Ref. RDC/NC/6510

7th December 2009

ACOUSTIC CONSULTANTS

FIVE FORDS SLUDGE TREATMENT AND SUSTAINABLE ENERGY SCHEME
NOISE IMPACT ASSESSMENT

architectural

environmental

occupational

industrial

noise control at source

project management

planning

legal services

expert witness

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1.0 SUMMARY

At the request of Imtech Process a noise impact assessment has been conducted in the surrounding area of the proposed development at the Five Fords sludge treatment works near Marchwiel. An ambient noise survey has been performed to assess the background noise levels at the nearest residential location. The likely industrial noise from the proposed new processes has been modelled and the specific noise due to the activity has been predicted at the boundary of the nearest noise-sensitive residences. All measurements and assessments have been conducted in accordance with the requirements contained within BS4142:1997 – 'Method for rating industrial noise affecting mixed residential and industrial areas'. Propagation of noise from the proposed development to the residences has been predicted using the methods of ISO 9613-2:1996 "Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation".

Our assessment in accordance with BS4142 indicates that noise levels due to the new development will be below the level of marginal significance in the daytime and at the level of marginal significance at night, however, the night-time levels are less than the levels specified in the scope of BS4142 for its use. Comparison with indoor living conditions criteria of BS8233 and World Health Organisation guidelines suggests that night-time noise levels in bedrooms will be 10 dB below the specified maximum levels for good sleeping conditions.

Treatment options have been discussed should it be required to reduce the night-time rating level to the background level of 25dB. It is not likely that reduction below the 25dB level would result in any perceivable benefit to noise levels in residents bedrooms.

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2.0 BRIEF FOR CONSULTANCY

PDA Ltd. was engaged to carry out the following:

a) Predictive noise model

Using predicted noise levels supplied by you for the plant to be installed in the new development we will calculate the specific noise due to the development at the nearest noise sensitive residences during both daytime and night-time operation. We will also take into account noise due to any increase in deliveries to the site where you indicated this is likely to occur. Specific noise levels at noise sensitive receivers will be calculated using the methods of ISO 9613-2 "Acoustics – Attenuation of sound during propagation outdoors: General method of calculation".

b) Impact Assessment

The background noise levels (L_{90}) from the noise survey undertaken for the previous Advanced Digestion proposal, and specific noise levels calculated in part a) will be assessed in accordance with the requirements of Planning Policy Guidance document 24 (PPG24) "Planning and Noise", BS4142 "Method for rating industrial noise affecting mixed residential and industrial areas" and other standards as appropriate in accordance with the policies of the Local Authority.

c) Remediation

Where the assessment of part b) indicates that the development is unlikely to meet the requirements of the Local Authority with respect to noise, we will propose suitable basic remediation measures.

d) Report

The results from parts a), b) and c) will be presented in a full and detailed report in a format that is suitable for submission to the local authority.

3.0 AMBIENT NOISE SURVEY DETAILS

3.1 Site Description

The proposed site is located immediately to the south of the existing sludge treatment works off Cefn Road, near Marchwiel. The nearest noise sensitive properties are the rear of houses on the eastern end of Marcella Crescent and the eastern end of Ridgeway which are 340m south-west from the centre of the proposed development. Five Fords farm is approximately 400m north of the proposed site. The next nearest property on Cefn Road is approximately 620m from the centre of the site.

3.2 Survey Times and Personnel

Daytime ambient nose measurements were conducted on the 26th September, 2nd October and 5th October 2008. Measurements were attended and made by Mr. Liam Kavaney, Mr Joe Grimes and Dr Richard Cookson, all of PDA Ltd.

Night-time ambient noise measurements were conducted on the morning of 6th October 2008. Measurements were attended and made by Mr Joe Grimes of PDA Ltd.

3.3 Equipment

With the exception of measurements made on 5th October, all measurements were conducted with a CEL Instruments 593 C100 sound level meter, for which a calibration certificate is held. The CEL 593 sound level meter is a type 1 (as per BS EN 60651: 1994 and IEC 651) computing sound level meter capable of operating as an integrating sound level meter in compliance with BS EN 60204:1994 (IEC 804).

Measurements made on the 5th October were conducted with a Rion NA-28 sound level meter, for which a calibration certificate is held. The Rion NA-28 is a Class 1 sound level meter in accordance with IEC 61672-1:2002 capable of operating as an integrating sound level meter with frequency analysis and statistical functions.

The sound level meter was mounted on a tripod approximately 1.5 metres above ground level and at least 3.5 metres from any reflecting surfaces, throughout the survey.

The sound level meter was field calibrated both before and after each measurement period, during which time no significant deviation from the calibrated level was observed. The sound level meter was fitted with a microphone windshield at all times.

3.4 Weather

During the course of the daytime survey weather was dry, cloud cover varied between 20% and 100%, the temperature was between 9°C and 11°C, and wind speeds varied between 1 and 3 m/s.

3.5 Measurement Positions & Procedure

Initial measurements were made at two measurement positions; Location 1 - on the car-park/garages area at the eastern end of Ridgeway adjacent to the farm off the A525, and Location 2 - in the field at the rear boundary of the houses on Marcella Crescent. The noise climate at these two locations was found to be the same and subsequent measurements were taken from Location 1 only (see Figure 2).

The sound level meter was set up to measure dB(A) and octave bands in terms of L_{Aeq}, L_{Amax} and L_{A90} values using a fast time weighting. Measurements were set to five minute sample intervals with measurement samples being conducted consecutively.

4.0 NOISE ASSESSMENT CRITERIA

4.1 PPG24

In assessing the noise impact of the proposed development, the guidance taken from PPG24 "Planning and Noise" has been implemented. PPG24 states that for industrial and commercial developments near existing residential property, noise can be assessed in accordance with BS4142. In the same paragraph PPG24 also states; *"general guidance on acceptable noise levels within buildings can be found in BS 8233"*.

4.2 BS4142:1997

The effect of noise on the nearest noise sensitive residence will be assessed in accordance with BS4142:1997 – 'Method for rating industrial noise affecting mixed residential and industrial areas'.

This standard describes a method of determining the level of a noise, together with procedures for assessing whether the noise in question is likely to give rise to complaints from persons living in the vicinity.

