An Independent Review of the Financial Viability Assessment

Submitted in Support of Planning Application 16/05464

for the Extraction of Sand at Freeth Farm

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Summary

Hills Quarry Products Limited (HQPL) have submitted revised ROMP (3809/NW) planning application 16/05464 and planning application 16/05708 to extract a small tonnage (circa 307,000 te) of sand and transport it by open conveyor to Sands Farm whose planning permission (N/10/03280/WCM) expires on 30 November 2022. The extraction area is a recently designated SHINE Monument and extends to around 11 hectares close to 4 dwellings at Freeth Farm and is around 1km from the majority of houses in Compton Bassett.

The latest revised application proposes (inter alia) a 35m buffer zone and involves the construction of 4m high x 19m wide noise attenuation bunds using 27,000 te of sandy top soil starting at 16m from the Freeth Farm Cottage boundaries, impairing the visual amenity for a 2 year period and creating a carcinogenic silica dust hazard.

A buffer zone of 35m from the property boundaries is not in line with the normal UK planning authority practice of 100m; does not meet the DoE planning guide (100m); does not meet the Institute of Air Quality Management (IAQM) guidance (100m); cannot achieve statutory noise limits and poses a carcinogenic silica dust health hazard.

The proposal has little social and commercial merit and does not provide adequate environmental protection for the local community who have sent in over 600 letters of objection, including a number of legal representations.

HQPL have claimed that the development is only just economic with an IRR of 9.3% so any increase in the buffer zone from 35m would make the development uneconomic based on their Financial Viability Assessment (FVA) which has only recently been made available.

This report shows that HQPL's FVA has grossly underestimated the available sand tonnage by using the incorrect density for compacted sand; exaggerated sand extraction and processing losses; and has ignored the significant residual capital value of the conveyors and loading shovels, one of which will only be 2 years old when the 6 year extraction is completed. The project IRR is significantly increased by each of these three factors.

This report shows that the true IRR for the project with a 35m buffer zone is 30% and that the project would remain commercially viable with an IRR of 21% for an increase in the buffer zone to 84m, which is equivalent to a buffer zone of 100m from the main property. The project would still achieve an IRR of 17.7% even using HQPL's exaggerated sand losses.

It can be reliably concluded that the buffer zone can be increased to 84m from the Freeth Farm Cottages property boundaries and HQPL would still be able to achieve a return of 18-21% IRR which is significantly higher than the 9.3% IRR in the current proposal.

This would mean that HQPL's project would remain commercially viable in line with UK mineral extraction norms; would meet statutory noise limits without the need for any 4m high visually intrusive noise attenuation bunds; would remove the carcinogenic silica dust risk; and would have the additional benefits of providing proper environmental protection for local residents and removing the risk of legal challenge.

It is recommended that the planning conditions are revised to include a buffer zone of 84m, together with continuous noise monitoring in line with best practices for mineral extraction.

Conclusions

1. HQPL's Financial Viability Assessment is incorrect and has grossly underestimated the commercial viability (IRR 9.3%) by using an incorrect value for the compacted sand density; exaggerated sand losses from extraction and processing and by assigning zero residual capital value to conveyors that would be only 6 years old and a loading shovel that would be only 2 years old at completion.

2. If the measured density for compacted Freeth Farm sand is used, combined with normal extraction losses quoted by DEFRA (although this is not critical) and appropriate residual capital values for the conveyors and loading shovels, as confirmed by Wiltshire Council's own independent assessment), then the IRR is 30%.

3. The buffer zone can be increased to 84m from the Freeth Farm Cottage property boundary (100m from the Freeth Farm Cottage itself), then the IRR would be 21.0% which is significantly greater than the level of commercial viability incorrectly claimed by HPQL.

4. The commercial viability of the 84m buffer zone is robust, if HQPL's sand extraction and processing losses (15%) are used, the sand tonnages would remain in line with HQPL's initial extraction estimate of 307,200 te and the IRR would be 17.7%.

5. A buffer zone of 84m (100m from Freeth Farm Cottages) would be in line with UK buffer zone norms; the noise levels would be within statutory limits without the need for the intrusive 4m high noise attenuation bunds; and the carcinogenic silica dust levels would meet the Institute of Air Quality Management guidelines and HQPL would still be able to achieve returns of 17.7-21% IRR which is well in excess of 9.3% IRR.

6. Planning conditions should be revised to include a buffer zone of 84m, together with continuous noise monitoring in line with best practices for mineral extraction.

Introduction

Hills Quarry Products Limited ("HPQL") have submitted revised ROMP (3809/NW) planning application 16/05464 and planning application 16/05708 to extract a small tonnage (circa 300,000 te) of sand and transport it by open conveyor to Sands Farm whose planning permission (N/10/03280/WCM) expires on 30 November 2022.

The extraction area is a recently designated SHINE Monument and extends to around 11 hectares close to 4 dwellings at Freeth Farm and is around 1km from the majority of houses in Compton Bassett.

HPQL's original ROMP application in 2016 originally proposed a derisory buffer zone of 10m from the boundaries of Freeth Farm Cottages.

The guidance on quarry dust from the Institute of Air Quality Management shows that statutory dust limits are likely to be exceeded for quarries located at distances of less than 50m from adjacent properties. The typical buffer zone around sand quarries in the UK is around 100m to keep any exposure to carcinogenic silica dust to safe levels and to maintain noise levels to within statutory limits.

HQPL's proposed 10m buffer zone not only breached statutory noise levels to a very significant extent but also posed a significant health risk as the Freeth Farm sand is exceptionally fine as confirmed by HQPL's consultants.

In addition, the minimal 10m buffer zone was not sufficient to prevent future subsidence of the adjacent properties, particularly as HQPL's consultants had used an incorrect cohesion factor value of 4kPa that was appropriate to sandstone rock. The appropriate cohesion factor value for a mineral deposit of compacted sand is less than 2kPa so that the edges of the proposed excavation would be unstable and that a greater buffer zone than 10m would be required to ensure a safe level of stability against future subsidence.

As a result, HQPL proposed an increase in the buffer zone from 10m to 35m together with the construction of 4m high x 19m wide noise attenuation bunds starting at 16m from the property boundaries and partly surrounding Freeth Farm Cottages for a period of up to 2 years, with a significant increase in the carcinogenic dust exposure risk together with external noise levels above statutory limits and internal noise levels that were likely to be around 20dB in excess of those allowed by BS8233:2014 and which were also likely to exceed the Significant Observed Adverse Effect Level (SOAEL), both of which are unlawful.

Wiltshire Council *"mooted"* a further extension of the 35m buffer zone but that this was resisted by HQPL on the grounds that it would *"cause the project to be financially unviable"*.

The 35m buffer zone and giant 4m noise attenuation bunds can only achieve a noise level of 47dB during sand extraction which exceeds the statutory limit for normal operations (background + 10dB) in all years of the proposed development, with noise levels of 70dB during temporary operations (mainly top-soil stripping for bund construction/removal) for 8 weeks per year over a period of 6 years, amounting to nearly a year of exposure to 70dB noise during the course of the proposed development.

HPQL argued that the development would be rendered uneconomic by any increase in the proposed 35m buffer zone and that Wiltshire Council should agree to planning conditions that did not meet statutory noise and health limitations and did not provide adequate environmental protection for local residents.

HPQL produced a Financial Viability Assessment ("FVA") together with some additional documents to support their economic arguments but kept the details secret on the grounds that they were commercially confidential.

A number of these documents, including the FVA have now been obtained under the Freedom of Information Act and some have been supplied by Wiltshire Council following an expert legal opinion advising Wiltshire Council officer's that *"failure to provide the background material underpinning the viability assessment in the present case, in circumstances where such material as was in the public domain was opaque and incoherent, was a clear and material legal error in the decision-taking process".*

This report critically examines the additional documents that have been obtained, including HPQL's FVA with particular emphasis on the commercial viability and the level of environmental protection that can be achieved with an increased buffer zone.

Financial Viability Assessment

HPQL's FVA initial assessment dated 21 November 2018 for the "higher tonnage" of 323,000 te saleable sand, available with a 10m buffer zone showed a return on investment (IRR) of 11.1%, as shown below and given in more detail in Appendix 1.

Year	2019	2020	2021	2022	2023	2024
Tonnes of Sand		75,000	75,000	75,000	75,000	23,000
Price		14.65	14.65	14.65	14.65	14.65
Sales Income		1,098,750	1,098,750	1,098,750	1,098,750	336,950
Land Resale						287,500
Total Income	0	1,098,750	1,098,750	1,098,750	1,098,750	624,450
Variable Costs		190,500	190,500	190,500	190,500	58,420
Fixed Costs		264,700	264,700	264,700	264,700	81,175
Capital	2,119,114			220,000		
Total Costs	2,119,114	455,200	455,200	675,200	455,200	139,595
Net Profit	-2,119,114	643,550	643,550	423,550	643,550	484,855
					IRR	11.08%

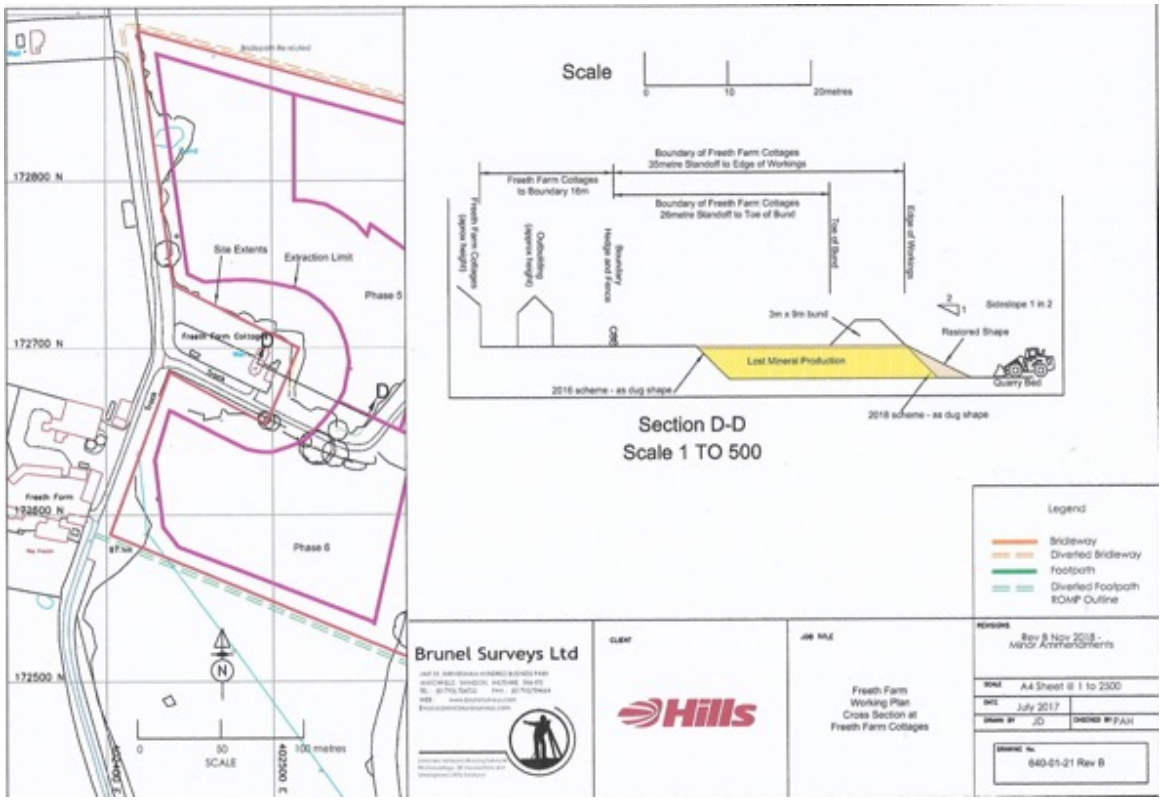
HPQL's FVA second assessment dated 21 November 2018 for the "lower tonnage" of 307,200 te saleable sand, available with a 35m buffer zone showed a return on investment (IRR) of 9.3%, as shown below and given in more detail in Appendix 1.

