THREE SPIRES ACOUSTICS

Marsten Developments (Worcester) Ltd

Polytec-Holden, Bromyard

Environmental Noise Assessment

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Three Spires Acoustics Ltd

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Environmental Noise Assessment

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EXECUTIVE SUMMARY

Three Spires Acoustics Ltd have been instructed by Professor Colin Waters on behalf of Marsten Developments (Worcester) Ltd to undertake an environmental noise assessment at Polytec-Holden Plastic Factory, Bromyard, Herefordshire. The assessment is required in order to determine the extent that noise emissions from Polytec may have on a proposed residential development site located adjacent to the factory and also to determine the current effect of noise on existing residential properties in the vicinity.

A site survey has been undertaken to establish the existing ambient and background noise at the proposed development site and at existing residential properties within the vicinity of the factory, with and without the factory in operation.

The noise survey has also identified the principal noise sources within the factory site, which contribute to offsite noise levels.

Noise control engineers have been consulted to recommend noise mitigation measures for each noise source in order that offsite limits may achieve a maximum boundary level of 40dB(A) and a level within the development site of below 35dB(A).

Noise modelling predictions have been undertaken using Bruel & Kjaer Predictor 7810 software. Noise models have been created for the current situation and for situations with proposed mitigation measures in place.

The models demonstrate that if the proposed noise control measures are implemented this may achieve a site boundary level of 30dB(A) with the majority of the development lying within the less than 30dB(A) contour region. The models also indicate that the level of noise from the factory at the existing closets residential properties will be reduced by up to 25dB(A).

1. INTRODUCTION

Three Spires Acoustics Ltd have been instructed by Professor Colin Waters on behalf of Marsten Developments (Worcester) Ltd to undertake an environmental noise assessment at Polytec-Holden Plastic Factory, Bromyard, Herefordshire. The assessment is required in order to determine the extent that noise emissions from Polytec may have on a proposed residential development site located adjacent to the factory and also to determine the current effect of noise on existing residential properties in the vicinity.

The report presents the findings of the noise survey of ambient noise levels with and without the factory in operation and the identification of the principal noise sources at the factory which contribute to offsite levels. Noise modelling has been undertaken in order to determine and rank the affect of each principal noise source in order that corresponding noise control measures may be assigned in a cost beneficial way

1.1. OBJECTIVES

- To undertake attended site measurements in order to determine the sound emissions from individual noise generating sources at the Polytech Holden site
- To rank the noise sources to determine the priority order for mitigation
- To establish the existing A-weighted and octave band L_{10}, L_{90}, L_{eq} and L_{max} noise levels at the proposed development site and at existing noise sensitive receptor with and without the factory in operation.
- To recommend noise mitigation options for the primary noise sources
- To create a Bruel & Kjaer Predictor noise model to predict factory noise at a representative points within the proposed development and at existing residential properties, to demonstrate the effect with and without noise mitigation.

2. SITE AND DEVELOPMENT DESCRIPTION

Polytec-Holden, plastic manufacturing factory is located on a small industrial estate on the B4214 Tenbury Road, Bromyard, Herefordshire. Polytec manufactures plastic body parts for the automotive industry such as bumpers and running boards. The factory is located within a mixed residential industrial area with existing residential properties within the vicinity. The proposed development is located on unoccupied land at Porthouse Farm, Bromyard. Part of this land has been designated by the Local Planning Authority (Malvern Hills District Council) as land for residential development. Aerial photographs of the site, the principal noise sources and measurement locations are presented in Appendix A.

3. NOISE SURVEY

A site survey was undertaken on the 10th November 2010 to establish the existing ambient and background noise at the proposed development site and at existing residential properties within the vicinity of the factory. Measurements were undertaken periodically throughout the day and between 22.00 & 00.00 at night. The principal daytime noise sources which contribute to the acoustic environment are considered to be factory noise, traffic noise from vehicles on the Tenbury Rd and birdsong. The principal night time noise is considered to be factory noise and periodic local traffic passing along Tenbury Rd. The factory noise is aurally dominant in the absence of traffic noise and contains tonal and distinctive elements to the noise. The group of bungalows in Frome Close have direct line of site to certain areas of the factory and the noise from the digester fan, paint dryer fan and compressor house B, are aurally dominant. Periodic noise from fork lift truck movements were also audible.