Briefly the standard may be thought of as a procedure for comparing the noise from industrial sources with background noise levels in the absence of the industrial noise and determining the likelihood of complaints.

In accordance with BS 4142 the background noise level is the A-weighted sound pressure level at the assessment position that is exceeded for 90% of a given time interval (L_{A90}). The specific noise level is the equivalent continuous (L_{Aeq}) sound pressure level at the assessment position produced by the noise source over a given time interval.

Certain acoustic features can increase the likelihood of complaint over that expected from a simple comparison between the specific noise level and the background level. Where such features are present, these are taken into account by adding 5 dB to the specific noise level this is called the rating level.

This 5 dB correction should be applied if one or more of the following features occur, or are expected to be present.

- The noise contains a distinguishable, discrete, continuous tone (whine, hiss, screech, hum, etc.)
- The noise contains distinct impulses (bangs, clicks, clatters, or thumps)
- The noise is irregular enough to attract attention.

From the above the rating level is established, this being the value that is compared with the background noise.

According to BS 4142 a rating level of:

- 10 dB(A) or more above the background is an indication that complaints, attributable to the operation of the noise source, are likely.
- 5 dB(A) above the background is of marginal significance.
- 10 dB(A) below the background is a positive indication that complaints attributable to the operation of the noise source are unlikely.

The Scope of BS4142 states that;

> *"The method is not suitable for assessing the noise ... when the background and rating noise levels are both very low. For the purposes of this standard, background noise levels below about 30 dB and rating levels below about 35 dB are considered to be very low."*

Despite the above statement, there is no equivalent standard for use when noise levels are very low, and BS4142 is still widely used in these circumstances. However, the limits suggested by BS4142 may not always be appropriate for these very quiet circumstances.

4.3 BS 8233:1999/World Health Organisation guidelines on community noise

BS8233:1999 'Sound insulation and noise reduction for buildings – Code of practice' gives guidance on acceptable noise levels inside buildings. In the case of residential buildings BS8233 gives maximum indoor levels for reasonable and good resting and sleeping conditions. These are given in the table below;

Table 1. BS8233 recommended indoor ambient noise levels

Criterion	Typical Situation	Design range $L_{Aeq,T}$	
		Good	**Reasonable**
Reasonable Resting/Sleeping Conditions	Living rooms	30	40
	Bedrooms	30	35

The 'Good' criterion of BS8233 for bedrooms is equivalent to the recommended level given in the World Health Organisation 'Guidelines for Community Noise'.

PPG24 suggests that indoor noise levels (due to noise break-in) may be estimated from outdoor ambient noise levels by assuming a 13 dB reduction from the façade noise level due to a partially open window, equating to a 10dB reduction from the free-field noise level outside the property.

4.4 BS 5228 Part 1 & Part 4

PPG24 in Paragraph 21 of Annex 3 recommends BS5228 "Noise control on construction and open sites" for detailed guidance when assessing noise from construction sites.

BS5228 discusses the factors that need to be considered when determining criteria, although there are no specific limits given for noise and vibration levels. Instead heavy emphasis has been placed on community relations with people living and working in the vicinity of site operations. Noise from a site will tend to be more readily acceptable by local residents if they consider the site operator is doing all that they can to avoid unnecessary noise.

Daytime construction is usually acceptable as long as construction noise levels do not significantly exceed the existing ambient noise level. Higher daytime noise levels can be tolerated if local residents are informed of the short duration of any particularly noisy task.

For dwellings, times of site operations outside normal weekday working hours will need special consideration. Noise control targets for evening periods will need to be stricter than those for the daytime.

BS5288 also suggests that very strict noise control targets should be applied to any site which is to operate at night. Site noise at the façade of noise sensitive premises may need to be as low as 40 dB L_{Aeq} to 45 dB L_{Aeq}.

5.0 MEASURED LEVELS

5.1 Basic Assessment

The measured 'A' weighted broad band sound pressure levels from the measurement position are presented in terms of L_{Aeq}, and L_{A90} in Tables 2, 3 and 4 below. The L_{Aeq} levels are the logarithmic average of all the measurements during that period. The L_{A90} daytime levels have been logarithmically averaged over one-hour intervals, whilst the L_{A90} night-time levels have been left in 5 minute periods. The L_{A90} levels have been shown as a minimum to maximum range. The levels presented in the Tables have been rounded to the nearest decibel. Full data is presented at the end of this report.

Table 2. Summary of weekday daytime results

Position	**L_{Aeq}, dB.**	**L_{A90}, min–max, dB.**
Location 1	45	33 - 42
Location 2	43	34 -36

Table 3. Summary of night-time results

Position	**L_{Aeq}, dB.**	**L_{A90}, min–max, dB.**
Location 1	36	25 - 33

Table 4. Summary of Sunday daytime results

Position	**L_{Aeq}, dB.**	**L_{A90}, min–max, dB.**
Location 1	46	40 - 43

6.0 DESCRIPTION OF NOISE SOURCES

6.1 Existing ambient noise sources at nearest noise sensitive receivers

During the daytime measurements the dominant noise sources were distant traffic and birdsong (mainly crows) supplemented by occasional noise from nearby residences in Marchwiel. During the night-time measurement the dominant noise sources were distant traffic supplemented by distant plant noise.

6.2 Proposed noise sources due to new development

The proposed noise sources for the new development consist of a large number of small distributed outdoor sources. Noise source data has been supplied as a maximum sound pressure level at 1m which will be used to specify maximum noise levels from equipment manufacturers when specific equipment is sourced. The specification refers to the maximum noise level 1m from the source measured over a reflecting plane and at this stage the frequency spectrum of the sources is not known. In the case of the CHP units, these are to be supplied in acoustically treated 'containerised' units.