Year	2019	2020	2021	2022	2023	2024
Tonnes		75,000	75,000	75,000	75,000	7,200
Price		14.65	14.65	14.65	14.65	14.65
Sales Income		1,098,750	1,098,750	1,098,750	1,098,750	105,480
Land Resale						287,500
Total Income	0	1,098,750	1,098,750	1,098,750	1,098,750	392,980
Variable Costs		193,393	193,393	193,393	193,393	18,566
Fixed Costs		264,700	264,700	264,700	264,700	25,411
Capital	2,118,724			220,000		
Total Costs	2,118,724	458,093	458,093	678,093	458,093	43,977
Profit	-2,118,724	640,657	640,657	420,657	640,657	349,003
					IRR	9.27%

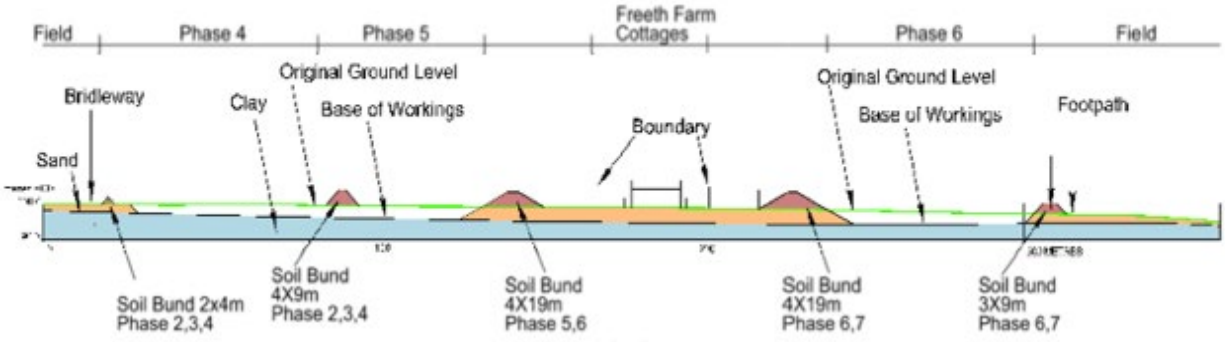
Key Assumptions:

1. Buffer Zone 10m and 35m from Freeth Farm Cottage Boundary
2. Sand Density 1.5 te/m^3
3. Sand Extraction Losses 15%
4. No residual value for conveyors or loading shovels

The sand tonnages were calculated by Brunel Surveys Limited using a 3D model to estimate the extracted volumes based on the bore hole depths and then estimated the amount of sand lost as a result of increasing the buffer zone from 10m to 35m (referred to below as a stand-off distance). The lost mineral production from the increase in buffer zone is shown in yellow in the diagram below, as taken from HQPL's submission.



Note: The noise attenuation bund dimensions shown above are incorrect as they would actually be 4m high and 15m wide (as shown below) and not 3m high and 9m wide (as shown above). However, as the bunds are constructed using top soil, they do not affect the amount of sand available for extraction or the amount of lost sand production due to the increase in buffer zone from 10m to 35m as measured from the boundary of Freeth Farm Cottages to the edge of the workings.



HPQL argued (Freeth Farm Quarry ROMP Viability Assessment, page 2, para 1.7) that the original application volume of 323,000 te (10m buffer zone) was known to be viable but the further reduction to 307,200 te (35m buffer zone) *"is shown in the financial model to reduce*

the commercial viability (as measured by the Internal Rate of Return) of the project to a position of very marginal commercial viability".

HPQL also stated (Freeth Farm Quarry ROMP Viability Assessment, page 2, para 1.8) that *"The project now sits precariously on the edge of viability. Should the available sand reserve be reduced any further to achieve any additional perceived acoustic benefit, the deliverability of the development would not be guaranteed and in all probability will not proceed".*

However, as with the incorrect cohesion factor value used by HQPL's geotechnical consultants to justify the 10m buffer zone, Brunel Surveys Limited have similarly used an incorrect value for the density of compacted sand to justify the 35m buffer zone and have exaggerated the likely sand extraction losses by assuming a value of 15%, although this is not a critical factor.

The following sections will show that if the correct density for compacted sand is used combined with normal extraction losses of 10% as quoted by DEFRA (although this is not critical) and appropriate residual values for the conveyors and loading shovels (as recommended by Wiltshire Council's independent consultant), then the IRR is actually 29-33%, depending on the assumed extraction losses.

The following sections will also show that the buffer zone can be increased to 84m from the Freeth Farm Cottage property boundary (100m from Freeth Farm Cottage itself), then the IRR would be 21.0% which is significantly greater than the level of commercial viability incorrectly claimed by HPQL.

A buffer zone of 100m from Freeth Farm Cottages would be in line with UK buffer zone norms; the noise levels would be within statutory limits without the need for the intrusive 4m high noise attenuation bunds; and the carcinogenic silica dust levels would meet the Institute of Air Quality Management guidelines with no loss of commercial viability.

Density of Compacted Sand

This section shows that the Brunel Surveys Limited report entitled "*Report on Volume Reduction Due to Noise Mitigation"*, dated 27 March 2019 has assumed an incorrect value for the density of compacted sand (1.5 te/m^3) which is then used in combination with the estimated mineral resource volume to calculate the saleable sand tonnage and thereby assess the likely commercial viability. However, using an incorrect density for compacted sand means that the mineral resource volume estimated using their 3D analysis of the site has been converted into an incorrect saleable tonnage.

Note: The additional effect of reduced sand extraction losses on the commercial viability are calculated in the next section.

The Brunel Surveys Limited report states that their June 2015 estimate of the saleable quantity of sand for a 10m buffer zone was as follows:

> *"By modelling, total resource volume is 253,333 m3. Anticipated extraction and processing losses 15% of total - remaining volume 215,333 m3. Saleable sand quantity at 1.5 tonnes per cubic metre 323,000 tonnes".*

In relation to HQPL's March 2018 proposal of a 35m buffer zone the above report also states that:

> *"The March 2018 revised sand production area has been reduced by 3,561 m2. this represents a reduction in the resource of 3.5% and a reduction in the saleable tonnage of 15,800 tonnes. The saleable quantity in the March 2018 scheme is calculated to be 307,200 tonnes".*

Brunel Surveys Limited selected value of "*1.5 tonnes per cubic metre"* for the density of compacted sand is incorrect.

Values for the density of compacted sand taken from the literature are in the range 1.682 to 1.870 tonnes per cubic metre (1682-1870 kg/m^3) as shown in Appendix 2.

However, a sample of Freeth Farm sand taken from close to borehole FR091/88 has been measured using a modified Proctor method. This measurement shows that the average compacted sand density for Freeth Farm sand was 1.700-1.770 tonnes per cubic metre, which represents an average of 1.735 tonnes per cubic metre (1.735 te/m^3).

If the correct sand density of 1.735 tonnes per cubic metre is used, with the exaggerated extraction and production losses of 15%, then the saleable sand quantity with a buffer zone of 35m is around 355,328 te (and not 307,200 te) and the IRR increases to 20.12%, as shown below.

	2019	2020	2021	2022	2023	2024
Tonnes		**86,750**	**86,750**	**86,750**	**86,750**	**8,328**
Price		**14.65**	**14.65**	**14.65**	**14.65**	**14.65**
Sales Income		**1,270,888**	**1,270,888**	**1,270,888**	**1,270,888**	**122,005**
Land Resale						**287,500**
Total Income	**0**	**1,270,888**	**1,270,888**	**1,270,888**	**1,270,888**	**409,505**
Variable Costs		**193,393**	**193,393**	**193,393**	**193,393**	**18,566**
Fixed Costs		**264,700**	**264,700**	**264,700**	**264,700**	**25,411**
Capital	**2,118,724**			**220,000**		
Total Costs	**2,118,724**	**458,093**	**458,093**	**678,093**	**458,093**	**43,977**
Profit	**-2,118,724**	**812,795**	**812,795**	**592,795**	**812,795**	**365,528**
					IRR	**20.12%**

Key Assumptions:

1. Buffer Zone 35m from Freeth Farm Cottage Boundary
2. Sand Density 1.735 te/m^3
3. Sand Extraction Losses 15%
4. No residual value for conveyors or loading shovels

Sand Extraction Losses

This section shows that the Brunel Surveys Limited report entitled "*Report on Volume Reduction Due to Noise Mitigation"*, dated 27 March 2019 has used an exaggerated value for the sand extraction losses of 15% and so that the saleable sand tonnage has been underestimated, which in turn means that the commercial viability (IRR) has been underestimated.

The Brunel Surveys Limited report states that their June 2015 estimate of the saleable quantity of sand for a 10m buffer zone was as follows: *"By modelling, total resource volume is 253,333 m3. Anticipated extraction and processing losses 15% of total - remaining volume 215,333 m3. Saleable sand quantity at 1.5 tonnes per cubic metre 323,000 tonnes".*

The extraction and processing losses are more likely to be around 10% according to research funded through Defra's Aggregates Levy Sustainability Fund where the ratio of waste to saleable product by weight is shown to be 1:9, which is equivalent to 10% sand losses during extraction and processing. This is confirmed in the extracted page shown in Appendix 2, taken from the Quarry Fines & Waste Guide by C. Mitchell, 2007.

If the correct sand density of 1.735 tonnes per cubic metre is used, and the extraction and processing losses are limited to 10%, then the saleable sand quantity with a buffer zone of 35m is around 373,094 te and the IRR increases to 23.99%.

	2019	2020	2021	2022	2023	2024
Tonnes		**91,088**	**91,088**	**91,088**	**91,088**	**8,744**
Price		**14.65**	**14.65**	**14.65**	**14.65**	**14.65**
Sales Income		**1,334,432**	**1,334,432**	**1,334,432**	**1,334,432**	**128,105**
Land Resale						**287,500**
Total Income	**0**	**1,334,432**	**1,334,432**	**1,334,432**	**1,334,432**	**415,605**
Variable Costs		**193,393**	**193,393**	**193,393**	**193,393**	**18,566**
Fixed Costs		**264,700**	**264,700**	**264,700**	**264,700**	**25,411**
Capital	**2,118,724**			**220,000**		
Total Costs	**2,118,724**	**458,093**	**458,093**	**678,093**	**458,093**	**43,977**
Profit	**-2,118,724**	**876,339**	**876,339**	**656,339**	**876,339**	**371,628**
					IRR	**23.99%**

Key Assumptions:

1. Buffer Zone 35m from Freeth Farm Cottage Boundary
2. Sand Density 1.735 te/m^3
3. Sand Extraction Losses 10%
4. No residual value for conveyors or loading shovels

Residual Values of Conveyors and Loading Shovels

HPQL's Financial Viability Assessment was reviewed by an external consultant (Mr Gerald Eve) and a short report was produced for Wiltshire Council on 8 February 2019.

The report states (inter alia) that the

> *"conveyors form a considerable part of the total expenditure and capital cost of the proposed development. In both models the cost of the conveyors is written off over the proposed life in each model. We consider that the conveyors are likely to have some residual value and it is reasonable to assume that they could be reused at another quarry. Installation/commissioning cost would have to be written off but there could be a substantial residual value"*

and

> *"We have considered if this value could materially affect the financial models. The reduction in the level of sales from 323,000t to 307,200t is 15,800t. At the 75,000t/annum projected sales level this equates to 2.5 months of sales. We do not consider there would be any material difference in the value of the conveyors after this additional time/use. Although it may be appropriate to reflect some residual values in the financial models, as the values would likely be the same, their inclusion does not have a material effect on the relative differences in the IRR".*

In addition, the report states (inter alia) that:

> *"The proposed development benefits from the use of a fully depreciated loading shovel. This slightly distorts the calculated fixed cost per tonne. However the fixed costs that have been adopted do not seem unreasonable".*

It is clear from the above that the residual capital values of both the conveyors and loading shovels are substantial and would affect the absolute value of the IRR. The relative difference in IRR is actually irrelevant.

The relative difference between the IRR for 323,000 te (10m standoff) of 11.07% and the IRR for 307,200 te (35m standoff) of 9.27% is actually irrelevant as it is the absolute value of the IRR that matters in each case.

The consultant (Mr Gerald Eve) did not assess the likely impact of including appropriate residual capital values for the conveyors and loading shovels on the resultant IRR. This is assessed below.

HQPL's submission shows that the conveyor initial capital cost is £1,103,909 (Appendix 1) and such conveyors have a typical operating life of at least 10 years. Using a straight-line depreciation method, the residual capital value after 5 years operation on the Freeth Farm site (actually 4.3 years of operation based on the tonnages moved in each year) would be 50% of the initial capital cost so that a residual capital value of £551,954 for the conveyors should be included in the IRR calculation.

The HPQL's assessment (Appendix 1) states that:

> *"One loading shovel to be purchased for start of extraction. This will last the life of the reserve. The other shovel required is currently in Hills' fleet, fully depreciated and believed to have a life remaining of 3 years. At the start of year 4 a new loading shovel is purchased to replace the one at the end of it's economic life".*

The initial capital cost of the new loading shovel bought in year 1 has been taken as £220,000 with a typical operating life is 10 years. Using a straight-line depreciation method, the residual value after 5 years operation (actually 4.3 years based on the actual tonnages moved in each year) has been taken as 50% of the initial capital cost i.e. £110,000. However, a sensitivity analysis has also been included with the residual value taken as 25% of the initial capital cost (55,000).

