name	Distance to Receptor, m	Type	No. Plant	Plant Activity	Operation Mode	Operational On Time (s)	V_{res}	Criteria	Pass/Fail	Free Field (VDV_{day})	Ground Floor (VDV_{day})	First Floor (VDV_{day})	Criteria	Pass / Fail [3][4]
R44	Brickhill Way, Calvert	6.5	Rotary Bored Piling	307	Rotary Bored Piling Rig	2	Augering	N/A	27216	0.001	3 [1]	Pass	0.0003	0.0007	0.0013	0.8	Pass
							Auger Hitting Base of Hole	N/A	504	0.021	3 [1]	Pass	0.0052	0.0104	0.0209	0.8	Pass
							Spinning off	N/A	5040	0.001	6 [2]	Pass	0.0002	0.0007	0.0013	0.8	Pass
R45	Cotswolds Way, Calvert	6.5	Rotary Bored Piling	287	Rotary Bored Piling Rig	2	Augering	N/A	27216	0.001	3 [1]	Pass	0.0004	0.0007	0.0014	0.8	Pass
							Auger Hitting Base of Hole	N/A	504	0.023	3 [1]	Pass	0.0057	0.0113	0.0226	0.8	Pass
							Spinning off	N/A	5040	0.001	6 [2]	Pass	0.0002	0.0007	0.0007	0.8	Pass
R46	Cotswolds Way, Calvert	6.5	Rotary Bored Piling	240	Rotary Bored Piling Rig	2	Augering	N/A	27216	0.001	3 [1]	Pass	0.0004	0.0009	0.0018	0.8	Pass
							Auger Hitting Base of Hole	N/A	504	0.029	3 [1]	Pass	0.0070	0.0140	0.0281	0.8	Pass
							Spinning off	N/A	5040	0.001	6 [2]	Pass	0.0002	0.0009	0.0018	0.8	Pass
R47	Cotswolds Way, Calvert	6.5	Rotary Bored Piling	320	Rotary Bored Piling Rig	2	Augering	N/A	27216	0.000	3 [1]	Pass	0.0003	0.0006	0.0013	0.8	Pass
							Auger Hitting Base of Hole	N/A	504	0.020	3 [1]	Pass	0.0050	0.0099	0.0198	0.8	Pass
							Spinning off	N/A	5040	0.001	6 [2]	Pass	0.0002	0.0006	0.0012	0.8	Pass
R49	Brackley Lane, Calvert	6.5	Rotary Bored Piling	97	Rotary Bored Piling Rig	2	Augering	N/A	27216	0.002	3 [1]	Pass	0.0013	0.0027	0.0053	0.8	Pass
							Auger Hitting Base of Hole	N/A	504	0.085	3 [1]	Pass	0.0208	0.0416	0.0832	0.8	Pass
							Spinning off	N/A	5040	0.003	6 [2]	Pass	0.0007	0.0026	0.0052	0.8	Pass
R50	12 Brackley Lane, Calvert	6.5	Rotary Bored Piling	46	Rotary Bored Piling Rig	2	Augering	N/A	27216	0.005	3 [1]	Pass	0.0032	0.0065	0.0130	0.8	Pass
							Auger Hitting Base of Hole	N/A	504	0.208	3 [1]	Pass	0.0509	0.1019	0.2038	0.8	Pass
							Spinning off	N/A	5040	0.007	6 [2]	Pass	0.0017	0.0064	0.0128	0.8	Pass

Maximum predicted PPV = 0.208 mm/s

Lower limit for building damage = 3 mm/s

Predictions are 15x less than lower limit.

Maximum predicted VDV = 0.2423 $m/s^{1.75}$

Daytime LOAEL for human exposure = 0.2 $m/s^{1.75}$

Predicted levels indicate vibration could be perceivable.

Receptor ID	Activity Name	Plant	Monthly VDV_{day}
			Jan-23
R44	Single piling rig operating Cumulative effect of both piling rigs	Rotary Bored Drilling Rig [1] Rotary Bored Drilling Rig [1]	0.0209 0.0248
R45	Single piling rig operating Cumulative effect of both piling rigs	Rotary Bored Drilling Rig [1] Rotary Bored Drilling Rig [1]	0.0226 0.0269
R46	Single piling rig operating Cumulative effect of both piling rigs	Rotary Bored Drilling Rig [1] Rotary Bored Drilling Rig [1]	0.0281 0.0334
R47	Single piling rig operating Cumulative effect of both piling rigs	Rotary Bored Drilling Rig [1] Rotary Bored Drilling Rig [1]	0.0198 0.0235
R49	Single piling rig operating Cumulative effect of both piling rigs	Rotary Bored Drilling Rig [1] Rotary Bored Drilling Rig [1]	0.0832 0.0990
R50	Single piling rig operating Cumulative effect of both piling rigs	Rotary Bored Drilling Rig [1] Rotary Bored Drilling Rig [1]	0.2038 0.2423
R51	Single piling rig operating Cumulative effect of both piling rigs	Rotary Bored Drilling Rig [1] Rotary Bored Drilling Rig [1]	0.1133 0.1348
R52	Single piling rig operating Cumulative effect of both piling rigs	Rotary Bored Drilling Rig [1] Rotary Bored Drilling Rig [1]	0.1719 0.2045
R53	Single piling rig operating Cumulative effect of both piling rigs	Rotary Bored Drilling Rig [1] Rotary Bored Drilling Rig [1]	0.0803 0.0954
R53	Single piling rig operating Cumulative effect of both piling rigs	Rotary Bored Drilling Rig [1] Rotary Bored Drilling Rig [1]	0.0413 0.0491

Vibration Risk Assessments – SHO

Assessment Conclusion

- Predicted vibration levels (PPV) are not expected to exceed any of the criteria for cosmetic building damage specified within the HS2 CoCP based on cautious predictions.
- Predicted daytime vibration dose values (VDV_{day}) are predicted to be the highest at R50 and R52 (12 and 13 Brackley Lane)
- Predicted daytime vibration dose values (VDV_{day}) are not expected to exceed the SOAEL impact threshold of 0.8 $ms^{-1.75}$ VDV_{day} for human disturbance inside the nearby residential properties.
- The potential for harmful effects at the nearby residential properties in Calvert due to EKFB's works are low.
- It is likely that vibration from the works will be perceptible at the closest receptors.