Noise limits for proposed outdoor plant are detailed in Table 5 below;

Table 5 – Proposed noise sources

Area	Plant	Sound pressure level at 1m [dB(A)] [d]	Duty cycle	Operating times
1	Odour control ductwork	55	1	24h
	Tankers offloading	80	0.958 [a]	0800 – 1700
	Pump mixer	75	1	24h
2	Pump mixer	75	0.33	24h
	Thickener feed pumps	60	3	24h
	Thickeners	50	3	24h
	Odour ductwork	55	1	24h
4	Digester feed pumps	70	2	24h
	Pump mixer pump	75	0.67	24h
	Recirculation pump	70	1	24h
	Pump mixer pump	75	0.67	24h
	Recirculation pump	70	1	24h
	Thickener mixer pump	75	0.33	24h
	Heat exchanger recirculation	70	1	24h
	Odour ductwork	55	1	24h
5	Gas holder inflation	75	1	24h
	Pressure relief system gas holder blower	75	0 [c]	24h
	Waste gas destructor	75	0 [c]	24h
6	CHP unit / standby generator [e]	60	2	24h
	CHP water circulation pump	65	2	24h
	Boiler	75	0 [c]	24h
	Boiler water circulation pump	75	0 [c]	24h
	Exhaust flue	75	1	24h
8	Digested sludge mixer pump	75	0.33	24h
	Polymer offloading	80	1	0800 – 1700
	Digested sludge transfer pump	75	1	24h
13	Odour control fans	75	1	24h
	Odour ductwork	55	1	24h

Notes;

a) Duty cycle is a 'fraction on-time' derived from the number of plant operating multiplied by the estimated on-time fraction.

b) Based on 19 tankers per eight-hour day. Although there are three offloading stations which in theory could operate simultaneously BS4142 daytime assessments are performed over a one hour period. As the offload phase for each tanker takes only 10 minutes it is unlikely that the noise level will significantly exceed the average duty when taken over a one-hour assessment period. For avoidance of doubt the duty cycle used is double the average calculated duty.

c) The pressure relief gas holder, waste gas destructor, boiler and boiler recirculation pumps are only used during break-down / emergencies where for some reason the CHP units are not able to process the gas produced. These have not been included in the general noise calculations.

d) Sources have been treated as point sources for propagation calculations from small pumps etc. For Odour control ductwork, Thickeners and CHP units a correction has been applied for the estimated surface area of the plant.

e) A standby diesel generator is proposed for maintenance / emergency use when the CHP is not operating. The standby generator should not produce higher noise levels than the CHP such that the overall levels calculated in the model will be maintained during maintenance.

6.3 Proposed noise sources during construction phase

Although the exact construction programme has not yet been determined the type and number of plant likely to be used in each phase of the construction process has been supplied. Likely noise levels due to the plant operation have been determined in accordance with the suggested procedures of BS5228. As the particular plant has not yet been selected measurements of similar activities have not been used in the construction noise model. Instead the following sources have been used, in order of preference;

A. The European Union harmonised noise limits for outdoor equipment where these have been defined for the particular item of plant. These limits are periodically decreased to ensure reducing noise levels with advances in technology. As it is unlikely that all plant used on the site will be new, the limits enforced for plant manufactured from 3rd January 2002 have been used. Note that from 3rd January 2006 noise limits for new plant have been reduced by a further 3dB.

B. The limits expressed in part A. require knowledge of the power (in kJ) of the item of plant. Where this is not known and cannot be reasonably estimated sound power levels for typical plant of the type selected have been used. Generally the larger and louder items of plant have been selected from the European Commission database of equipment subject to noise limits, which contains the rated noise levels of all equipment certified for operation in the European Union (See http://ec.europa.eu/enterprise/mechan_equipment/noise/citizen/app/).

C. Where plant are not subject to EU noise limits and manufacturers data is not available the measured sound power levels from BS 5228 have been used. These represent a very conservative assumption as the measurements in BS 5228 have not been updated since the 1986 issue of the standard and hence represent the noise levels generated by technology from over 20 years ago.

D. Sound power levels for heavy goods vehicle operation has been assumed to be 80dB(A) as this again is the maximum EU limit for these types of vehicles. Sound power levels for transit vans have been taken from the measured value for a diesel Ford Transit van from the VCA Car fuel data database (See http://www.vcacarfueldata.org.uk/search/search.asp).

Full details of the sound power value used and the source of data are given in the source calculation sheets appended to this report.

The sound power levels represent the static sound power level of the items of plant under full operational load. These have been adjusted for the estimated duty cycle of the plant. Both in terms of it's activity level during typical usage, and the likely percentage of time operated over the working day.

7.0 NOISE PROPAGATION CALCULATIONS

Noise propagation calculations from the site of the proposed development to the closest residential receivers have been calculated for the operational phase in accordance with ISO 9613-2 "Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation".

ISO 9613-2 is basically a method for calculating the 'worst case' propagation of noise outdoors (i.e. for downwind propagation or under a "*well-developed moderate ground-based temperature inversion, such as commonly occurs at night*"). The method takes the sound power of the source and applies corrections for directivity and attenuation due to various environmental factors. The factors considered for this assessment were as follows;

- A_{div} – the attenuation due to geometrical divergence
- A_{gr} – the attenuation due to the ground effect

For the purposes of this assessment it was assumed that the sources will be omni-directional. Due to the large number of small individual sources which make up the proposed new development this is likely to be a reasonable assumption.

Further attenuation factors are specified in the standard, for attenuation due to atmospheric absorption, attenuation due to barriers and attenuation due to propagation through foliage, industrial sites and areas of housing. These further attenuations have all been neglected as there are not believed to be significant barriers between the source and receiver or large areas of foliage. There is likely to be some additional attenuation due to atmospheric absorption however these additional terms all require the octave band frequency spectrum of the source noise in order to calculate the attenuation and this is not available at this time.

For the construction phase propagation has been estimated in accordance with the procedures of BS 5228. These use a correction factor for distance attenuation over either hard or soft ground. In this case the 'soft ground' attenuation factor has been used. This is broadly equivalent to the method of ISO 9613 described above and takes into account geometrical divergence and attenuation due to the ground effect in the single correction factor.

8.0 BS4142 ASSESSMENT

8.1 Calculation Procedure

To be able to conduct an assessment of the noise generated by the new industrial development in accordance with BS4142 we have undertaken calculations of the likely noise contribution at the nearest noise sensitive residence.

Corrections have been applied for distance (geometrical) attenuation assuming hemispherical propagation from the sources. Additional attenuation due to ground absorption has been applied in accordance with equation (10) of ISO 9613-2:1996 which is valid for A-weighted "*sound propagation ... over porous ground or mixed ground most of which is porous*".