The initial capital cost of the new loading shovel bought in year 4 is shown as £220,000 (Appendix 1) and the typical operating life of a loading shovel is 10 years. This new loading shovel has only operated for 2.3 at the end of the extraction period and has a significant residual capital value. Using a straight-line depreciation method, the residual capital value of the new loading shovel after 3 years operation (actually 2.3 years based on the actual tonnages moved in each year) has been taken as 70% of the initial capital cost i.e. £154,000. However, a sensitivity analysis has also been included with the residual capital value taken as 25% of the initial capital cost i.e. £77,000.

If the residual capital costs are included as described above (£551,954 for the conveyors and £264,000 for the 2 loading shovels), then the IRR is 29.98% for a buffer zone of 35m.

Year	2019	2020	2021	2022	2023	2024
Tonnes		91,088	91,088	91,088	91,088	8,744
Price		14.65	14.65	14.65	14.65	14.65
Sales Income		1,334,432	1,334,432	1,334,432	1,334,432	128,105
Land Resale						287,500
Total Income	0	1,334,432	1,334,432	1,334,432	1,334,432	415,605
Variable Costs		193,393	193,393	193,393	193,393	18,566
Fixed Costs		264,700	264,700	264,700	264,700	25,411
Capital	2,118,724			220,000		
Conveyor Residual Value						551,955
Shovels Residual Value						264,000
Total Costs	2,118,724	458,093	458,093	678,093	458,093	43,977
Profit	-2,118,724	876,339	876,339	656,339	876,339	1,187,583
					IRR	29.98%

Key Assumptions:

1. Buffer Zone 35m from Freeth Farm Cottage Boundary
2. Sand Density 1.735 te/m^3
3. Sand Extraction Losses 10%
4. Residual value for conveyors (£551,955) and loading shovels (£264,000)

Note 1: The comparable IRR for a 10m standoff with the incorrect sand density of 1.5 te/m^3 and sand extraction losses of 15% but including the residual capital values shown above would increase the IRR from 11.1% to 19.6%. The comparable IRR for a 35m standoff with the incorrect sand density of 1.5 te/m^3 and sand extraction losses of 15% and the residual capital values shown above would increase the IRR from 9.3% to 17.6%.

Note 2: A sensitivity analysis has been carried out on the residual values for the conveyors and loading shovels. If the residual capital values are only 50% of the straight-line depreciation values based on a 10 year life (£275,977 for the conveyors and £132,000 for the 2 loading shovels), then with a buffer zone of 35m and a saleable sand quantity of around 373,094 te, the IRR would reduce from 29.98% to 27.19%.

This confirms that including the significant residual capital values for the conveyors and loading shovels has a significant increase in the absolute value of the IRR so that the project is highly commercially profitable with a buffer zone of 35m and that the relative difference between the respective IRR values is irrelevant.

This also means that HQPL can achieve a commercial profitability level well in excess of 9.3-11.1% with a significant increase in the buffer zone.

The increase in buffer zone that can be achieved whilst retaining a robust level of commercial profitability is analysed in detail in the next section.

Buffer Zone Increases with no loss of Commercial Viability

It is clear from the foregoing that the IRR from a buffer zone of 35m would be around 30% and well above the commercially viable range of 9.3-11.1% as suggested by HQPL.

As a result, the buffer zone can be increased substantially to improve the level of environmental protection whilst retaining a viable level of commercial profitability.

A buffer zone of 84m from the Freeth Farm Cottages boundary (100m from Freeth Farm Cottages itself) would improve the level of environmental protection to within lawful limits.

Such an increase in the buffer zone from 35m to 84m would decrease the saleable sand tonnage from 373,094 te to 324,632 te which is close to the higher saleable sand tonnage of 323,000 te and well above the 307,200 te that HPQL state is commercially viable.

Note: The sand volumes and tonnages for an 84m buffer zone have been calculated using the numerical integration methodology shown in Appendix 4.

If the appropriate residual capital values of the conveyors and loading shovels are taken into account, the buffer zone is increased from 35m to 84m from the Freeth Farm Cottages boundary (100m from Freeth Farm Cottages itself), then the IRR would be 21.04% which is well above the IRR range of 9.3-11.1% that HPQL agrees is acceptable, as shown below.

Year	2019	2020	2021	2022	2023	2024
Tonnes		79,256	79,256	79,256	79,256	7,609
Price		14.65	14.65	14.65	14.65	14.65
Sales Income		1,161,096	1,161,096	1,161,096	1,161,096	111,465
Land Resale						287,500
Total Income	0	1,161,096	1,161,096	1,161,096	1,161,096	398,965
Variable Costs		193,393	193,393	193,393	193,393	18,566
Fixed Costs		264,700	264,700	264,700	264,700	25,411
Capital	2,118,724			220,000		
Conveyor Residual Value						551,955
Shovel Residual Value						264,000
Total Costs	2,118,724	458,093	458,093	678,093	458,093	43,977
Profit	-2,118,724	703,003	703,003	483,003	703,003	1,190,943
					IRR	21.04%

Key Assumptions:

1. Buffer Zone 84m from Freeth Farm Cottage Boundary
2. Sand Density 1.735 te/m^3
3. Sand Extraction Losses 10%
4. Residual value for conveyors (£551,955) and loading shovels (£264,000)

Discussion

Buffer zones are required to ensure that the local environmental impacts on local residents are kept within statutory limits, particularly for fine carcinogenic silica dust present in the Freeth Farm sand (Appendix 3) and harmful levels of noise. The present proposal involves a buffer zone of 35m and the construction of noise attenuation bunds that are 4m high and 19m wide and situated 26m from the property boundaries.

HPQL admit that the 35m buffer zone will not keep noise levels within statutory limits and it is clear the 27,000 tonnes of sandy top-soil that will be required to construct the bunds will generate significant amounts of carcinogenic silica dust during their construction.

HPQL's submissions also admit the potential for dust formation during top soil removal and bund formation and states that:

> *"there are receptors to the west which would be within 200m of these potentially dusty operations, particularly bund formation. Freeth Farm Cottages in particular have the potential to be affected when the wind is blowing from the north, east and south (depending on the stage of bund construction)."*

The best practice exclusion zones adopted by various planning authorities to keep noise and dust levels to within statutory limits are shown below:

Planning Authority	Exclusion Zone or Stand-off Distance
Buckinghamshire	**200m (or 100m with a 5m bund)**
Durham	**250m**
Hampshire	**250m**
Lancashire	**100m**
Somerset	**200m**
West Dorset	**100-250m**
Wales	**100m**

HQPL's argument that a reduced level of environmental protection should be allowed based on the argument that an increased buffer zone would render the proposed development commercially non-viable has been exposed as a misrepresentation of the true position.

The following sections show that a 35m buffer zone is not best practice and does not prevent harmful dust levels and noise levels at Freeth Farm Cottages above the statutory limits. The final section of the report demonstrates that acceptable dust and noise levels can be achieved with a buffer zone of 84m from the Freeth Farm property boundaries which is 100m from the property itself.

Carcinogenic Silica Dust

In relation to quarry dust, the Department of Environment issued a detailed technical report on buffer zones in 1995 which states:

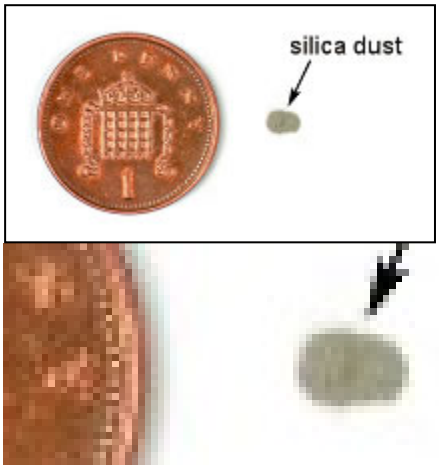
> *"The DoE study concluded that severe or persistent concerns about dust are most likely to be experienced near to significant dust sources (generally within 100m). In practice, standoff distances are often incorporated into local planning policy, with distances of 250-500 metres typically adopted"*

By itself, silica is not toxic. The health risk arises when silica particles are small enough to get into the deepest parts of the lungs, especially the alveoli where inhaled air passes into the bloodstream. Chronic or long-term exposure to fine silica particles can lead to lung inflammation and produce a severe lung disease known as silicosis. This has prompted government and international health agencies to declare silica to be a human carcinogen (IARC, 2012; NTP, 2011; Steenland, 2014).

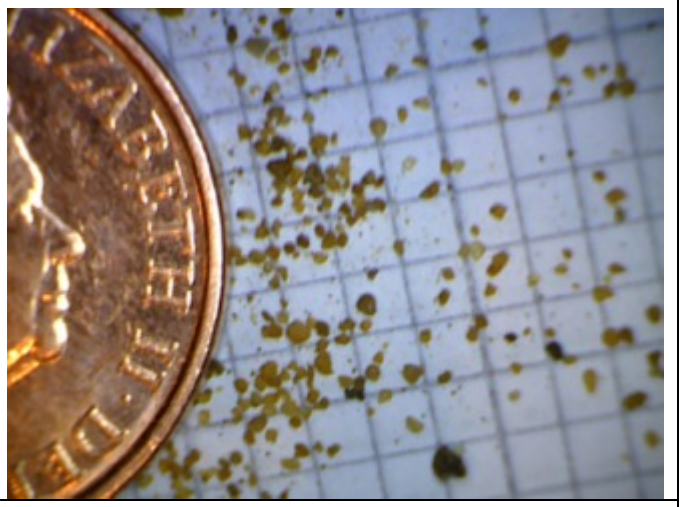
The Health and Safety Executive (HSE) advice on is that the daily amounts of silica needed to cause adverse health effects are small. The picture below is taken from the HSE publication, with acknowledgements to HSE.

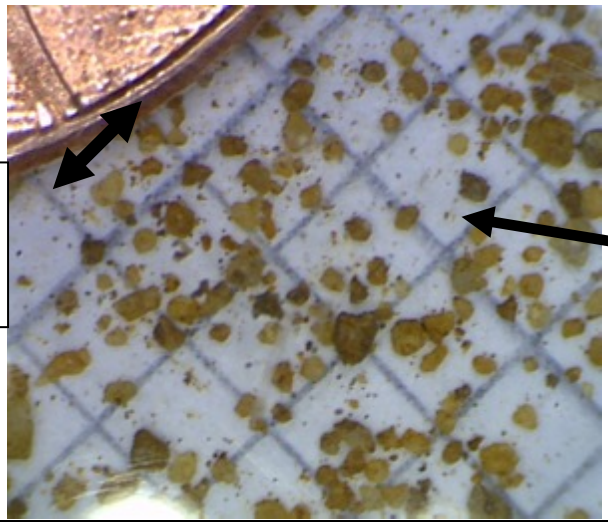
A representative sample of the Freeth Farm sand has been examined under a microscope to determine the distribution of sand particle sizes, as shown below.

HSE Silica Dust Particle



Freeth Farm sand particle sizes





Scale 2mm or 2000µm

Ultra-fine particles 2-10µm

The Freeth Farm silica sand has also been investigated by HQPL's consultants ACS Testing Limited. Their evaluation dated 29 November 2018 states that *"We have estimated the likely average grading in accordance with the ISO 656 sieve apertures"* as a *"0/2mm FP Cat f_3 fine concreting sand"*.

The 0/2mm FP Cat f_3 classification is the finest sand classification that means that up to 3% of the content by weight will pass through a 63μm sieve, as shown below.

Line	Particle size fractions *d/D*	Fines content	Category
	mm	% m/m	
1	0/2 to 0/5	≤ 3	f_3
2	0/2 to 0/5	≤ 16	f_{16}
3	0/2 to 0/5	> 16	$F_{declared}$
4	2/4 to 32/63	≤ 0.5	$f_{0.5}$
5	2/4 to 32/63	≤ 1	f_1
6	2/4 to 32/63	≤ 2	f_2
7	2/4 to 32/63	≤ 3	f_3
8	2/4 to 32/63	≤ 4	f_4
9	2/4 to 32/63	> 4	$F_{declared}$
Note: For special areas of application, the particle size fraction/grade of delivered particles 1/3 mm in category $f_{0.5}$, f_1 *or* f_3 *may be used.*			

If it assumed that the largest particles are all 63μm, this would mean that each spherical particle would weigh around 0.433 x 10^{-6} g, so that a 1kg sample of sand would contain up to 30g of fines which would equate to around 70 million fine particles for every kilogram of sand.

The actual particle size distribution shown above shows that the Freeth Farm sand is ultra-fine with the largest of the fine particles being less than 10μm in diameter so there are likely to be significantly more than 70 million fine particles per kilogram.

This means that the 27,000 te of sandy top-soil needed to build the 4m high x 19m wide noise attenuation bunds will contain trillions of such particles that will form the basis of a significant carcinogenic health risk due to their close proximity (42m) from the occupied Freeth Farm Cottage buildings during the 24 weeks when the bunds are being constructed and removed. This is why an increased buffer zone is essential to provide adequate environmental protection.