An additional ambient and background noise survey was undertaken between 13:30 and 16.00 on the 13th November 2010 after the factory closed for the weekend

The site survey also identified the principal noise sources within the Polytec site which contribute to the offsite levels. The site survey indicated a total of seven pieces of plant and equipment which were both objectively and subjectively dominant on and offsite. Measurements of the sources were undertaken in order to determine sound pressure and subsequent sound power levels.

There are a number of limiting factors when undertaking field sound power measurements which may affect the uncertainty factor of such measurements. Where possible steps have been taken to reduce these limiting factors and it is considered that the resulting measurements give a "reasonable" estimation of sound pressure and power levels for the principal noise sources, with the measurement uncertainty factor being in the region of + or – 3dB(A). Measurements of low frequency noise below 125Hertz may be subject to higher levels of uncertainty

The weather conditions and wind were both noted and were good throughout the survey periods.

Measurements were carried out using Bruel & Kjaer 2250's (sn 2505888) real time analyser, complying with IEC 651 Type 1. The analysers were set to record all broadband and statistical A-weighted and octave band sound pressure levels including L_{90}, and L_{eq}. The analysers were set to log measurements every 1 second and 1 minute. Further narrow band frequency analysis was undertaken of all primary noise sources. The meters were calibrated with a Bruel and Kjaer type 4231 calibrator both before and after the surveys and no significant drift was observed.

Examples of Time History Graphs and tabulated noise measurement results from this survey are contained in Appendix B. Full details are available on request.

4. RESULTS

4.1. PRINCIPAL NOISE SOURCES

Table 1 below presents the findings of the factory site survey which has identified seven significant noise sources which contribute to the offsite noise levels. An aerial photograph presented in Appendix A identifies the location of each source and sound power calculations for each source are presented in Appendix B.

Table 1: Principal Noise Sources from Polytec-Holden Factory

Item	Description	LP(A)	LW*(L)*
NS1	Solvent Digester Fan	83	106
NS2	Paint Dryer Fan	83	102
NS3	Extraction system	85	104
NS4	Compressor House B	84	108
NS5	Compressor House A	66	99
NS6	Chemical Mixer Extract	70	102
NS7	Dust Extractor	80	105

4.2. AMBIENT NOISE SURVEY

Table 2 below presents the factory noise level measured at various locations within the proposed residential site and at existing residential properties in the vicinity of the factory. The measurements are of the residual and background noise levels and therefore exclude the effect of local traffic noise.

Table 2: Offsite Measurements Factory Operational.

Location	Noise Index		Description
	$L_{Aeq,T}$	$L_{A90,T}$	
MP1 **Frome Close Bungalows**	45 dB(A)	43 dB(A)	Factory noise clearly audible and dominating the acoustic environment, in the absence of traffic noise. Digester Fan & Paint Dryer Fan dominant. Occasional noise from fork lifts reversing alarms.
MP2 **Detached House Tenbury Rd**	37 dB(A)	35 dB(A)	Factory noise clearly audible and dominating the acoustic environment, in the absence of traffic noise. Digester Fan & Paint Dryer Fan dominant. Occasional noise from forklifts reversing alarms
MP3 Development Site	36-45 dB(A)	35-43 dB(A)	Factory noise clearly audible and dominating the acoustic environment, in the absence of traffic noise. Digester Fan & Paint Dryer Fan dominant. Occasional noise from forklifts reversing alarms
MP4 **Site Boundary** **(top of bund)**	55 dB(A)	53dB(A)	Factory noise audible and dominating the acoustic environment. Digester Fan & Paint Dryer Fan dominant. Occasional noise from forklift reversing alarms movement of parts and materials
MP5 **Rear of Co-Op Supermarket**	33dB(A)	31dB(A)	Factory noise inaudible

Table 3 below presents pre-existing ambient and background noise levels at various locations within the proposed development site and at existing residential properties in close proximity to the Polytec site.

Table 3: Offsite Measurements Factory Closed

Location	Noise Index		Description
	Day Time Residual[1] $L_{Aeq,T}$	Day Time $L_{A90,T}$	
Frome Close Bungalows	37 dB(A)	36 dB(A)	Acoustic environment dominated by traffic on Tenbury Rd & bird song
Site Boundary (top of bund)	36 dB(A)	34 dB(A)	Acoustic environment dominated by traffic on Tenbury Rd & bird song
Development Site	32-37 dB(A)	30-35 dB(A)	Acoustic environment dominated by traffic on Tenbury Rd & bird song

Table 4 below presents the noise levels at the specific measurement locations within the proposed development site, with and without the factory in operation.