In order to calculate the ground absorption it has been assumed that the source height is generally 1m above ground level and the receiver height is 5m above ground level (approximate upstairs window height) giving a mean propagation height of 3m.

It was assumed that the overall noise produced by the site would not require acoustic character correction. Although some of the sources were intermittent these were each only a small fraction of the site noise and were unlikely to switch on/off at the same time, similarly although frequency for the sources is not available, with such a large number of individual sources of similar sound power it is unlikely that specific tones will be dominant even if some of the sources were tonal in themselves.

8.2 Calculation Results

The specific noise levels at the nearest residences on Ridgeway and Marcella Crescent were calculated as shown below;

Table 6 – daytime specific noise calculation

Area	Sound power L_{wA} [dB]	Distance [m]	Ground attenuation [dB]	Sound pressure at receiver L_{pA} [dB] (hemispherical propagation)
1	88.5	380	4.5	24.4
2	82.9	315	4.5	20.4
4	88.8	380	4.5	24.7
5	83.0	350	4.5	19.6
6	87.9	320	4.5	25.4
8	89.5	360	4.5	25.9
13	83.1	330	4.5	20.3
Total				**32.1**

Table 7 – Night-time specific noise calculation

Area	Sound power L_{wA} [dB]	Distance [m]	Ground attenuation [dB]	Sound pressure at receiver L_{pA} [dB] (hemispherical propagation)
1	80.4	380	4.5	16.3
2	82.9	315	4.5	20.4
4	88.8	380	4.5	24.7
5	83.0	350	4.5	19.6
6	87.9	320	4.5	25.4
8	84.2	360	4.5	20.6
13	83.1	330	4.5	20.3
Total				**30.4**

8.3 Comparison with background

PPG24 states that the likelihood of complaints about noise from developments can be assessed, where the Standard is appropriate, using guidance in BS 4142.

As stated in section 4.1 BS4142 compares the noise level produced by the industrial source with the background L_{A90} noise level within the area with the absence of the source.

Details of our assessments are included below.

Daytime assessment

Background Noise Level L_{A90}	=33dB
Contribution from source alone L_{Aeq}	=32dB
Acoustic Character Correction	=+0dB
Rating Level (BS4142:1997)	=32dB
Excess of Rating Level Over Background Level dB	= -1dB

Night-time assessment

Background Noise Level L_{A90}	=25dB
Contribution from source alone L_{Aeq}	=30dB
Acoustic Character Correction	=+0dB
Rating Level (BS4142:1997)	=30dB
Excess of Rating Level Over Background Level dB	= +5dB

In accordance with BS4142 the assessment is below the level of marginal significance during the day, and at the level of marginal significance during the night. However it should be noted that the night-time assessment has both a rating level below 35 dB and a background below 30 dB which is below the suggested minimum noise level criterion for the application of BS4142 (See section 4.1).

9.0 CONSTRUCTION PHASE NOISE ASSESSMENT

The noise during the construction phase has been modelled at the nearest noise sensitive residences in accordance with BS 5228. The traverse correction for mobile plant has been neglected in accordance with the procedure as the traverse length of the site is less than half of the distance from the nearest point of the site to the nearest receptor. This is a conservative treatment as the traverse adjustment results in a reduction to the overall noise level. Daily L_{Aeq} noise levels and durations at the nearest noise sensitive residences are summarised in Table 8 below. Distances have been calculated from the centre of the site to the nearest residences in Marchwiel.

Table 8 – Construction phase daytime noise level

Construction phase	Sound pressure level at nearest noise sensitive receiver L_{Aeq} [dB]	Planned duration [wks]
1	56	4
2	58	8
3	58	8
4	57	12
5	50	24
6	46	12
7	56	8
8	51	6

According to BS 5228 significant impacts due to noise are likely where the construction noise level exceeds the pre-existing ambient noise level by 10 dB or more. As the minimum measured ambient L_{Aeq} prior to construction was 43 dB, this suggests that significant noise impacts are likely at levels greater than 53 dB. As such construction phases 1,2,3,4 and 7 are likely to cause significant impact over a total period of approximately 40 weeks.

Where significant impact is predicted steps should be taken to reduce noise levels where possible. Ideally noise levels should be as low as possible although noise must be considered in conjunction with other impacts, so lower noise levels with for example a much longer duration may not necessarily be regarded as a reduction in impact.

The above predictions are based on unshielded propagation and may be reduced by careful use of shielding such as positioning of site cabins, hoardings or mounding of spoil prior to removal. As a rule of thumb partial line-of-sight shielding reduces noise levels by approximately 5dB whilst full line-of-sight shielding reduces levels by approximately 10 dB. Also reducing the number of each type of plant operating by half will reduce the L_{Aeq} due to that particular plant by 3dB.

The proposed site hours are 7:30am to 6pm during weekdays and possibly Saturday morning, as such the increased impact due to evening and traditional weekend leisure-time working will be avoided.

Further to the above the following measures can be used to reduce impacts of construction noise:

- The contractors should develop and maintain positive relations with local residences and building owners to inform of site progress and to forewarn of periods of unusually high noise levels and the likely duration.
- The use of well maintained equipment at all times.
- The use of low noise equipment wherever possible.
- Stationary plant equipment could use acoustic enclosures or be located some distance away from the residential locations wherever possible.

For the construction phases causing significant noise impact the following items are the dominant noise sources and noise reduction strategies should be targeted at treating these items to obtain maximum effect. The assumed sound power of each of these items is shown in the calculation sheets for each phase in the appendix to this report. Where possible plant with a lower sound power rating should be utilised, or the strategies outlined above should be employed to reduce the impact at nearby sensitive receivers where possible.

Phase 1;
The 25t all terrain dumpers, bulldozers and woodchippers.

Phase 2;
The 25t all terrain dumpers, bulldozers, vibrating compaction rollers and 35t excavators.

Phase 3;
The hydraulic pecker, pre-cast concrete piling, vibrating compaction rollers, 25t dumpers and 35t Excavators.

Phase 4;
The 25t dumpers, vibrating compaction rollers and 35t excavators.

Phase 7;
The 25t dumpers and vibrating compaction rollers.