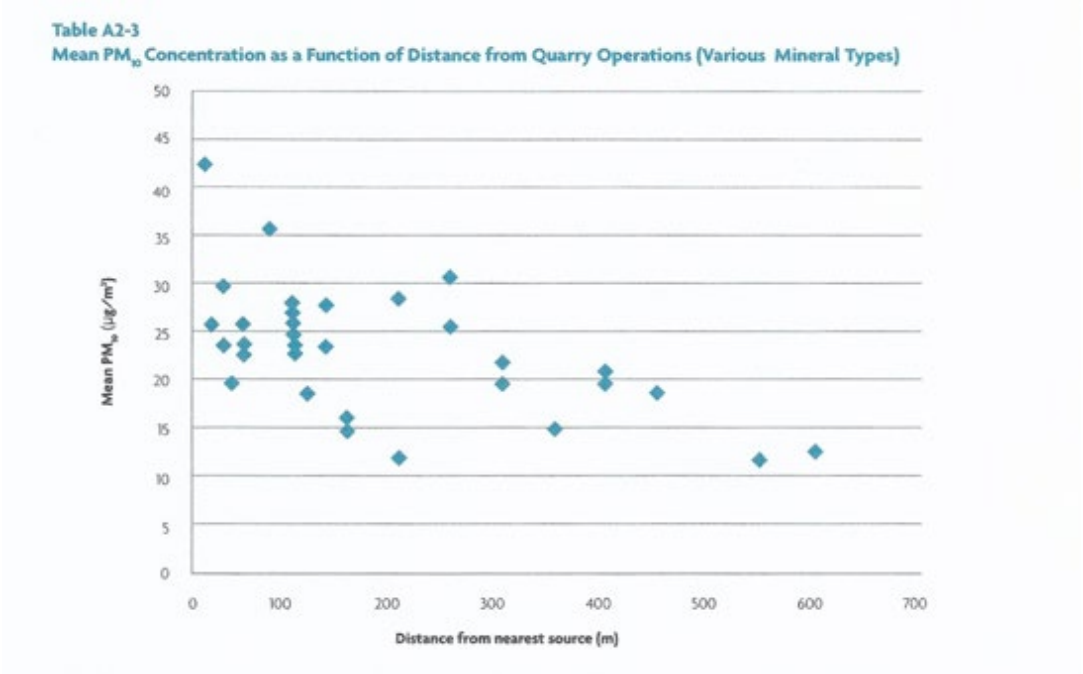
The Department of the Environment Planning Guide, Section 5.3 states that:

> *"Residents living in proximity to quarries can potentially be affected by dust up to 0.5km from the source, although continual or severe concerns about dust are most likely to be experienced within about 100m of the dust source. The main potential impacts of dust are visual impacts, coating/soiling of property (including housing, washing and cars), coating of vegetation, contamination of soils, water pollution, change in plant species composition, loss of sensitive plant species, increased inputs of mineral nutrients and altered pH balances. Respirable particles, i.e. those less than 10 micrometres (10μm) in diameter, have the potential to cause effects on human health, depending on exposure levels".*

The Institute of Air Quality Management (IAQM) Guidance on Mineral Dust states that:

> *"Smaller dust particles remain airborne for longer, dispersing widely and depositing more slowly over a wider area. Large dust particles (greater than 30 µm), which make up the greatest proportion of dust emitted from mineral workings, will largely deposit within 100m of sources. Intermediate-sized particles (10–30 µm) are likely to travel up to 200–500m. Smaller particles (less than 10µm) which make up a small proportion of the dust emitted from most mineral workings, are only deposited slowly but may travel 1000m or more"*

The IAQM guidance for Mineral Dust considers the effects of 10µm particles (PM_{10}) as a function of distance from quarry operations as shown below:



The Control of Substances Hazardous to Health Regulations 2002 (COSHH), as amended, requires a formal risk assessment to be carried out to control exposure to respirable crystalline silica (RCS).

Rather than carry out a formal risk assessment as required under the COSSH regulations, HQPL have simply claimed that there is always a dust risk during farming activities such as ploughing. However, ploughing only usually occurs around twice a year. That is in the Winter months before planting, usually 1-2 days and again in late Autumn after harvesting. The ploughing takes place generally at distances much greater than 16m from Freeth Farm Cottages. In addition, the ground is invariably wet in late Autumn and Winter due to the very high water table on the Freeth Farm site, so the dust risk from ploughing is minimal and not at all similar to heaping and removing 27,000 te of sandy top soil at 16m from the Freeth Farm Cottages property boundaries over a 24 week period during Phases 5, 6 and 7.

Noise

HQPL admit that the sand extraction noise levels for normal operations exceed the statutory limit for normal operations (background + 10dB) in years 4 and 5 of the proposed operations with a 35m buffer zone and 4m high x 19m wide noise attenuation bunds.

HQPL argue that this limitation should be waived as they claim that the development would be rendered uneconomic with any increase in the buffer zone.

However, HQPL's schedule of activities shows that temporary activities, (top soil removal and bund formation that are allowed to have a noise level of up to 70 dB for up to 8 weeks per year), will overlap with normal activities of sand extraction for each respective Phase in each 12 month period as shown below.

Year	Phases in each Year	Top Soil Removal (weeks)	Bund Formation (weeks)
1	24 weeks Phase 1 + First 28 weeks Phase 2	**12.86**	**9.68**
2	Last 31 weeks Phase 2 + First 21 weeks Phase 3	**10.78**	0.08
3	Last 19 weeks Phase 3 + First 33 weeks Phase 4	7.56	2.76
4	39 weeks Phase 5 + First 13 weeks Phase 6	**20.72**	**17.93**
5	Last 25 weeks Phase 6 + First 27 weeks Phase 7	6.88	**9.60**
6	Last 7 weeks Phase 7 + 8 weeks Phase 8	2.06	5.94
	Total amount of temporary activities relating to top soil and bunds	62.00	44.84

HPQL's submissions state that "*7.6.13 In the event that proposed extraction operations are combined with temporary operations the cumulative calculated site noise levels would be below the noise limits for Temporary operations."*

It is difficult to see how this can be achieved as the statutory breaches of noise levels are likely to occur in each 12 month period as highlighted in **red** in the Table above.

These statutory breaches occur in 4 out of the first 5 years for periods of up to **20.72** weeks during Year 4, which is unlawful. The longest period is **20.72** weeks in Year 4 due to the coincidence of the various temporary activities from Phases 5 and 6.

An independent report by Anderson Acoustics Limited dated 3 June 2020 stated that:

> *"No assessment has been carried out for internal noise levels within the dwellings. It is considered that internal noise guideline limits may not be met at all times during Phase 5 and 6. With a partially open window for ventilation, the internal noise level at Freeth Farm Cottages may be around 20 dB in excess of the internal noise guidance limits from BS8233:2014"*

HPQL's submissions show that the noise levels will be close to or above the statutory limits for significant periods but the proposed noise monitoring scheme is limited to 4 times per year despite the fact that continuous noise monitoring is both simple to achieve and inexpensive.

The independent report by Anderson Acoustics Limited also points out that the predicted first floor noise levels may be over 49dB during Phases 5 and 6 and the internal noise levels at Freeth Farm Cottages may be around 20dB in excess of those allowed by BS8233:2014 and may exceed the Significant Observed Adverse Effect Level (SOAEL).

In addition, statutory breaches of the 8 week limit for temporary operations are also likely to occur in 4 out of the first 5 years and for periods up to 21 weeks during Phases 5 and 6 in Year 4. HQPL cannot argue that this limitation should be waived on economic grounds.

The Anderson Acoustics Limited report states that:

> *"The proposed noise monitoring scheme would be unlikely to capture breaches of the noise limit, were they to occur, and would also be unlikely to be able to be used to establish if nuisance was present or not.*
>
> *Continuous monitoring with remote access and triggered alerts is not being considered, despite it being an establish and effective management tool for noise from extraction operations.*
>
> *The monitoring proposal is considered inadequate as it does not provide a control measure to identify if the noise from the mineral operations is exceeding the site noise limit. Continuous monitoring should also be used to objectively evaluate complaints, if they are received.*
>
> *A weather station linked to the monitor can be used to identify periods where weather may have elevated the noise levels. The noise monitoring station can also use audio recordings so periods with noise levels in excess of the noise limits can be investigated. Exceedances of the noise limits by ambient noise levels can also be managed through collection of a robust noise baseline, in hourly periods, to establish the variation in noise levels. It is considered that the "Environmental Noise Scheme" is not sufficient to demonstrate compliance with a planning noise limit condition or to evaluate complaints. Continuous noise monitoring at Freeth Farm Cottages is recommended"*

It is concluded that a continuous noise monitoring that is both simple to achieve and inexpensive should be a high priority planning condition in order to protect local residents from prolonged excessive noise over a 6 year period.

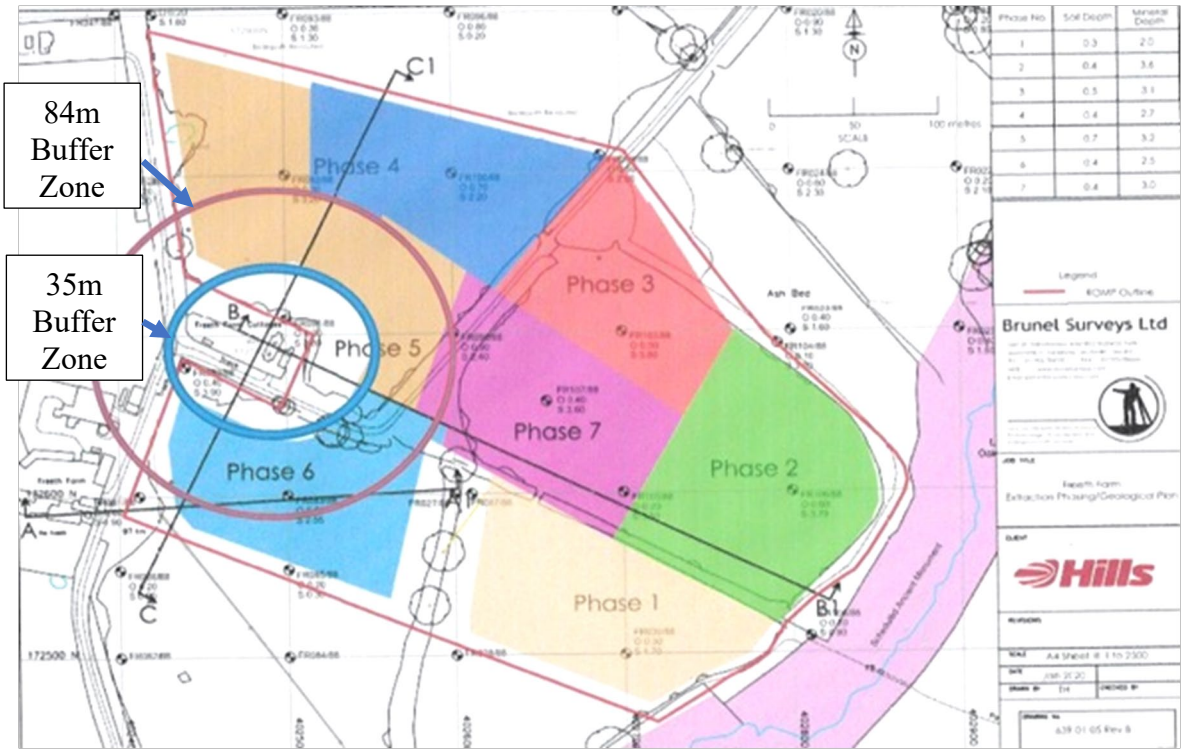
The effect of an increased buffer zone from 35m to 84m

It is clear that a buffer zone of 35m would not provide adequate environmental protection and would be likely to be open to legal challenge.

HQPL's argument that any further increase in the buffer would render the development uneconomic is based on an incorrect Financial Viability assessment that has used an incorrect density for compacted sand; exaggerated the likely sand losses due to extraction and processing and which has not taken the residual values of the conveyors and loading shovels into account.

If the appropriate figures are used, the IRR for a 35m buffer zone increases from 9.3% to 29.98%, as shown in the previous sections.

This means that the buffer zone can be significantly increased from 35m to 84m in relation to the property boundary, which is a distance of 100m from the Freeth Farm Cottages (as shown below), without endangering the commercial viability.



A buffer zone of 84m (100m from Freeth Farm Cottages) will be in line with UK buffer zone norms; the noise levels would then be within statutory limits without the need for the intrusive 4m high x 19m wide noise attenuation bunds; and the carcinogenic silica dust levels will meet the Institute of Air Quality Management guidelines and all of this could be achieved with a commercial of commercial viability of around 21.04% IRR.

As a test for robustness for a buffer zone of 84m, if the level of extraction and processing sand losses are taken as 15%, the sand tonnages would remain in line with HQPL's initial extraction estimate of 307,200 te and the IRR would be 17.72%, as shown below.