Table 4: Development Site Measured Noise Levels

Location	Noise Level Factory Operational		Residual Noise Level Factory Closed Day		Residual Level Factory Closed Night (estimated 3dB(A) reduction)	
	$L_{Aeq,T}$	$L_{90,T}$	$L_{Aeq,T}$	$L_{90,T}$	$L_{Aeq,T}$	$L_{90,T}$
MP3a	43	40	38	36	35	33
MP3b	45	43	37	34	34	31
MP3c	39	38	36	33	33	30
MP3d	36	35	35	33	32	30

[1] NB Residual noise measured in the absence of local traffic movements

4.3. NARROW BAND ANALYSIS

Narrow band analysis has been undertaken using Bruel & Kjaer FFT & Tonal noise assessment software. This has indicated that the digester fan contains tonal elements at 275, 550 & 824 Hertz. The paint Dryer fan has a dominant tone at 563Hertz. The dust extractor has a dominant tone at 296 Hertz and this will be audible throughout the development site and will need to be specifically mitigated against. The compressors house emissions are broader band in nature with no dominant tonal character. The extract next to the paint dryer fan contains more board band frequency spectrum, while the chemical mixer extract has dominant 160 &200 hertz third octaves

5. NOISE CONTROL

When considering noise control options it is necessary to look at the noise in three parts, i.e. the noise source, transmission path and the receiver. Any one of these three may be treated in some way to reduce the noise impact. The noise sources within the Polytec site are predominately aerodynamic noise sources where there is direct disturbance of air due to an intake or extract fan, with its associated motor noise. Treatment of such noise is typically undertaken by use of the following methods;

5.1. INLINE SILENCERS

These may be absorptive which tend to be used over a broad band of frequencies and are typically used for attenuation of fan noise, however they are less effective at low frequencies. Reactive silencers may be tuned to reduce specific frequencies and are more effective at low frequencies than absorptive ones. Combinations of both types may also be used. All silencers will impede air flow and may affect the efficiency of the system and thus can increase operating costs. It is therefore important to correctly identify the problem and specify the most cost effective solution.

5.2. BARRIERS

For a barrier to be most effective it must be placed close to the source or the receiver and comprise of materials of significant mass, and dimensions. Barriers may also be lined with absorptive materials.

5.3. ACOUSTIC ENCLOSURES

Enclosures must consist of materials with a high sound reduction index and be carefully designed in order not to create cooling & access problems and should be designed by a suitable qualified and experienced acoustic engineer. They may also be lined with an absorbent material. A combination of mitigation measures including noise control management techniques will be able to resolve many problems.

5.4. FORK LIFT REVERSING ALARMS

The site surveys indicated that periodic noise from fork lift revering alarms was audible offsite. The current alarms are traditional tonal alarms which can cause offsite disturbance. White noise broad band and self adjusting reversing alarms can reduce the tonal annoyance and adjust their noise level according to the underlying ambient noise level. It is recommended that white noise reversing alarms are fitted to all lift trucks that operate during the night.

5.5. SOURCE SPECIFIC NOISE CONTROL

Specialist noise control engineers at Noico Ltd have been commissioned to design noise control solutions for each principal noise source identified by the survey in order to reduce the cumulative emissions to achieve a boundary level of 40dB(A) and a development site level of below 35dB(A). Table 5 below presents the specific noise control measures Noico have calculated to achieve the above targets.

In addition to the proposed noise control measures outlined below, a 4.5metre high density block work wall is proposed to be built at the bottom of the existing bund running from the existing hard standing area to the middle of the main factory unit.

Table 5: Noise Control Solutions for Principal Noise Sources.