Note that part of construction phase 2 is described as 'Upgrade to Cefn Road at site entrance'. The particular operations at the site entrance have not been determined at this time. Particular care must be taken with these operations as the nearest residences in this case are much closer than those for the main site with houses approximately 80m from the current site entrance and these are likely to be subjected to considerably higher noise levels for than predicted for the duration of work at the site entrance. Good relations and maximum attention to reduction of noise impact at these locations will be required for this phase of the development. Possible temporary re-location of the site entrance further away from the noise sensitive properties could also be considered.

10.0 VIBRATION

The only significant vibration sources at the distances considered to the nearest residences are likely to be due to piling operations. The type of piling required for the site has not yet been determined and vibration levels are also dependent on the local geology and soil type. It is recommended that vibration measurements for the piling rig selected on a similar soil type are obtained prior to commencing piling operations and the likely vibration levels at nearby sensitive properties are estimated. It is however unlikely that very high vibration levels at the nearest residences will be experienced due to the relatively large distance (around 280m) from the nearest properties to the edge of the site.

11.0 DISCUSSION

Assessment of the operational noise of the plant in accordance with BS4142 shows that the daytime noise level is 1 dB below the background noise level and as such is 6 dB below the 'marginal significance' criterion of BS4142. For the night-time assessment the rating level is 5dB above the background level and is therefore at the level of 'marginal significance'. It should be considered however, that these levels are below the noise levels at which BS4142 is intended for use and the criteria specified may not be appropriate at these levels. Considering the predicted night-time specific noise due to the source of 30 dB, and an assumed attenuation of 10dB due to an open window, this would result in an internal level of 20dB in bedrooms which is 10 dB below the 'good' criterion for sleeping conditions given in BS8233 and suggests that sleep disturbance would not be likely at these levels. In addition it is likely that the true rating level will be somewhat below that calculated due to atmospheric attenuation which has been neglected from the calculations due to a lack of frequency data for the noise sources.

It is also worthy of note that the background noise levels at the noise sensitive properties considered may increase somewhat prior to the development proposed, due to the construction of the proposed Wrexham Industrial Estate Southern Access Road. The rear boundaries of the noise sensitive residences considered are within 1km of the proposed road scheme, with a direct line-of-sight propagation path, and any increase in background noise levels due to the road will result in further masking of noise produced by the proposed treatment works development.

In order to achieve further reduction of the rating level at night remedial treatments would be required for number of the plant on-site. Calculations show that to achieve a night-time rating level equal to the pre-existing background would require a 10dB reduction of the noise levels from areas 6 and 8 and a 5dB reduction of noise levels from areas 2 and 4. These reductions could be achieved by one of the following methods, listed in order of preference;

a) Source plant with a lower sound power. By using 'Best Available Technology', and fitting manufacturers 'hush kits' to plant where available to achieve the required reduction at source.

b) Enclose noisy plant with an enclosure with an insertion loss equal to the required additional attenuation. Frequency data for the plant enclosed would be required to specify the design and PDA can advise on suitable design if required. Note that any vents or openings would also require acoustic treatments.

c) An imperforate barrier of minimum mass 10kg/m^2 which is positioned such that there is no line-of-sight propagation between the sources and the noise sensitive residences is likely to give a reduction of the order of 10dB. However, careful consideration needs to be given to reflected paths to ensure that the screening due to the barrier is not compromised and the actual reduction achieved is dependent on the frequency spectrum of the source.

The above assessments have assumed that there are no significant sources associated with the new development other than those specified in Table 5. In particular care should be taken to ensure that vibration or noise from plant is not transmitted to pipework or ductwork from which it is then radiated as a secondary noise source. PDA can advise on suitable attenuation measures if required when further details of the likely noise spectrum of the various sources is available. A further assumption is that the noise will be dominated by the plant located outdoors. In order for this assumption to be valid it should be ensured that noise break-out from any new buildings is limited to 75dB L_{WA} for each building. PDA can advise on suitable attenuation measures if required.

For the construction phase of the development although significant impact is predicted for a large proportion of the construction phase, no noise reduction strategies or shielding allowances have been applied and the 'significant impact' level is only exceeded by a maximum of 5dB. Hence, utilising the noise reduction methods suggested in Section 9 and by maintaining good communications and community relations it is likely that the construction can be achieved without significant adverse impact to the surrounding residences.

12.0 CONCLUSION

At the request of Imtech Process a noise impact assessment has been conducted in the surrounding area of the proposed development at the Five Fords sludge treatment works near Marchwiel. An ambient noise survey has been performed to assess the background noise levels at the nearest residential location. The likely industrial noise from the proposed new processes has been modelled and the specific noise due to the activity has been predicted at the boundary of the nearest noise-sensitive residences. All measurements and assessments have been conducted in accordance with the requirements contained within BS4142:1997 – 'Method for rating industrial noise affecting mixed residential and industrial areas'. Propagation of noise from the proposed development to the residences has been predicted using the methods of ISO 9613-2:1996 "Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation".

Our assessment in accordance with BS4142 indicates that noise levels due to the new development will be below the level of marginal significance in the daytime and at the level of marginal significance at night, however, the night-time levels are less than the levels specified in the scope of BS4142 for its use. Comparison with indoor living conditions criteria of BS8233 and World Health Organisation guidelines suggests that night-time noise levels in bedrooms will be 10 dB below the specified maximum levels for good sleeping conditions.

Treatment options have been discussed should it be required to reduce the night-time rating level to the background level of 25dB. It is not likely that reduction below the 25dB level would result in any perceivable benefit to noise levels in residents' bedrooms.