	2019	2020	2021	2022	2023	2024
Tonnes		**74,918**	**74,918**	**74,918**	**74,918**	**7,192**
Price		**14.65**	**14.65**	**14.65**	**14.65**	**14.65**
Sales Income		**1,097,552**	**1,097,552**	**1,097,552**	**1,097,552**	**105,365**
Land Resale						**287,500**
Total Income	**0**	**1,097,552**	**1,097,552**	**1,097,552**	**1,097,552**	**392,865**
Variable Costs		**193,393**	**193,393**	**193,393**	**193,393**	**18,566**
Fixed Costs		**264,700**	**264,700**	**264,700**	**264,700**	**25,411**
Capital	**2,118,724**			**220,000**		
Conveyor Residual Value						**551,955**
Shovel Residual Value						**284,000**
Total Costs	**2,118,724**	**458,093**	**458,093**	**678,093**	**458,093**	**43,977**
Profit	**-2,118,724**	**639,459**	**639,459**	**419,459**	**639,459**	**1,184,842**
					IRR	**17.72%**

Key Assumptions:

1. Buffer Zone 84m from Freeth Farm Cottage Boundary
2. Sand Density 1.735 te/m^3
3. Sand Extraction Losses 15%
4. Residual value for conveyors (£551,955) and loading shovels (£284,000)

As an acid test for the financial viability robustness with a buffer zone of 84m, with HQPL's exaggerated extraction and processing sand losses taken as 15%; the overall sand tonnages would remain in line with HQPL's initial extraction estimate of 307,200 te and with the residual value for the conveyors and loading shovels reduced by half to £275,977 and £142,000 respectively, the IRR would be 13.89% as shown below, which is well in excess of HQPL's proposed commercially viable acceptance limit of 9.3% IRR.

	2019	2020	2021	2022	2023	2024
Tonnes		**74,918**	**74,918**	**74,918**	**74,918**	**7,192**
Price		**14.65**	**14.65**	**14.65**	**14.65**	**14.65**
Sales Income		**1,097,552**	**1,097,552**	**1,097,552**	**1,097,552**	**105,365**
Land Resale						**287,500**
Total Income	**0**	**1,097,552**	**1,097,552**	**1,097,552**	**1,097,552**	**392,865**
Variable Costs		**193,393**	**193,393**	**193,393**	**193,393**	**18,566**
Fixed Costs		**264,700**	**264,700**	**264,700**	**264,700**	**25,411**
Capital	**2,118,724**			**220,000**		
Conveyor Residual Value						**275,977**
Shovel Residual Value						**142,000**
Total Costs	**2,118,724**	**458,093**	**458,093**	**678,093**	**458,093**	**43,977**
Profit	**-2,118,724**	**639,459**	**639,459**	**419,459**	**639,459**	**766,865**
					IRR	**13.89%**

Key Assumptions:

5. Buffer Zone 84m from Freeth Farm Cottage Boundary
6. Sand Density 1.735 te/m^3
7. Sand Extraction Losses 15%
8. Residual value for conveyors (£275,977) and loading shovels (£142,000)

As a result of the foregoing, it can be reliably concluded that the buffer zone can be increased to 84m from the Freeth Farm Cottages property boundaries (which is equivalent to a buffer zone 100m from the property itself) and HQPL would still be able to achieve a return of 14-21% IRR which is in line with the industry norms and which would have the additional benefits of providing proper environmental protection for local residents and removing the risk of legal challenge.

Conclusions

1. HQPL's Financial Viability Assessment is incorrect and has grossly underestimated the commercial viability (IRR 9.3%) by using an incorrect value for the compacted sand density; exaggerated sand losses from extraction and processing and by assigning zero residual capital value to conveyors that would be only 6 years old and a loading shovel that would be only 2 years old at completion.

2. If the measured density for compacted Freeth Farm sand is used, combined with normal extraction losses quoted by DEFRA (although this is not critical) and appropriate residual capital values for the conveyors and loading shovels, as confirmed by Wiltshire Council's own independent assessment), then the IRR is 30%.

3. The buffer zone can be increased to 84m from the Freeth Farm Cottage property boundary (100m from the Freeth Farm Cottage itself), then the IRR would be 21.0% which is significantly greater than the level of commercial viability incorrectly claimed by HPQL.

4. The commercial viability of the 84m buffer zone is robust, if HQPL's sand extraction and processing losses (15%) are used, the sand tonnages would remain in line with HQPL's initial extraction estimate of 307,200 te and the IRR would be 17.7%.

5. A buffer zone of 84m (100m from Freeth Farm Cottages) would be in line with UK buffer zone norms; the noise levels would be within statutory limits without the need for the intrusive 4m high noise attenuation bunds; and the carcinogenic silica dust levels would meet the Institute of Air Quality Management guidelines and HQPL would still be able to achieve returns of 17.7-21% IRR which is well in excess of 9.3% IRR.

6. Planning conditions should be revised to include a buffer zone of 84m, together with continuous noise monitoring in line with best practices for mineral extraction.

Appendix 1

HQPL's Financial Viability Assessment

Freeths Farm Financial Model 21/11/18 - Higher tonnage , 323,000te saleable

Trading Account		Year to Jan-20	Year to Jan-21	Year to Jan-22	Year to Jan-23	Year to Jan-24	Year to Jan-25	Total
Tonnage Sales		75,000	75,000	75,000	75,000	23,000	0	323,000
Ex Pit Price		14.65	14.65	14.65	14.65	14.65		
Sales Value		1,098,750	1,098,750	1,098,750	1,098,750	336,950	0	4,731,950
Variable Costs								
Rates	0.78	58,500	58,500	58,500	58,500	17,940		251,940
Wayleave Royalty	0.56	42,000	42,000	42,000	42,000	12,880		180,880
Depletion Land	0.70	52,310	52,310	52,310	52,310	16,042		225,284
Depletion Fees	0.35	26,057	26,057	26,057	26,057	7,991		112,221
Depletion Conveyor etc	3.82	286,558	286,558	286,558	286,558	87,878		1,234,109
Overburden	0.45	33,750	33,750	33,750	33,750	10,350		145,350
Archaeology	0.55	41,250	41,250	41,250	41,250	12,650		177,650
Land Reinstatement	0.20	15,000	15,000	15,000	15,000	4,600		64,600
		555,426	555,426	555,426	555,426	170,331	0	2,392,034
Gross Contribution		**543,324**	**543,324**	**543,324**	**543,324**	**166,619**	**0**	**2,339,916**
Fixed Costs								
Salaries/OPC		103,000	103,000	103,000	103,000	31,587		443,587
Temp Labour		4,400	4,400	4,400	4,400	1,349		18,949
Car Expenses		5,500	5,500	5,500	5,500	1,687		23,687
Mobile Plant Dep'n	Note 1	52,000	52,000	52,000	96,000	29,440		281,440
Hired Plant		19,800	19,800	19,800	19,800	6,072		85,272
Mobile Plant Repair		19,800	19,800	19,800	19,800	6,072		85,272
Fixed Plant Repairs		44,000	44,000	44,000	44,000	13,493		189,493
Plant Fuel/lubs		29,700	29,700	29,700	29,700	9,108		127,908
Electricity		24,200	24,200	24,200	24,200	7,421		104,221
Site Maintenance		7,700	7,700	7,700	7,700	2,361		33,161
Enviro -Monitoring		3,850	3,850	3,850	3,850	1,181		16,581
Surveys		1,650	1,650	1,650	1,650	506		7,106
Other		1,100	1,100	1,100	1,100	337		4,737
Fixed Costs		316,700	316,700	316,700	360,700	110,615	0	1,421,415
Net Contribution		**226,624**	**226,624**	**226,624**	**182,624**	**56,005**	**0**	**918,502**

Cashflow	Year to Jan-19	Year to Jan-20	Year to Jan-21	Year to Jan-22	Year to Jan-23	Year to Jan-24	Total
Capital Costs							
Conveyors	1,103,909						1,103,909
Electricity Connection	90,000						90,000
Legal / Professional	12,946						12,946
Planning /Welfare/Pumps&Pipes	91,316						91,316
Fencing	15,200						15,200
Civils - Sustrans	25,000						25,000
Land Purchase	512,784						512,784
Mobile Plant	260,000		0	220,000		0	480,000
SDLT on royalty	7,959						7,959
	2,119,114	0	0	220,000	0	0	2,339,114
Income							
Sales Income		1,098,750	1,098,750	1,098,750	1,098,750	336,950	4,731,950
Resale Value of Land						287,500	287,500
Variable Costs							
Rates		58,500	58,500	58,500	58,500	17,940	251,940
Wayleave Royalty		42,000	42,000	42,000	42,000	12,880	180,880
Overburden		33,750	33,750	33,750	33,750	10,350	145,350
Archaeology		41,250	41,250	41,250	41,250	12,650	177,650
Land Reinstatement		15,000	15,000	15,000	15,000	4,600	64,600
	0	190,500	190,500	190,500	190,500	58,420	820,420
Fixed Costs		264,700	264,700	264,700	264,700	81,175	
Net Cashflow	-2,119,114	643,550	643,550	423,550	643,550	484,855	719,942
Opening Cash	0	-2,119,114	-1,475,564	-832,014	-408,464	235,086	
Closing Cash	-2,119,114	-1,475,564	-832,014	-408,464	235,086	719,942	719,942
IRR	11.1%						

Note 1 One loading shovel to be purchased for start of extraction. This will last the life of the reserve.
The other shovel required is currently in Hills' fleet, fully depreciated, and believed to have a life remaining of 3 years.
At the start of year 4 a new loading shovel is purchased to replace the one at the end of it's economic life.

Freeths Farm Financial Model 21/11/18 - Lower tonnage 307,200te saleable

Trading Account

		Year to Jan-20	Year to Jan-21	Year to Jan-22	Year to Jan-23	Year to Jan-24	Year to Jan-25	Total
Tonnage Sales		75,000	75,000	75,000	75,000	7,200	0	307,200
Ex Pit Price		14.65	14.65	14.65	14.65	14.65		
Sales Value		1,098,750	1,098,750	1,098,750	1,098,750	105,480	0	4,500,480
Variable Costs								
Rates	0.78	58,500	58,500	58,500	58,500	5,616		239,616
Wayleave Royalty	0.56	42,000	42,000	42,000	42,000	4,032		172,032
Depletion Land	0.73	55,001	55,001	55,001	55,001	5,280		225,284
Depletion Fees	0.36	27,303	27,303	27,303	27,303	2,621		111,831
Depletion Conveyor etc	4.02	301,296	301,296	301,296	301,296	28,924		1,234,109
Overburden	0.45	33,750	33,750	33,750	33,750	3,240		138,240
Archaeology	0.58	43,372	43,372	43,372	43,372	4,164		177,650
Land Reinstatement	0.21	15,771	15,771	15,771	15,771	1,514		64,600
		576,993	576,993	576,993	576,993	55,391	0	2,363,362
Gross Contribution		**521,757**	**521,757**	**521,757**	**521,757**	**50,089**	**0**	**2,137,118**
Fixed Costs								
Salaries/OPC		103,000	103,000	103,000	103,000	9,888		**421,888**
Temp Labour		4,400	4,400	4,400	4,400	422		**18,022**
Car Expenses		5,500	5,500	5,500	5,500	528		**22,528**
Mobile Plant Dep'n		52,000	52,000	52,000	96,000	9,216		**261,216**
Hired Plant		19,800	19,800	19,800	19,800	1,901		**81,101**
Mobile Plant Repair		19,800	19,800	19,800	19,800	1,901		**81,101**
Fixed Plant Repairs		44,000	44,000	44,000	44,000	4,224		**180,224**
Plant Fuel/lubs		29,700	29,700	29,700	29,700	2,851		**121,651**
Electricity		24,200	24,200	24,200	24,200	2,323		**99,123**
Site Maintenance		7,700	7,700	7,700	7,700	739		**31,539**
Enviro -Monitoring		3,850	3,850	3,850	3,850	370		**15,770**
Surveys		1,650	1,650	1,650	1,650	158		**6,758**
Other		1,100	1,100	1,100	1,100	106		**4,506**
Fixed Costs		316,700	316,700	316,700	360,700	34,627	0	1,345,427
Net Contribution		**205,057**	**205,057**	**205,057**	**161,057**	**15,461**	**0**	**791,690**

Cashflow

	Year to Jan-19	Year to Jan-20	Year to Jan-21	Year to Jan-22	Year to Jan-23	Year to Jan-24	Total
Capital Costs							
Conveyors	1,103,909						**1,103,909**
Electricity Connection	90,000						**90,000**
Legal / Professional	12,946						**12,946**
Planning /Welfare/Pumps&Pipes	91,316						**91,316**
Fencing	15,200						**15,200**
Civils - Sustrans	25,000						**25,000**
Land Purchase	512,784						**512,784**
Mobile Plant	260,000		0	220,000		0	**480,000**
SDLT on royalty	7,569						**7,569**
	2,118,724	0	0	220,000	0	0	**2,338,724**
Income							
Sales Income		1,098,750	1,098,750	1,098,750	1,098,750	105,480	**4,500,480**
Resale Value of Land						287,500	**287,500**
Variable Costs							
Rates		58,500	58,500	58,500	58,500	5,616	**239,616**
Wayleave Royalty		42,000	42,000	42,000	42,000	4,032	**172,032**
Overburden		33,750	33,750	33,750	33,750	3,240	**138,240**
Archaeology		43,372	43,372	43,372	43,372	4,164	**177,650**
Land Reinstatement		15,771	15,771	15,771	15,771	1,514	**64,600**
	0	193,393	193,393	193,393	193,393	18,566	**792,138**
Fixed Costs		264,700	264,700	264,700	264,700	25,411	
Net Cashflow	-2,118,724	640,657	640,657	420,657	640,657	349,003	**572,906**
Opening Cash	0	-2,118,724	-1,478,067	-837,410	-416,754	223,903	
Closing Cash	-2,118,724	-1,478,067	-837,410	-416,754	223,903	572,906	**572,906**

IRR 9.3%

Note 1 One loading shovel to be purchased for start of extraction. This will last the life of the reserve.
The other shovel required is currently in Hills' fleet, fully depreciated, and believed to have a life remaining of 3 years.
At the start of year 4 a new loading shovel is purchased to replace the one at the end of it's economic life.