Noise Source	*Noise Control Description*	*Attenuation Hertz*							
		63	**125**	**250**	**500**	**1K**	**2K**	**4K**	**8K**
DIGESTER FAN	Acoustic Louvre Ventilation Air - In & Out, Blockwork Enclosure	11	15	23	34	46	48	42	40
PAINT DRYER FAN	Acoustic Louvre Enclosure End Intake **2 Sides +Top Acoustic Panel Enclosure**	11	14	20	33	44	46	39	37
EXTRACT NEXT TO PAINT DRYER	Exhaust Attenuator Upgrade	5	14	21	32	35	35	35	30
COMPRESSOR HOUSE "A"	Acoustic Louvre's & Acoustic Louvre Door	11	14	20	33	44	46	39	37
COMPRESSOR HOUSE "B"	Acoustic Louvers' & Acoustic Louvre Door	11	14	20	33	44	46	39	37
CHEMICAL MIXER EXTRACT	Exhaust Attenuator	5	18	19	30	35	35	35	30
DUST EXTRACTOR	Acoustic Panel Surround & Exhaust Attenuator	8	13	20	38	50	50	35	28

6. NOISE MODELLING

Predictions have been undertaken using Bruel & Kjaer Predictor 7810 software. This software allows for terrain and noise data to be processed according to ISO 9613 Part 2 1996- Attenuation of Sound During Propagation Outdoors, in order to predict environmental noise arising at the proposed development site. The Predictor software is one of a group of modelling software packages which are approved by DEFRA for use in the noise mapping England project carried out under the Environmental Noise England Regulations 2006.

6.1. ASSESSMENT

Sound power data from the seven identified sources has been used to calculate the expected noise levels at the proposed residential development and at existing noise sensitive receptors Noise modelling has been undertaken using the ISO9613 prediction method, with 5metre grid points, 1.5m & 4m contour heights. The noise model has been calibrated and compared against measurement data obtained from the offsite surveys. The predicted noise levels are within the ISO standard for acceptable uncertainty range.

6.2. NOISE MODEL 1: EXISTING SITUATION

Noise model 1, indicates that the site boundary level will be 55dB(A) and the existing development site closest to the factory is within the 45-50 & 50-55dB(A) contour region. The majority of the remainder of the site is within the 35-40 & 40-45dB(A) contour regions with a small region furthest away from the factory within the 30-35dB(A) & below 30dB(A) contour regions.

The model also indicates that existing residential properties at Frome Close, which have direct line of site to some of the principal noise sources are within the 40-45dB(A) contour region.

6.3. NOISE MODEL 2: ATTENUATED MODEL (NO BARRIER & 1.5M CONTOUR)

Noise model includes the same settings as the original situation, with the seven noise sources adjusted with the sound power attenuation data provided by Noico Ltd and with 1.5m contour height.

The model indicates that the site boundary level will be 30dB(A) and the majority of the proposed development site will be within "less than 30dB(A") contour region. A small area near the north of the factory closest to the dust extractor, will be in the 30-35dB(A) contour region. The predicted level at the Frome Close location is 20dB(A).

6.4. NOISE MODEL 3: ATTENUATED MODEL-(BARRIER & 1.5M CONTOUR)

Noise model includes the same settings as the original situation, with the seven noise sources adjusted with the sound power attenuation data provided by Noico Ltd and the inclusion of the 4.5m high barrier along the boundary of the factory site and the development site and with 1.5m contour heights.

The model indicates that the site boundary level will be 29dB(A) and the majority of the proposed development site will be within "less than 30dB(A") contour region. A small area near the north of the factory closest to the dust extractor, will be in the 30-35dB(A) contour region. The predicted level at the Frome Close location is 20dB(A).

6.5. NOISE MODEL 4: ATTENUATED MODEL -(NO BARRIER & 4M CONTOUR)

Noise model includes the same settings as the original situation, with the seven noise sources adjusted with the sound power attenuation data provided by Noico Ltd and with 4m contour height.

The model indicates that the site boundary level will be 30dB(A) and the majority of the proposed development site will be within "less than 30dB(A") contour region. A small area by the existing bund and to the north of the factory closest to the dust extractor, will be in the 30-35dB(A) contour region. The predicted level at the Frome Close location is 20dB(A).

6.6. NOISE MODEL 5: ATTENUATED MODEL -(BARRIER & 4M CONTOUR)

Noise model includes the same settings as the original situation, with the seven noise sources adjusted with the sound power attenuation data provided by Noico Ltd and the inclusion of the 4.5m high barrier along the boundary of the factory site and the development site and with 4m contour heights.