Summary of Measurement Results

Daytime ambient noise survey. Marchwiel

	Time	LAeq	LA90
Location 1	10:00:00	45.9	
	10:05:00	42	
	10:10:00	45.5	
	10:15:00	46.7	
	10:20:00	49.1	36
Location 2	10:25:00	43.8	
	10:30:00	41.1	
	10:35:00	42.7	
	10:40:00	43.5	
	10:45:00	41.8	
	10:50:00	41.3	
	10:55:00	41.6	
	11:00:00	39.8	
	11:05:00	44.4	36
Location 1	11:10:00	41.3	
	11:15:00	49.1	
	11:20:00	39.9	
	11:25:00	44.6	
	11:30:00	41.7	
	11:35:00	44	34
Location 2	11:40:00	40.8	
	11:45:00	44.4	
	11:50:00	44.5	
	11:55:00	39.6	
	12:00:00	44.5	
	12:05:00	42.2	34
Location 1	12:10:00	40.3	
	12:15:00	43.7	
	12:20:00	46.2	
	12:25:00	46.6	
	12:30:00	45.3	
	12:35:00	43.3	35
Location 2	12:40:00	44.2	
	12:45:00	43.4	
	12:50:00	39.2	
	12:55:00	39.4	
	13:00:00	42.8	
	13:05:00	40.9	34
Location 1	13:10:00	40.7	
	13:15:00	44.1	
	13:20:00	43.2	
	13:25:00	37.2	
	13:30:00	40.9	
	13:35:00	42	33
Location 1	14:00:00	46.2	
	14:15:00	47	
	14:30:00	48	
	14:45:00	43.4	42

Location 1	Avg L_{Aeq}	45	Min L_{A90}	33	Max L_{A90}	42
Location 2	Avg L_{Aeq}	43	Min L_{A90}	34	Max L_{A90}	36

Nighttime ambient noise survey

00:55	37.1	33.0
01:00	35.9	32.0
01:05	37.1	33.0
01:10	34.6	32.0
01:15	36.1	33.0
01:20	33.8	32.0
01:25	33.3	32.0
01:30	33.5	32.0
01:35	37.0	32.0
01:40	32.8	32.0
01:45	31.5	30.0
01:50	33.8	29.0
01:55	33.5	28.0
02:00	40.7	30.0
02:05	31.5	30.0
02:10	32.3	29.0
02:15	37.5	29.0
02:30	39.9	28.0
02:45	28.9	25.0
03:00	27.7	26.0
03:05	32.9	26.0
03:10	36.2	27.0
03:15	36.6	28.0
03:20	34.1	28.0
03:25	36.3	28.0
03:30	32.5	28.0
03:35	36.2	31.0
03:40	37.3	30.0
03:45	34.3	30.0
03:50	36.2	31.0

Avg L_{Aeq} 36

Min L_{A90} 25.0

Max L_{A90} 33.0

Sunday ambient noise survey

	LAeq	LA90
10:00	46	41.7
10:15	43.4	40.7
10:30	43.5	40.2
10:45	45.7	41.1
11:00	47	41.9
11:15	46.7	40.9
11:30	43.7	41.2
11:45	44.2	41.4
12:00	44.3	41.7
12:15	46	41.7
12:30	49.9	41.9
12:45	44.3	40.9
13:00	49.7	42.5
Avg L_{Aeq}	46	
Minimum L_{A90}		40
Maximum L_{A90}		43

Propagation calculations

Distances for plant areas to reciever

Region	Distance
1	380
2	315
4	380
5	350
6	320
8	360
13	330

Sources at area 1	Lp 1m	Eff area	Duty	Daytime	Nighttime	LwA Day	LwA Night
Tanker offloading	80	0	0.958333	1	0	87.8	0.0
Pump mixer	75		0.333333	1	1	78.2	78.2
Odour ductwork	55	138.2301	1	1	1	76.4	76.4
Total						**88.5**	**80.4**
Ground attenuation						**4.5**	**4.5**
Grand total						**84.0**	**75.9**
Area 2							
Pump mixer	75		0.333333	1	1	78.2	78.2
Thickener feed pumps	60		3	1	1	72.8	72.8
Thickeners	50	84	3	1	1	74.0	74.0
Odour ductwork	55	262.6371	1	1	1	79.2	79.2
Total						**82.9**	**82.9**
Ground attenuation						**4.5**	**4.5**
Grand total						**78.4**	**78.4**
Area 4							
Digester feed pumps	70		2	1	1	81.0	81.0
Pump mixer pump	75		0.666667	1	1	81.2	81.2
Recirculation pump	70		1	1	1	78.0	78.0
Pump mixer pump	75		0.666667	1	1	81.2	81.2
Recirculation pump	70		1	1	1	78.0	78.0
Thickener mixer pump	75		0.333333	1	1	78.2	78.2
Heat exchanger recirculation pumps	70		1	1	1	78.0	78.0
Odour ductwork	55	359.3982	1	1	1	80.6	80.6
Total						**88.8**	**88.8**
Ground attenuation						**4.5**	**4.5**
Grand total						**84.3**	**84.3**
Area 5							
Gas holder blowers	75		1	1	1	83.0	83.0
Pressure relief system gas holder	75		1.00E-06	1	1	23.0	23.0
Waste gas destructor	75		1.00E-06	1	1	23.0	23.0
Total						**83.0**	**83.0**
Ground attenuation						**4.5**	**4.5**
Grand total						**78.5**	**78.5**
Area 6							
CHP units / deisel generator	60	192	2	1	1	85.8	85.8
CHP Water circulation pumps	65		2	1	1	76.0	76.0
Boiler	75		1.00E-06			0.0	0.0
Boiler water circulation pumps	75		1.00E-06			0.0	0.0
Exhaust flue	75		1	1	1	83.0	83.0
Total						**87.9**	**87.9**
Ground attenuation						**4.5**	**4.5**
Grand total						**83.5**	**83.5**
Area 8							
Digested Sludge Mixer Pump	75		0.333333	1	1	78.2	78.2
Polymer offloading	80		1	1	0	88.0	0.0
Digested Sludge Transfer pump	75		1	1	1	83.0	83.0
Total						**89.5**	**84.2**
Ground attenuation						**4.5**	**4.5**
Grand total						**85.0**	**79.7**
Area 13							
Odour control fans	75		1	1	1	83.0	83.0
Odour ductwork	55	20.73451	1	1	1	68.2	68.2
Total						**83.1**	**83.1**
Ground attenuation						**4.5**	**4.5**
Grand total						**78.7**	**78.7**

Tanker delivery duty calculation

No of tankers	46
Offload time (h)	0.1666667
Operating hours	8
Offloading duty	**0.9583333**

Reciever levels

Area	Attenuatior	Daytime	Night-time
1		24.4	16.3
2		20.4	20.4
4		24.7	24.7
5		19.6	19.6
6		25.4	25.4
8		25.9	20.8
13		20.3	20.3
		32.1	30.4