Appendix 2

Density of Freeth Farm Sand

The references to verify the commonly accepted density of compacted sand as 1682 kg/m3 or 1.682 tonnes per m^3 can most easily be found via the links below:

https://www.civilclick.com/density-of-sand/

https://www.engineeringtoolbox.com/density-materials-d_1652.html

https://www.simetric.co.uk/si_materials.htm

However, the dry density of compacted sand is given as 1870 kg/m3 in "An Introduction to Geotechnical Engineering" 2nd Edition by AA Holtz Kovacs **ISBN**. 0-13-484394-0. 91780 134843940. Prentice-Hall International (UK) Limited

http://www4.hcmut.edu.vn/~cnan/Soilmech/AA%20Holtz%20&%20Kovacs%20-%20An%20Introduction%20to%20Geotechnical%20Engineering.pdf

On this basis the density of the compacted Freeth Farm sand would be expected to be within this range i.e. 1682 to 1870 kg/m^3.

Sand density can be affected by the ratio of coarse to fine sand particles where a relatively high ratio of fine sand particles to coarse sand particles results in a slightly higher density as the fine particles fill the interstices between the coarse particles and reduce the void content.

As you will recall, the Freeth Farm sand has a high proportion of very fine sand particles (at around 30% of fine particles by number or around 3% by weight as confirmed by HQPL's consultants, see Appendix 3).

As a result, the Freeth Farm compacted sand density is likely to be nearer to 1870 kg/ m^3 than 1682 kg/ m^3.

However, to get a more precise estimate, the density of a representative sample of Freeth Farm sand taken from close to borehole FR091/88 has been measured using a modified Proctor test.

The compacted sand density for Freeth Farm sand was measured as 1700 to 1770 kg/m^3, representing an average of 1735 kg/m^3.

Sand Losses during Extraction and Processing

Secondly, research funded through Defra's Aggregates Levy Sustainability Fund states that the ratio of waste to saleable product by weight is 1:9 which is equivalent to 10% sand losses during extraction and processing.

This is confirmed in the extracted page shown below, taken from the Quarry Fines & Waste Guide by C. Mitchell, 2007

Annual production

The quantity of quarry waste and **quarry fines** produced in the UK is unclear with little information in published literature and limited access to known data due to commercial sensitivity. Quarry waste and quarry fines originate in all rock types including sedimentary (sand and gravel, sandstone, limestone and dolomite), igneous (diorite, dolerite, granite and lava) and metamorphic (marble and slate). Estimated values for the production of **aggregate**, quarry waste and quarry fines are shown in Table 1. The total annual production of quarry waste in the UK is estimated at 22.8 million tonnes (based on a waste to saleable **product** ratio of 1:9). The total annual production of quarry fines is estimated at 53.9 million tonnes; this is based on estimates of fines production of 20% for limestone, igneous and metamorphic rock, and sand and gravel, and 25% for sandstone.

Quarry fines and waste — Table 1

Estimated production of aggregate, quarry waste and quarry fines in the UK.

Rock type	**Annual production** (million tonnes, 2005)		
	Saleable aggregate[1]	**Quarry waste**[4]	**Quarry fines**
Sandstone	10.0	1.1	3.3
Limestone[2]	67.3	7.5	18.8
Igneous and Metamorphic Rock	44.6	5.0	11.2
Sand and Gravel [3]	82.4	9.2	20.6
Total	204.3	22.8	53.9

[1] Estimated aggregate production from the Annual Minerals Raised Inquiry (2004)

[2] Limestone including dolomite and chalk

[3] Land- & marine-won sand and gravel

[4] Estimated quarry waste based from Defra mineral waste statistics, available **here**

The distribution of quarry fines stockpiles is not uniform across the country. The markets for bulk materials are usually local to urban centres and quarries in remote areas may have problems finding markets for fines. This is further complicated if there are local sources of alternative materials (free of the Aggregates Levy); such as slate waste in North Wales and china clay sand in south-west England. Fines are a particular problem in quarries producing

Appendix 3

Freeth Farm Sand and Carcinogen Dust Risk

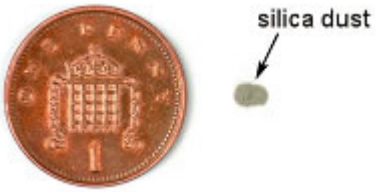
The Freeth Farm application proposes to extract around 300,000te of fine silica sand over a period of around 6 years using dry working methods whereby the sand is effectively de-watered with purpose built drainage channels.

The extraction site is very close to 4 properties (a few metres from the property boundaries) and within 1km of the village of Compton Bassett.

By itself, silica is not toxic. The health risk arises when silica particles are small enough to get into the deepest parts of the lungs, especially the alveoli where inhaled air passes into the bloodstream. Chronic or long-term exposure to fine silica particles can lead to lung inflammation and produce a severe lung disease known as silicosis, a form of pulmonary fibrosis.

This has prompted government and international health agencies to declare silica to be a human carcinogen (IARC, 2012; NTP, 2011; Steenland, 2014).

The Health and Safety Executive (HSE) advice on is that the daily amounts of silica needed to cause adverse health effects are small, as shown below.



The Department of the Environment Planning Guide, Section 5.3 states that:

> *"Residents living in proximity to quarries can potentially be affected by dust up to 0.5km from the source, although continual or severe concerns about dust are most likely to be experienced within about 100m of the dust source. The main potential impacts of dust are visual impacts, coating/soiling of property (including housing, washing and cars), coating of vegetation, contamination of soils, water pollution, change in plant species composition, loss of sensitive plant species, increased inputs of mineral nutrients and altered pH balances. Respirable particles, i.e. those less than 10 micrometres (10µm) in diameter, have the potential to cause effects on human health, depending on exposure levels".*

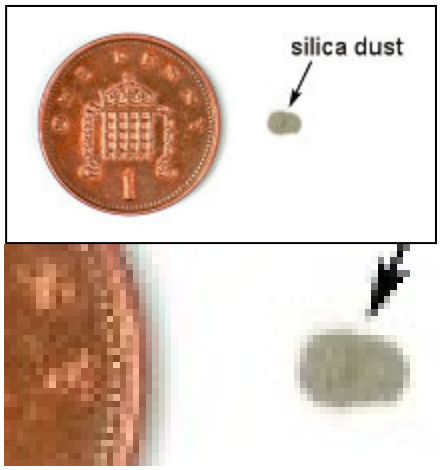
The Institute of Air Quality Management Guidance on Mineral Dust states that:

> *"Large dust particles (greater than 30 µm), which make up the greatest proportion of dust emitted from minerals workings, will largely deposit within 100 m of sources. Intermediate-sized particles (10-30 µm) are likely to travel up to 200-500 m."*

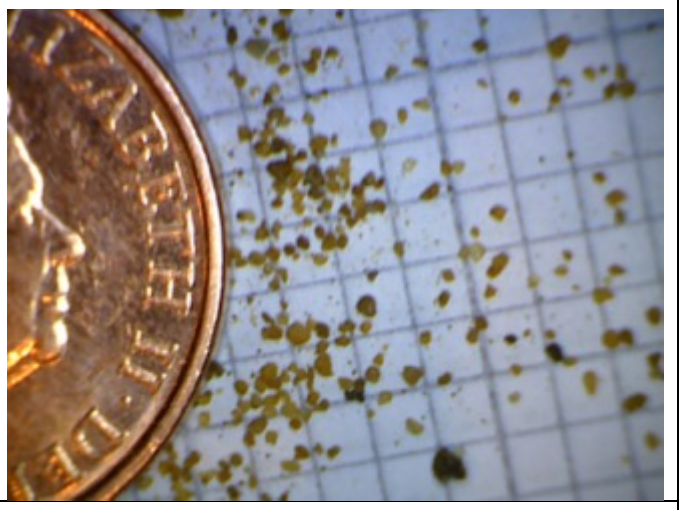
A representative sample of the Freeth Farm sand has been examined under a microscope to determine the distribution of sand particle sizes.

The microscopic examination has shown that the Freeth Farm sand is a very fine sand, with a bi-modal particle size distribution of large particles (around 500 µm diameter) and ultra fine particles (around 2-10 µm diameter), as shown below.

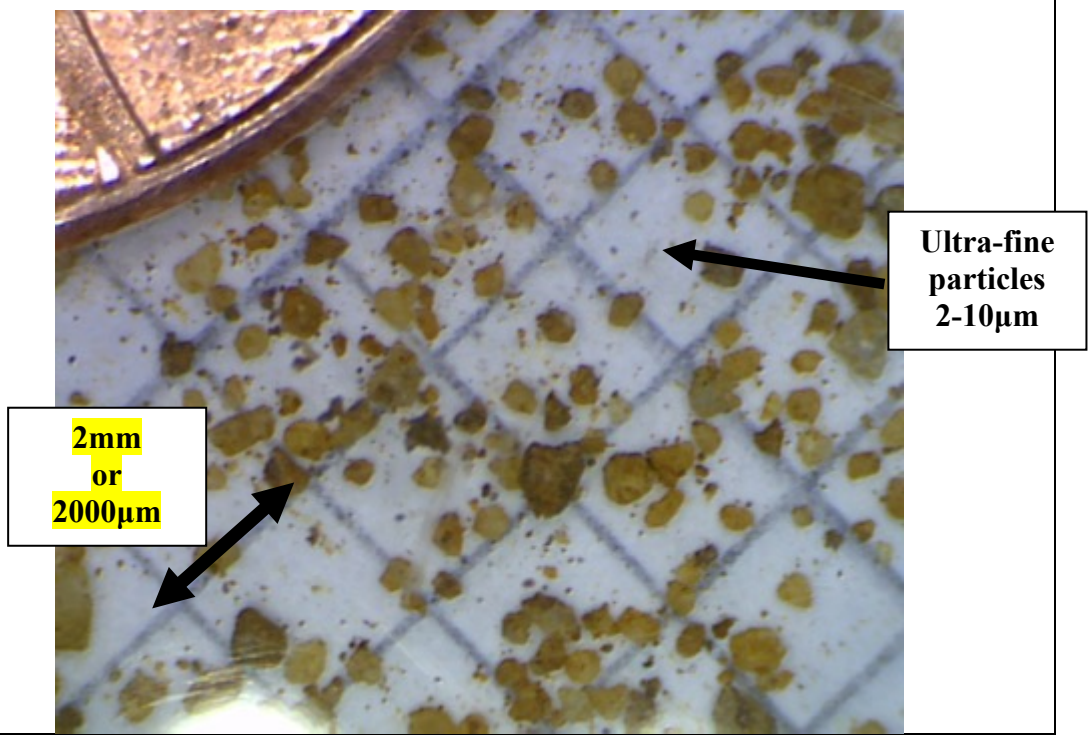
HSE Silica Dust Particle



Freeth Farm sand particle sizes



Freeth Farm sand particle sizes



The smallest sized particles appear as fine dots and are around 2-10µm in diameter, which is a size range that is respirable.

In terms of the number of particles in the sand, the Freeth Farm sand has been estimated to contain around 35% of fine <10µm particles (by number) and 65% of larger particles (by number).

The Freeth Farm silica sand has also been investigated by ACS Testing Limited. Their evaluation dated 29 November 2018 states that *"We have estimated the likely average grading in accordance with the ISO 656 sieve apertures"* as a *"0/2mm FP Cat f_3 fine concreting sand"*.