The model indicates that the site boundary level will be 29dB(A) and the majority of the proposed development site will be within "less than 30dB(A") contour region. A small area to the north of the factory closest to the dust extractor, will be in the 30-35dB(A) contour region. The predicted level at the Frome Close location is 20dB(A).

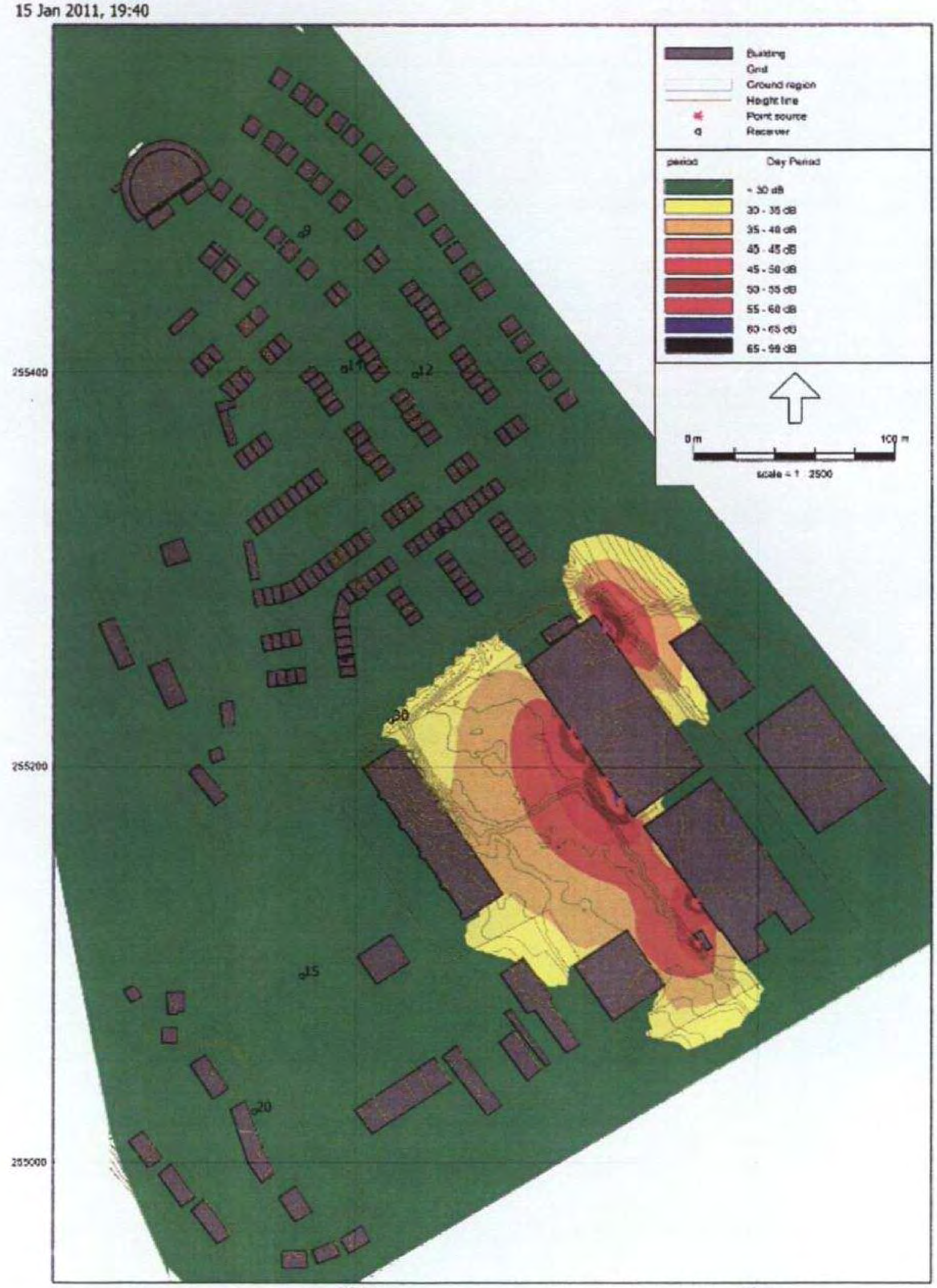
Figure 1: Noise Model 1- Existing Situation

15 Jan 2011, 19:56

industrial noise - ISO 9613 1/2 [version of Area - initial model] , Predictor V8.00