Ground attenuation to ISO 9613-2:1996

hm (mean height) 3 m

Site layout

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Rev	Nature of Revision	Drawn	Chkd	Appd	Date

PLANNING

Costain | Imtech ImtechProcess

DC-WW Unique Ref	Costain Ref	Imtech Ref
DC-WW SAP Ref A991.S.040.021	2480265	P1607

NORTH WALES AMP5 PROGRAMME
FIVE FORDS SLUDGE TREATMENT & SUSTAINABLE ENERGY

PROPOSED NOISE AREAS

Imtech ImtechProcess

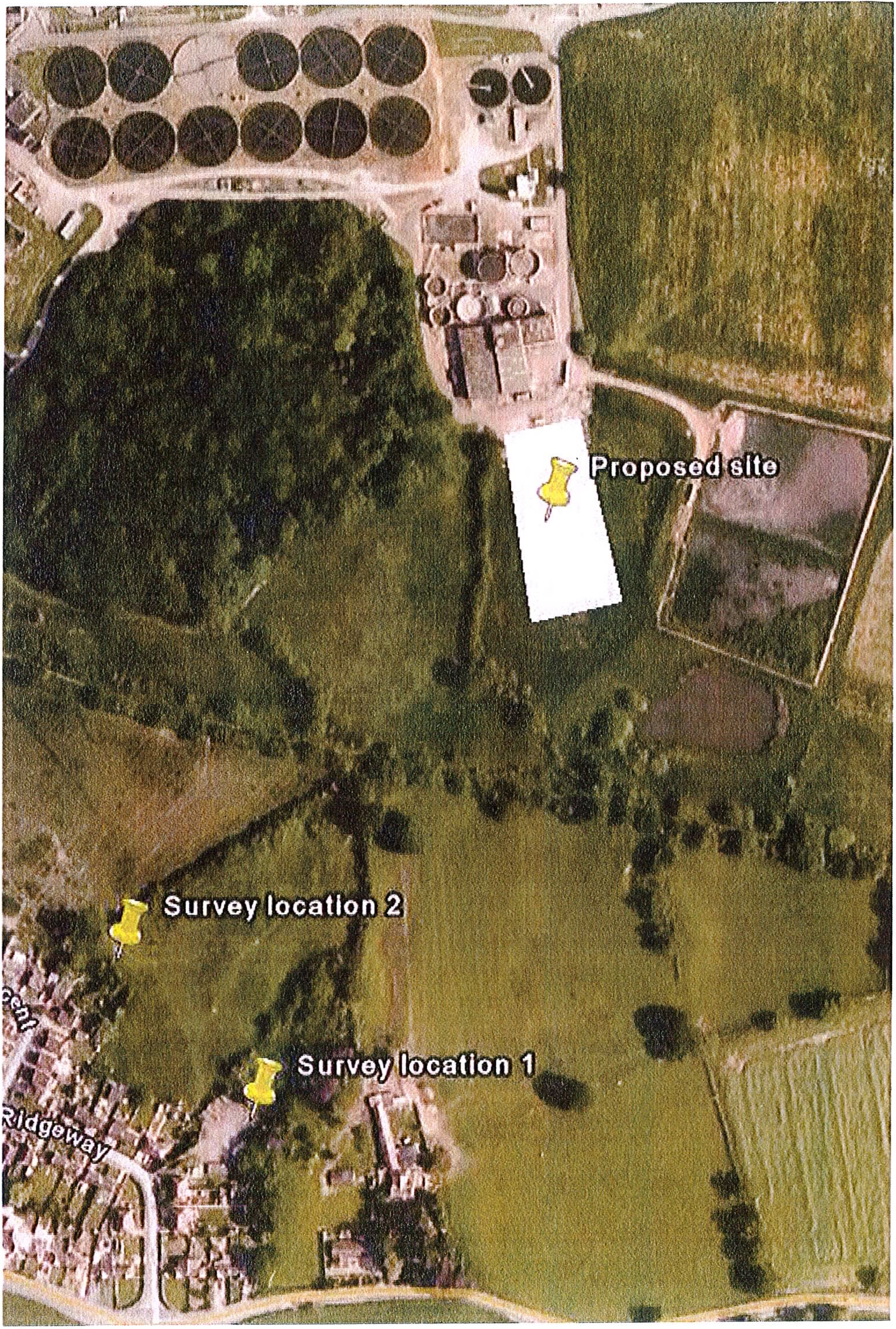
AECOM

Dwr Cymru - Welsh Water
Vista,
St Davids Park,
Ewloe,
FLINTSHIRE
CH5 3DT
Tel. 01244 529700
Fax. 01244 529698

Drawn	Checked	Approved	Date	Scale
WJW	LFM	JMo	27.11.09	AS SHOWN AT A1

Designer's Ref	Drawing no	Rev
60098354.10.009	2480265_1000_2450	A0

Survey locations


Proposed site
Survey location 2
Survey location 1
Ridgeway

Construction noise calculations

Plant	Assumed type	Engine power kW	Sound power	Source	Duty cycle	Distance correction Ks'	Total
25t Dumper		230	110.98	EEC directive	3	63.96	51.79
Bulldozers	Tracked, caterpillar D8T)	231	113	EEC directive	1.5	63.96	50.8
Woodchipper	Alba PDGGS2200		110	Europa noise database	2.25	63.96	49.56
35t Excavator		161	107.28	EEC directive	1.5	63.96	45.07
Gen site vehicles	Ford Transit 2006 Diesel		75	VCAcarfueldatabase	2.25	63.96	14.56
Low loader wagons			80	EEC directive	0.38	63.96	11.85
							55.95

Traverse length for mobile	140
Nearest point to noise sensitive	280
Mean distance	330