The 0/2mm FP Cat f_3 classification is the finest sand classification that means that up to 3% of the content by weight will pass through a 63μm sieve, as shown below.

Line	Particle size fractions *d/D*	Fines content	Category
	mm	% m/m	
1	0/2 to 0/5	≤ 3	f_3
2	0/2 to 0/5	≤ 16	f_{16}
3	0/2 to 0/5	> 16	$F_{declared}$
4	2/4 to 32/63	≤ 0.5	$f_{0.5}$
5	2/4 to 32/63	≤ 1	f_1
6	2/4 to 32/63	≤ 2	f_2
7	2/4 to 32/63	≤ 3	f_3
8	2/4 to 32/63	≤ 4	f_4
9	2/4 to 32/63	> 4	$F_{declared}$
Note: For special areas of application, the particle size fraction/grade of delivered particles 1/3 mm in category $f_{0.5}$, f_1 *or* f_3 *may be used.*			

If it assumed that the largest particles are all 63μm, this would mean that each spherical particle would weigh around 0.433 x 10^{-6} g. A 1kg sample of sand would contain up to 3% of fines (i.e. up to 30g of fines) which would equate to around 70 million fine particles for every kilogram of sand.

The actual particle size distribution shown above shows that the sand is ultra-fine with the largest of the fine particles being less than 10μm in diameter so there are likely to be significantly more than 70 million fine particles per kilogram.

This means that the 27,000 te of sandy top-soil needed to build the 4m high x 19m wide noise attenuation bunds at a distance of 35m from the Freeth Farm Cottage boundaries will contain trillions of such particles.

These trillions of fine particles form the basis of a significant carcinogenic health risk during the 24 weeks of bund construction and removal due to their close proximity (42m) from the Freeth Farm Cottage occupied buildings.

This is why an increased buffer zone is essential to provide adequate environmental protection.

This very fine sand will dry very quickly, particularly if there is any breeze, both during excavation, bunf formation and during open conveyor transport over a 1.2km distance and the very fine particles will be readily transported by a light breeze, as will be shown later.

Each of these activities has the potential to generate large amounts of fine dust that will be largely invisible to the naked eye.



HQPL have assessed the potential for dust formation during top soil removal and bund formation and states that :

> *"there are receptors to the west which would be within 200m of these potentially dusty operations, particularly bund formation. Freeth Farm Cottages in particular have the potential to be affected when the wind is blowing from the north, east and south (depending on the stage of bund construction)."*

HQPL appear to believe that dusty conditions will only be caused by strong winds as the Environmental Statement states that:

> ***"****Fortunately strong winds from the east and south east in particular are not as common as those from the south west and would be for 31 days in the year (21.5% of dry days in the year on average)."*

This fails to take account of the fact that very fine silica particles will be quickly dried and entrained to a significant extent by light winds and that the Freeth Farm Cottages boundaries are only 16m from the largest 4m high bunds surrounding them on 3 sides.

The applicant also states that the Freeth farm sand is likely to be damp when it is extracted so that *"the potential for dust release during the extraction phase is considered to be very low".*

This argument may be true for dust arisings during sand extraction but it is not true for top soil removal and bund formation and nor is it true for the transport of sand by open conveyor in dry conditions.

Fugitive Dust During Top Soil Removal and Bund Formation

Top soil will be dug using an excavator and dropped into large dump trucks, transported to close to the bund formation area and tipped. The pile of top soil will then be formed into one of the may bunds using a second excavator described as having a long reach, as shown below.

The top soil is very sandy as it is on top of a sand deposit and, in dry weather the top soil will be relatively dry. In addition, the initial excavator will extract a small amount of sand with the top soil as the surface of the sand deposit is neared.

This extracted sand and the sand in the top soil itself will quickly dry as it is dropped onto top of the bund during the extensive bund formation activities, particluarly for the 4m x 19m bunds that are up to 16m from the Freeth Farm Cottage boundaries.

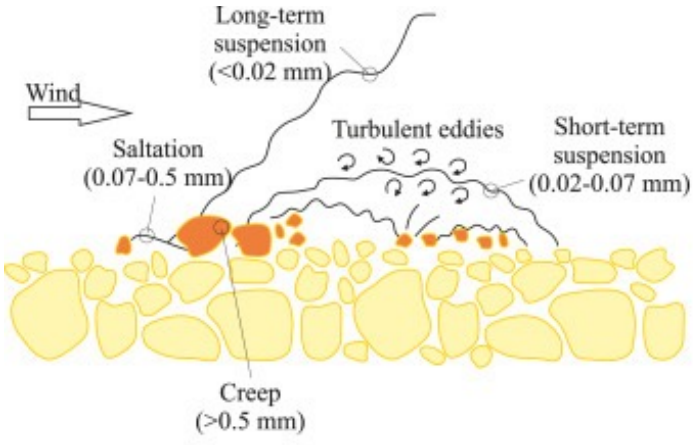
In dry conditions there will be a considerable amount of carcinogenic dust blow, some of which will be invisible to the operators as it is too fine to be visible.

The same potential for dust release will occur every time a bund is formed and every time a bund is subsequently dug up and moved elsewhere.

Top soil removal, bund formation, removal and reconstruction activities involve the movement of around 219,000 te of sandy top soil of which some 27,000 te will be used to form the 4m high x 19m wide bunds starting at 16m from Freeth Farm Cottages boundaries with no protection whatsoever during either bund formation or bund removal.

The closest bunds will surround Freeth Farm Cottages on 3 sides and the bund construction and removal involving 27,000 te of sandy top soil will take place in 4 separate stages making a total of nearly 24 weeks potential exposure to fine dust. HQPL have not assessed this risk.

The physics of sand entrainment are well established as shown below:



Carcinogenic Dust Risk

HQPL's risk assessment has failed to distinguish between the risk of nuisance dust (large silica particles blown by strong winds in dry conditions) and the risk of carcinogenic dust (fine silica particles entrained in light winds and dry conditions).

As we have seen, the 27,000 te of sandy top-soil needed to build the 4m high x 19m wide noise attenuation bunds will contain trillions of respirable particles that present a significant carcinogenic health risk due to their close proximity (42m) from the Freeth Farm Cottage occupied buildings. This is why an increased buffer zone is essential to provide adequate environmental protection.

The main carcinogenic health risk to the local residents who live at Freeth Farm Cottages, The Freeth and The Lodge has not been assessed by the applicant. The risks to the residents (adults and 3 children) arise mainly from wind blown fine carciogenic dust from the bund formation (before they are seeded) and during bund removal in dry conditions under a light breeze (or stronger) in Phases 5, 6 and 7 and also from the open conveyors for the 5 years of operation.

There are around 112 days of potential exposure to the 4m x 19m bund formation (11 weeks) and bund removal (5 weeks) during the temporary actvities in Phases 5, 6 and 7, a total of 16 weeks, a potential carcinogenic exposure in dry conditions combined with light breezes in the right direction.

A carcinogenic health risk from the construction/removal of just the closest 4m x 19m bunds starting at 16m from the property boundaries will occur at Freeth Farm Cottages for a period of around 12 weeks. Dry conditions would be expected for 65% of days. When the dry conditions combined with light breeze conditions (>3m/s) from all wind directions except from the north and west (72% of days), there would be a carcinogenic health risk from fine silica dust. The carcinogenic health risk exposure from these bunds is likely to amount to around 39 days over a 2 year period.

A carcinogenic health risk from all of the 4m x 19m bund construction and removal activities (16 weeks) will also occur at The Freeth in dry conditions (65% of days) combined with light breeze conditions (>3m/s) and from wind directions from the north and east (45% of days). The carcinogenic health risk exposure from the bunds is likely to amount to around 33 days days over a 2 year period.

HQPL's Inadequate Dust Mitigation Strategy

Hills dust mitigation strategy appears to relate to wind blown dust nuisance and relies on 3 main factors: 1. Sand moisture content; 2. Screening bunds and 3. Visual observation by the site staff and quarry manager, all of which have been shown to be ineffective for uncovered conveyors and are also likely to be ineffective on the extraction site for a number of reasons.

The sand moisture content will help to reduce nuisance dust and fine sand emissions from the site during sand excavation and the applicant has the option of using a water bowser.

At Freeth Farm Cottages there will be around 46 days of wind blown dust nuisance and 52 days of carcinogenic health risk from the bund formation/removal activities during Phases 5, 6 and 7 over a 2 year period. In addition, the carcinogen health risk from the open conveyors amounts to around 164 days over a 5 year period.

At The Freeth there will be around 33 days of carcinogenic health risk from the bund formation activities 52 days of carcinogenic health risk from the bund formation/removal activities during Phases 5, 6 and 7 over a 2 year period. In addition, the carcinogen health risk from the open conveyors amounts to around 164 days over a 5 year period.

Dust emissions from sand extraction can be mitigated to some extent by the screening bunds but not from the bund formation activities and the movement of sand by open conveyor.

Wind-blown nuisance dust emissions could potentially be monitored by vigilant staff but both the site staff or the quarry manager may have an incentive to continue working even if visible dust is being generated.

However, fine carcinogenic dust cannot be monitored by "visual observation" as the dust particles (<10μm) are invisible to the naked eye and, in any event, the 1.2km conveyor is not under visual observation by the site staff or the quarry manager.

Consequently, it can be reliably concluded that self-regulation by visual observation is a particularly ineffective form of control for fine dust particles that are invisible to the naked eye.

The applicant's "air quality expert" (Mr. M. Stoaling of Isopleth Limited) admits that *"crystalline silica is a health risk where sufficiently high exposure occurs"* and further admits that *"smaller particles travel further as a function of deposition velocity"*.

However, there is a high potential for exposure to fine carcinogenic sand particles in dry, light breeze conditions from the 4m high bunds that will surround Freeth Farm Cottage at a distance of 16m from the property boundaries. Fine dust will be released in dry light wind conditions until construction is complete and they are properly seeded. However, fine dust will be released again during their removal; and the fine dust blow from 1.2km long open conveyor with around 28 dog-legs, part of which will be elevated by 6m to the height of a motorway bridge.

The IAQM guidance for Mineral Dust (Box 2. Typical Impacts with Distance From the Experience of the Working Group) states that:

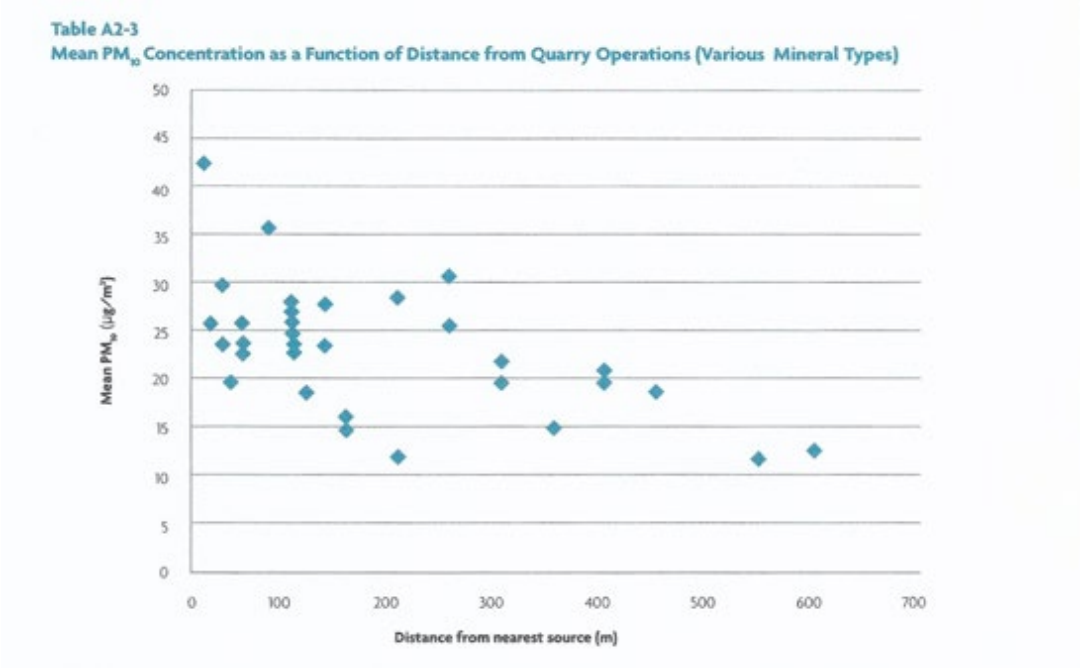
> *"Adverse dust impacts from sand and gravel sites are uncommon beyond 250m and beyond 400m from hard rock quarries measured from the nearest dust generating activities (see Appendix 2). In the absence of other information it is commonly accepted that the greatest impacts will be within 100m of a source and this can include both large (>30 µm) and small dust particles. The greatest potential for high rates of dust deposition and elevated PM_{10} concentrations occurs within this distance. Intermediate-sized particles (10 to 30 µm) may travel up to 400 m, with occasional elevated levels of dust deposition and PM_{10} possible. Particles less than 10µm have the potential to persist beyond 400 but with minimal significance due to dispersion"*

And

> *"Smaller dust particles remain airborne for longer, dispersing widely and depositing more slowly over a wider area. Large dust particles (greater than 30 µm), which make up the greatest proportion of dust emitted from mineral workings, will largely deposit within 100m of sources. Intermediate-sized particles (10–30 µm) are likely to travel up to 200–500m. Smaller particles (less than 10µm) which make up a small proportion of the dust emitted from most mineral workings, are only deposited slowly but may travel 1000m or more"*

In this context the *"smaller particles"* are 2-10µm and make up 35% by number of the silica dust particles in the Freeth Farm sand and which the Institute of Air Quality Management guidance for mineral dust advises may travel *"1000m or more"*.

