Rosefield Solar Farm

Applicant's Response to Action Point 39 from ISH1

EN010158/APP/8.27
Deadline 4
June 2026
Rosefield Energyfarm Limited

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1. Vibration Technical Note

1.1. Introduction

1.1.1. This technical note has been prepared in response to Action Point 39 of Issue Specific Hearing 1 (ISH1) which required the Applicant to 'provide a technical note on its position on noise and vibration with respect to piling and substantiate why it would not exceed the relevant threshold criteria'.

1.1.2. Noise impacts associated with the percussive piling works form part of the assessment presented in **ES Volume 2, Chapter 13: Noise and Vibration [EN010158/APP/6.2.3]**.

1.2. Piling Vibration – Assessment Methodology

1.2.1. BS 5228-2:2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites – Vibration' (BS 5228-2) provides guidance on vibration levels that can be used to assess the likely impacts of construction activities. Annex E of the standard sets out empirical formulae for the prediction of peak particle velocity (PPV) vibration levels for various types of construction works, including percussive piling works. The formula for calculating groundborne vibration for percussive piling works is presented below:

$$v_{res} \leqslant k_p \left[\frac{\sqrt{W}}{r^{1.3}} \right]$$

Vres = Resultant PPV, in millimetres per second (mm/s)

kp = Scaling factor depending on soil type

W = Nominal hammer energy of piling rig, in joules

r = slope distance from the pile toe to receptor, in metres

Values of k_p for use in predictions of vibration from percussive piling

Ground conditions	Value of k_p
All piles driven to refusal	5
Pile toe being driven through:	
Very stiff cohesive soils	3
Dense granular soils	
Fill containing obstructions which are large relative to the pile cross-section	
Pile toe not being driven through:	
Stiff cohesive soils	1.5
Medium dense granular soils	
Compacted fill	
Pile toe being driven through:	
Soft cohesive soils	1
Loose granular soils	
Loose fill	
Organic soils	

1.2.2. For the purposes of the assessment, piling hammer energy values of 950 joules and 1200 joules have been considered. This reflects the typical range of hammer energy for specialist Solar PV piling rigs, as presented in the examples provided below. In both instances, a pile toe depth of 3m has been adopted, which has been informed by the Applicant's Engineering Team.

Figure 1: MGI Tonker 830 PV piling rig

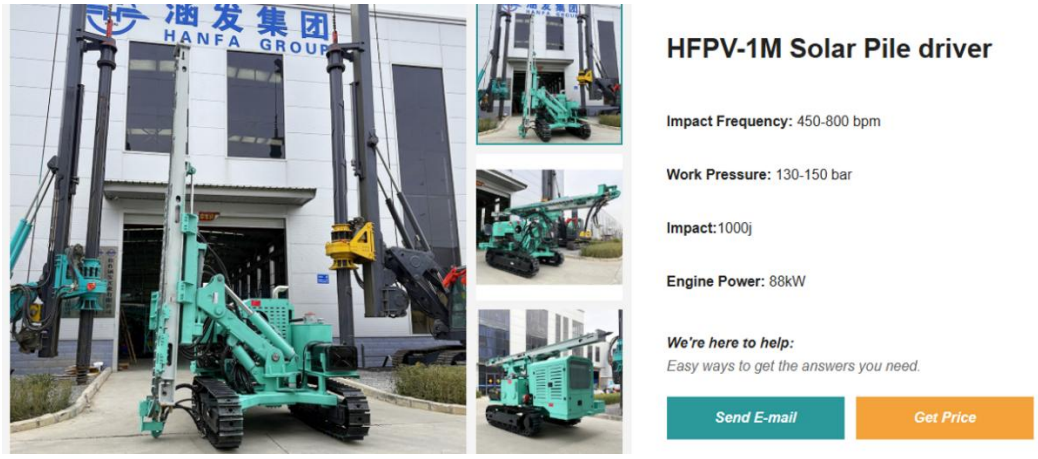

Figure 2: Hanfa Group HFPV-1M piling rig

1.2.3. The predicted vibration levels have been assessed against the relevant PPV threshold levels within BS 5228-2. Annex B of BS 5228-2 provides guidance on the significance of vibration effects in terms of human response to vibration and also structural response. The human perception and disturbance effect thresholds are presented in **Table 1** below.