Phase 2

Plant	Assumed type	Engine power kW	Sound power	Source	Duty cycle	**Distance correction Ks'**	**Total**
25t Dumper		230	110.98	EEC directive	6	63.96	54.8
Bulldozers	Tracked, caterpillar D8T)	231	113	EEC directive	1.5	63.96	50.8
Vibrating compaction rollers	Typical power from Catarpillar website	116	111.71	EEC directive	1.5	63.96	49.51
35t Excavator		161	107.28	EEC directive	3	63.96	48.08
Mobile Crane	Typical LIEBHERR LTM1035	206	109	http://www.xs4a	0.75	63.96	43.79
6m3 readymix concrete wagons	Discharge only, assumed 12 mins		112	BS5228	0.19	63.96	40.84
Wheeled tipper lorry	Unloading	3mins	113	BS5228	0.1	63.96	38.83
Hiab lorries	http://www.xs4all.nl/~rigolett/ENGELS/equipment/mobcran2		97	Internet data	0.75	63.96	31.79
Artic trailer wagons			80	EEC directive	3	63.96	20.81
Wheeled tipper lorry	movement only 12 mins per visit		80	EEC directive	0.38	63.96	11.85
							57.93

Traverse length for mobile		140
Nearest point to noise sensitive		280
Mean distance		330

Plant	Assumed type	Engine power kW	Sound power	Source	Duty cycle	**Distance correction Ks'**	**Total**
Hydraulic Pecker	Assume pecker worst case		119	BS5228	1	63.96	55.04
Piling	Pre cast concrete, 20m deep as per ref 31, assume 1 pile every 1.5 hours?		116	BS5228	0.63	63.96	50.01
Vibrating compaction rollers	Typical power from Catarpillar website	116	111.71	EEC directive	1.5	63.96	49.51
25t Dumper		230	110.98	EEC directive	1.5	63.96	48.78
35t Excavator		161	107.28	EEC directive	3	63.96	48.08
6m3 readymix concrete wagons	Discharge only, assumed 12 mins		112	BS5228	0.38	63.96	43.85
Artic trailer wagons			80	EEC directive	3	63.96	20.81
Low loader wagons			80	EEC directive	0.38	63.96	11.85
							58.28

Traverse length for mobile	140
Nearest point to noise sensitive	280
Mean distance	330

Phase 4

Plant	Assumed type	Engine power kW	Sound power	Source	Duty cycle	**Distance correction Ks'**	**Total**
25t Dumper		230	110.98	EEC directive	6	63.96	54.8
Vibrating compaction rollers	Typical power from Catarpillar website	116	111.71	EEC directive	1.5	63.96	49.51
35t Excavator		161	107.28	EEC directive	3	63.96	48.08
6m3 readymix concrete wagons	Discharge only, assumed 12 mins		112	BS5228	0.38	63.96	43.85
On site batching plant	19m3/h		104	BS5228	0.75	63.96	38.79
Vibrating hammer for sheet piling	assume 4m depth 120min per pile		94	BS5228	0.67	63.96	28.28
							56.88

Traverse length for mobile	140
Nearest point to noise sensitive	280
Mean distance	330

Plant	Assumed type	Engine power kW	Sound power	Source	Duty cycle	**Distance correction Ks'**	**Total**
Mobile concrete pump			109	BS5228	0.75	63.96	43.79
Mobile Crane	Typical LIEBHERR LTM1035	206	109	http://www.xs4all.nl/~rigolet	0.75	63.96	43.79
80t tracked crane	Kobelco CKE800		104	ec.europa.eu database	1.5	63.96	41.8
Poker vibrator for concrete compaction			98	BS5228	3.75	63.96	39.78
On site batching plant	19m3/h		104	BS5228	0.75	63.96	38.79
6m3 readymix concrete wagons	Discharge only, assumed 12 mins		112	BS5228	0.11	63.96	38.62
Power float			100	BS5228	1.5	63.96	37.8
Artic trailer wagons			80	EEC directive	0.01	63.96	-3.38
							49.7

Traverse length for mobile	140
Nearest point to noise sensitive	280
Mean distance	330

Phase 6

Plant	Assumed type	Engine power kW	Sound power	Source	Duty cycle	**Distance correction Ks'**	**Total**
Mobile Crane	Typical LIEBHERR LTM1035	206	109	http://www.xs4all.nl/~rigo	1	63.96	45.04
Mobile elevated platform	Typical Hitachi HX140B		97	ec.europa.eu database	2	63.96	36.05
Artic trailer wagons			80	EEC directive	0.02	63.96	-2.13
							45.55

Traverse length for mobile	140
Nearest point to noise sensitive	280
Mean distance	330

Plant	Assumed type	Engine power kW	Sound power	Source	Duty cycle	**Distance correction Ks'**	**Total**
25t Dumper		230	110.98	EEC directive	4.5	63.96	53.55
Vibrating compaction rollers	Typical power from Catarpillar website	116	111.71	EEC directive	1.5	63.96	49.51
35t Excavator		161	107.28	EEC directive	3	63.96	48.08
6m3 readymix concrete wagons	Discharge only, assumed 12 mins		112	BS5228	0.11	63.96	38.62
Paving machine	Caterpillar BB740		103	ec.europa.eu database	0.75	63.96	37.79
Wheeled tipper lorry	Unloading	3mins	113	BS5228	0.05	63.96	35.81
Wheeled tipper lorry	movement only 12 mins per visit		80	EEC directive	0.19	63.96	8.84
							55.99

Traverse length for mobile	140
Nearest point to noise sensitive	280
Mean distance	330

Phase 8

Plant	Assumed type	Engine power kW	Sound power	Source	Duty cycle	**Distance correction Ks'**	**Total**
Bulldozers	Tracked, caterpillar D8T)	231	113	EEC directive	0.75	63.96	47.79
35t Excavator		161	107.28	EEC directive	1.5	63.96	45.07
Mobile Crane	Typical LIEBHERR LTM1035	206	109	http://www.xs4all	0.75	63.96	43.79
Wheeled tipper lorry	Unloading	3mins	113	BS5228	0.05	63.96	35.81
Hiab lorries	http://www.xs4all.nl/~rigolett/ENGELS/equipment/mob		97	Internet data	1.5	63.96	34.8
Low loader wagons			80	EEC directive	0.76	63.96	14.86
Artic trailer wagons			80	EEC directive	0.38	63.96	11.85
Wheeled tipper lorry	movement only 12 mins per visit		80	EEC directive	0.19	63.96	8.84
							50.9

Traverse length for mobile	140
Nearest point to noise sensitive	280
Mean distance	330