The IAQM guidance for Mineral Dust considers the effects of 10µm particles (PM_{10}) as a function of distance from quarry operations as shown below:



The IAQM guidance shows that at distances less than 50m, the PM_{10} concentration may exceed the statutory limits for PM_{10} particles and it may also exceed the statutory limits for $PM_{2.5}$ particles, referred to as the fine fraction.

In the case of Freeth Farm Cottages, the bund formation and removal activities will take place at a distance of 16-35m from the property boundaries and some sand excavation will take place within 50m of the property boundaries.

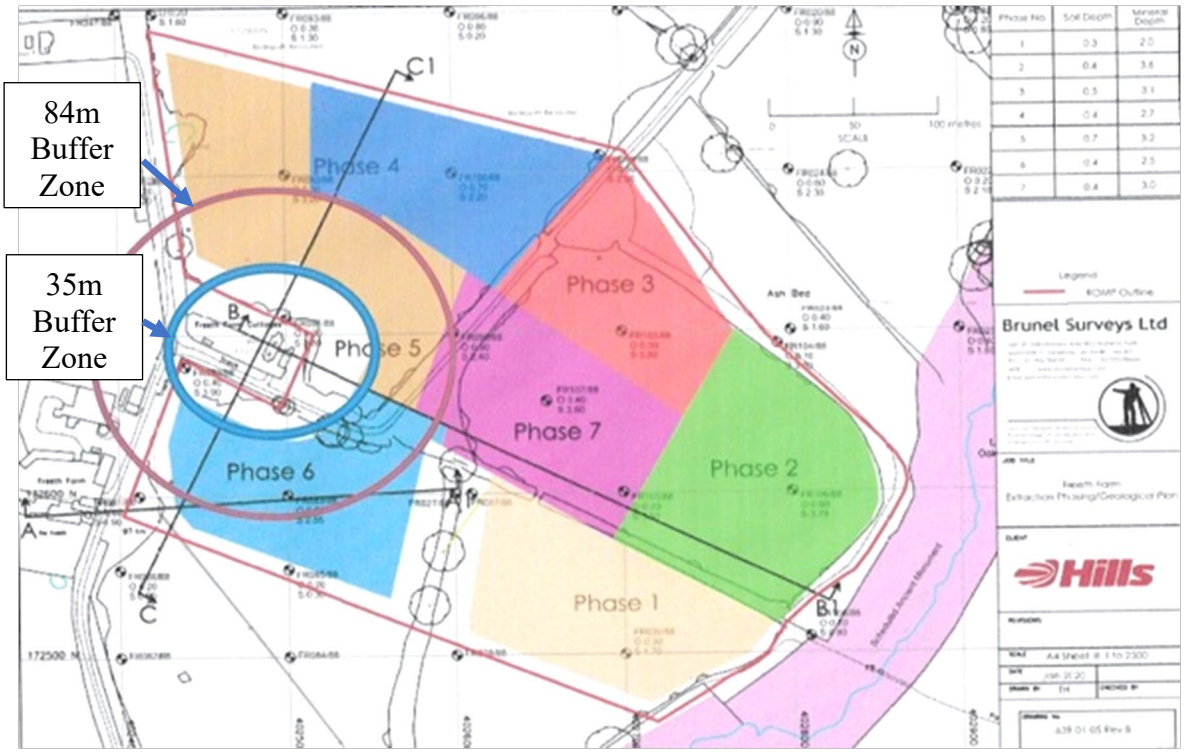
In addition, the Freeth Farm sand is known to have a high proportion of fine fraction particles, estimated at 35% by number and carcinogenic particles are highly likely to be present around Freeth Farm Cottages and The Freeth for significant periods during Phases 5 and 6.

This risk is non-trivial to the extent that HQPL should be asked to provide an indemnity against future health claims from the local community against Wiltshire Council in the event that this development is consented in its present form.

In addition, Hills Quarry Products Limited should put their insurers on notice of the likely increased risks arising from these activities or their insurance cover may be jeopardised.

Appendix 4

The proposed extraction plan contains details of various borehole data recording the topsoil and sand depths on a 100m grid as shown below.



The sand depth data from the boreholes enable the extractable sand volume to be calculated based on the known surface area.

Brunel Surveys Limited Report dated 7 November 2018 stated that:

> *"By modelling, total resource volume is 253,333 m^3*
> *Anticipated extraction and processing losses 15% of total – remaining volume 215,333 m^3 Saleable sand quantity at 1.5 tonnes per cubic metre 323,000 tonnes"*

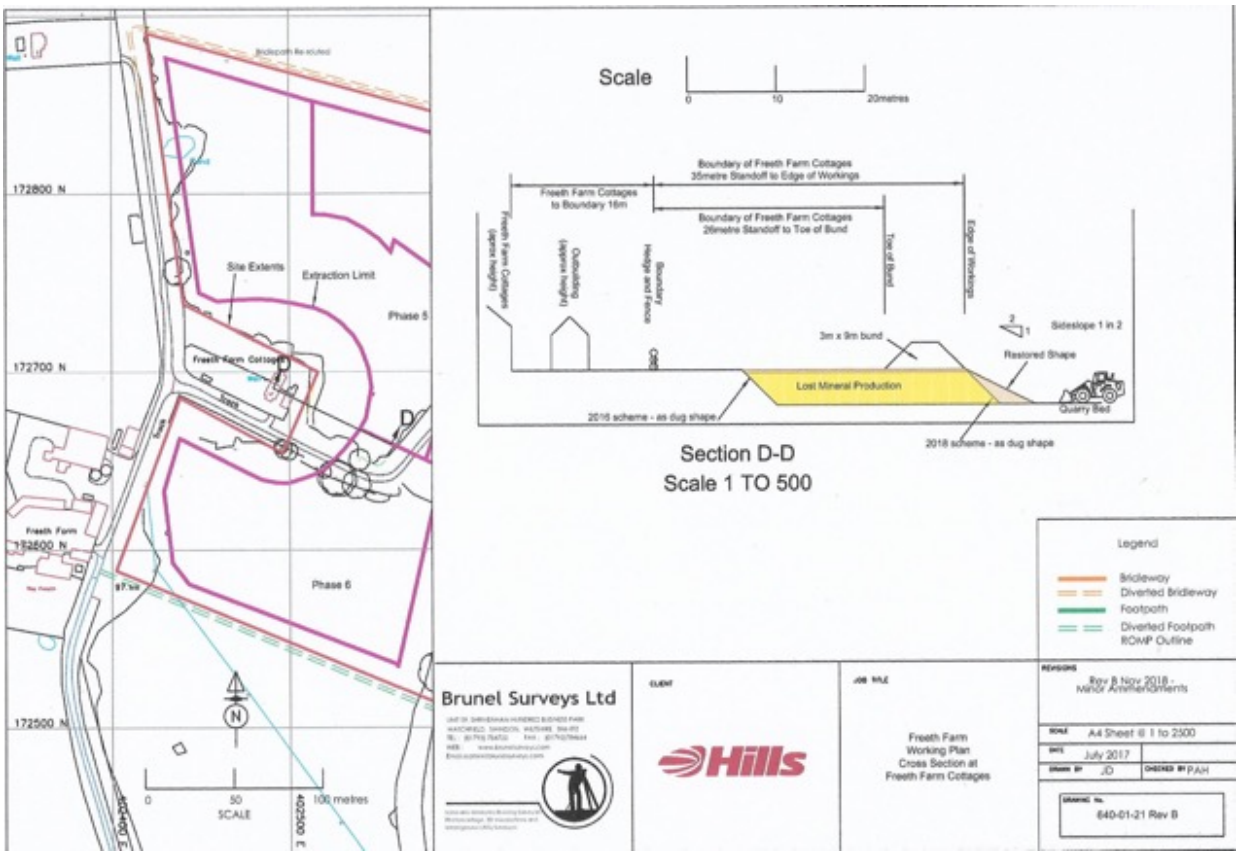
With a 10m buffer zone the volume of extractable sand is 215,333 m^3 as estimated by Brunel Surveys limited. As shown above, this was subsequently converted to an extractable sand tonnage using a sand density of 1.5 te/m^3, resulting in a predicted saleable sand tonnage of 323,000 te, the higher tonnage shown in Appendix 1.

Brunel Surveys Limited Report dated 7 November 2018 also stated that:

> *"The March 2018 revised sand production area has been reduced by 3,561 m^2. This represents a reduction in the resource area of 3.5% and a reduction in the saleable tonnage of 15,800 tonnes. The saleable quantity in the March 2018 scheme is calculated to be 307,200 tonnes."*

A 35m buffer zone reduces the area available for sand production area by 3,561 m^2, so the volume of extractable sand can be calculated by multiplying the area of reduction by the

average sand depths taken from the borehole data for that area. This has been converted to a reduction in the available sand tonnage by multiplying by the Brunel Surveys Limited assumed (incorrect) sand density of 1.5 te/m^3.



The Brunel Surveys Limited calculations based on the various areas and the borehole data. show that the reduction in the saleable sand tonnage caused by an increase in buffer zone from 10m to 35m to be 15,800 te. This reduces the total saleable sand tonnage from 323,000te to 307,200 te, the lower sand tonnage shown in Appendix 1.

This report has taken the borehole data from the 100m x 100m grid (as shown previously) and used it to create a high resolution grid of 10m x 10m by linearly interpolating values between the 100m borehole data points.

A sample of the high resolution grid for the top left-hand corner of the proposed extraction area, is shown in the table below, where the original borehole sand depth data from the 100m grid is highlighted in yellow and the high resolution values between these fixed points have been obtained by linear interpolation.

The high resolution borehole data values on the 10m x 10m grid allow the loss of sand volume for an increase in the buffer zone from 35m to 84m to be calculated by a process of numerical integration using the individual values from a given area defined by the respective buffer zone distances.

Grid Refs		402400	402410	402420	402430	402440	402450	402460	402470	402480	402490	402500
	Dist (m)	400	410	420	430	440	450	460	470	480	490	500
172900	900	1.40	1.36	1.32	1.28	1.24	1.20	1.16	1.12	1.08	1.04	1.00
172890	890	1.46	1.43	1.41	1.38	1.35	1.33	1.30	1.27	1.24	1.22	1.19
172880	880	1.52	1.51	1.49	1.48	1.46	1.45	1.44	1.42	1.41	1.39	1.38
172870	870	1.58	1.58	1.58	1.58	1.58	1.58	1.57	1.57	1.57	1.57	1.57
172860	860	1.64	1.65	1.66	1.68	1.69	1.70	1.71	1.72	1.74	1.75	1.76
172850	850	1.70	1.73	1.75	1.78	1.80	1.83	1.85	1.88	1.90	1.93	1.95
172840	840	1.76	1.80	1.84	1.87	1.91	1.95	1.99	2.03	2.06	2.10	2.14
172830	830	1.82	1.87	1.92	1.97	2.02	2.08	2.13	2.18	2.23	2.28	2.33
172820	820	1.88	1.94	2.01	2.07	2.14	2.20	2.26	2.33	2.39	2.46	2.52
172810	810	1.94	2.02	2.09	2.17	2.25	2.33	2.40	2.48	2.56	2.63	2.71
172800	800	2.00	2.09	2.18	2.27	2.36	2.45	2.54	2.63	2.72	2.81	2.90

Using the high resolution grid and borehole methodology for the area on the full 10m x 10m grid which includes the 35m and 84m buffer zone areas, it can be shown that the extractable sand tonnage for an 84m buffer zone would 306,865 te (sand density 1.735 te/m^3) and the IRR would be 21.04%.

A buffer zone of 84m (100m from Freeth Farm Cottages) would be in line with UK buffer zone norms; the noise levels would then be kept within statutory limits without the need for the intrusive 4m high x 19m wide noise attenuation bunds; and the carcinogenic silica dust levels would meet the Institute of Air Quality Management guidelines and all of this could be achieved with a commercial of commercial viability of around 21.04% IRR.