Table 1: Guidance on effects of vibration levels perceptible to humans

Vibration level (PPV)	Effect
0.14mm/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
0.3mm/s	Vibration might be just perceptible in residential environments
1.0mm/s	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents
10mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level

1.2.4. For human receptors, a PPV vibration level of 1.0mm/s has been adopted within **ES Volume 2, Chapter 13: Noise and Vibration [EN010158/APP/6.2.3]** as the threshold for potentially significant vibration impacts. Beyond this level, BS5228-2 states that it is likely that vibration in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.

1.2.5. Considerably greater levels of vibration are required to cause cosmetic damage to buildings and structures, with BS 7385-2:1993 *'Evaluation and measurement for vibration in buildings - Guide to damage levels from groundborne vibration'* noting that the probability of damage tends towards zero at 12.5mm/s peak component particle velocity.

1.3. Piling Vibration – Appraisal of Results

1.3.1. **Table 2** and **Table 3** present the predicted groundborne vibration levels associated with percussive piling works, for nominal hammer energy values of 950 joules and 1200 joules respectively.

Table 2: Vibration generated by percussive piling works (950 joules hammer energy)

Scaling factor (k_p)	PPV vibration level at a range of setback distances, mm/s									
	10m	20m	30m	40m	50m	60m	70m	80m	90m	100m
$k_p = 5$	7.3	3.1	1.8	1.3	1.0	0.8	0.6	0.5	0.4	0.4

Scaling factor (k_p)	PPV vibration level at a range of setback distances, mm/s									
	10m	20m	30m	40m	50m	60m	70m	80m	90m	100m
k_p = 3	4.4	1.9	1.1	0.8	0.6	0.5	0.4	0.3	0.3	0.2
k_p = 1.5	2.2	0.9	0.6	0.4	0.3	0.3	0.2	0.2	0.1	0.1
k_p = 1	1.5	0.6	0.4	0.3	0.2	0.2	0.1	0.1	0.1	0.1

Table 3: Vibration generated by percussive piling works (1200 joules hammer energy)

Scaling factor (k_p)	PPV vibration level at a range of setback distances, mm/s									
	10m	20m	30m	40m	50m	60m	70m	80m	90m	100m
k_p = 5	8.2	3.5	2.1	1.4	1.1	0.8	0.7	0.6	0.5	0.4
k_p = 3	4.9	2.1	1.2	0.9	0.6	0.5	0.4	0.3	0.3	0.3
k_p = 1.5	2.5	1.0	0.6	0.4	0.3	0.3	0.2	0.2	0.1	0.1
k_p = 1	1.6	0.7	0.4	0.3	0.2	0.2	0.1	0.1	0.1	0.1

1.3.2. Based on a worst-case k_p scaling factor value of five for piles being driven to refusal, the 1mm/s PPV significance criterion has the potential to be exceeded when piling works are taking place within approximately 50m of residential properties. The piling works would not take place within this threshold distance, and therefore, the vibration levels generated by the percussive piling works would not give rise to significant adverse effects.

1.3.3. When piles are not being driven to refusal, the resultant vibration levels would be lower, owing to the reduced k_p scaling factor, as shown in **Table 2** and **Table 3**.

1.3.4. Piling works for the Solar PV mounting structure would be a highly transient activity, with each pile typically taking less than a minute to install. As a result, percussive piling works taking place in the vicinity of a sensitive receptor would only occur for a limited period of time.

1.3.5. If groundborne vibration has the potential to adversely affect livestock in adjacent fields, alternative rotary bored piling techniques could be adopted in specific locations. This would be established through appropriate consultation with the relevant agricultural tenants. Where specific concerns are raised, temporary measures would be introduced to reduce

the construction induced vibration levels. This is captured and secured within the **Outline Construction Environmental Management Plan (Outline CEMP) [EN010158/APP/7.2.5]**.

1.4. Conclusion

1.4.1. Overall, piling works would not take place within 50m of residential properties, and therefore, the vibration levels generated by the works would not give rise to significant adverse effects. This is secured in the **Design Commitments [EN010158/APP/5.9.6]**, updated at Deadline 4.

1.4.2. In regards to livestock, where specific concerns are raised, temporary measures would be introduced to reduce the construction induced vibration levels. This is captured and secured within the **Outline CEMP [EN010158/APP/7.2.5]**.

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