Figure 2: Noise Model - Attenuated Noise Sources Only(1.5m contour height)

15 Jan 2011, 19:40



Industrial noise - ISO 9613 1/2 [version of Area - Scenario 14] , Predictor V8.00

Figure 3: Noise Model 3 - Attenuated Noise Sources & 4.5m Barrier, (1.5m Contour Height)

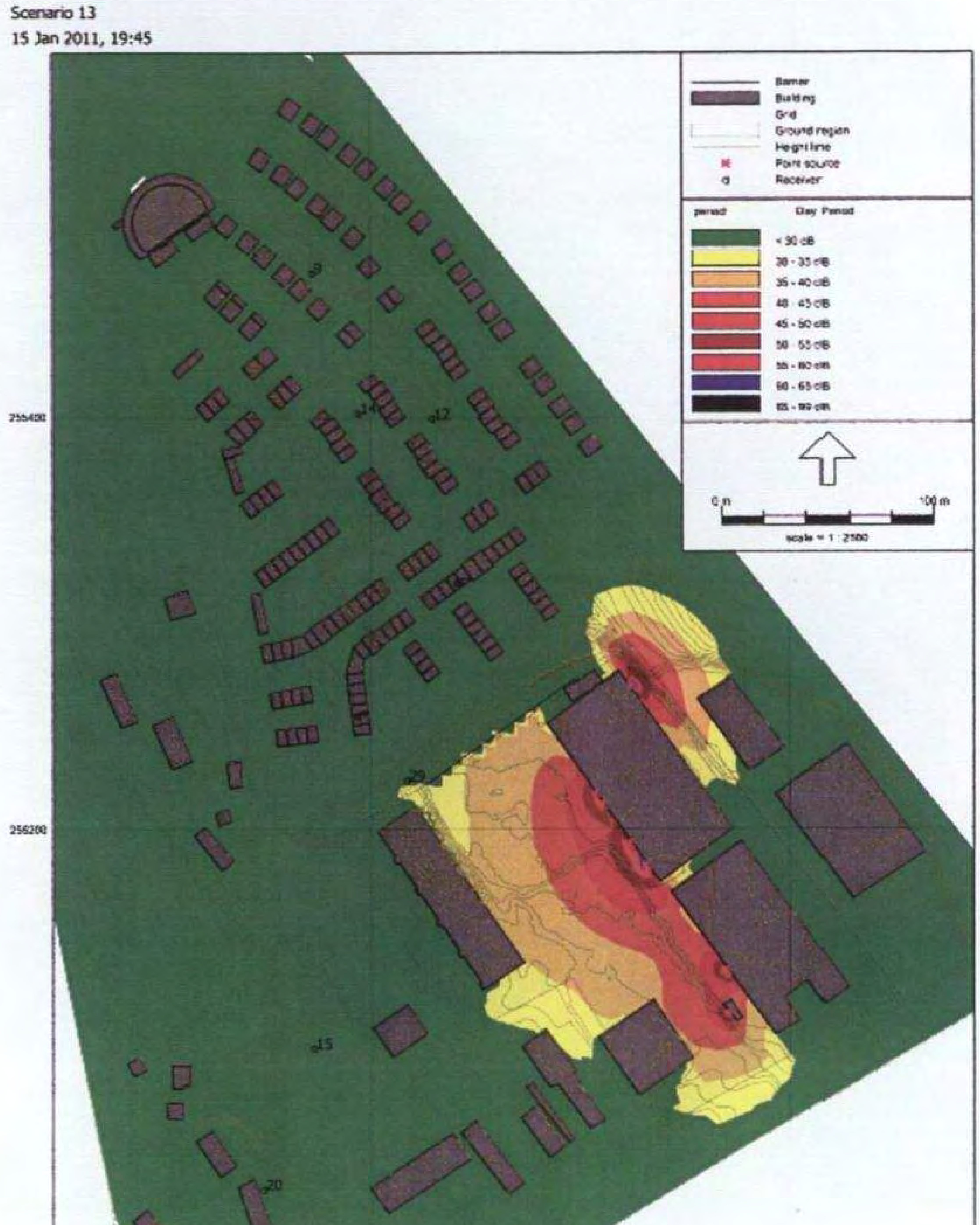


Figure 4: Noise Model 4 Attenuated Noise Sources Only (4m contour height)

Scenario 7

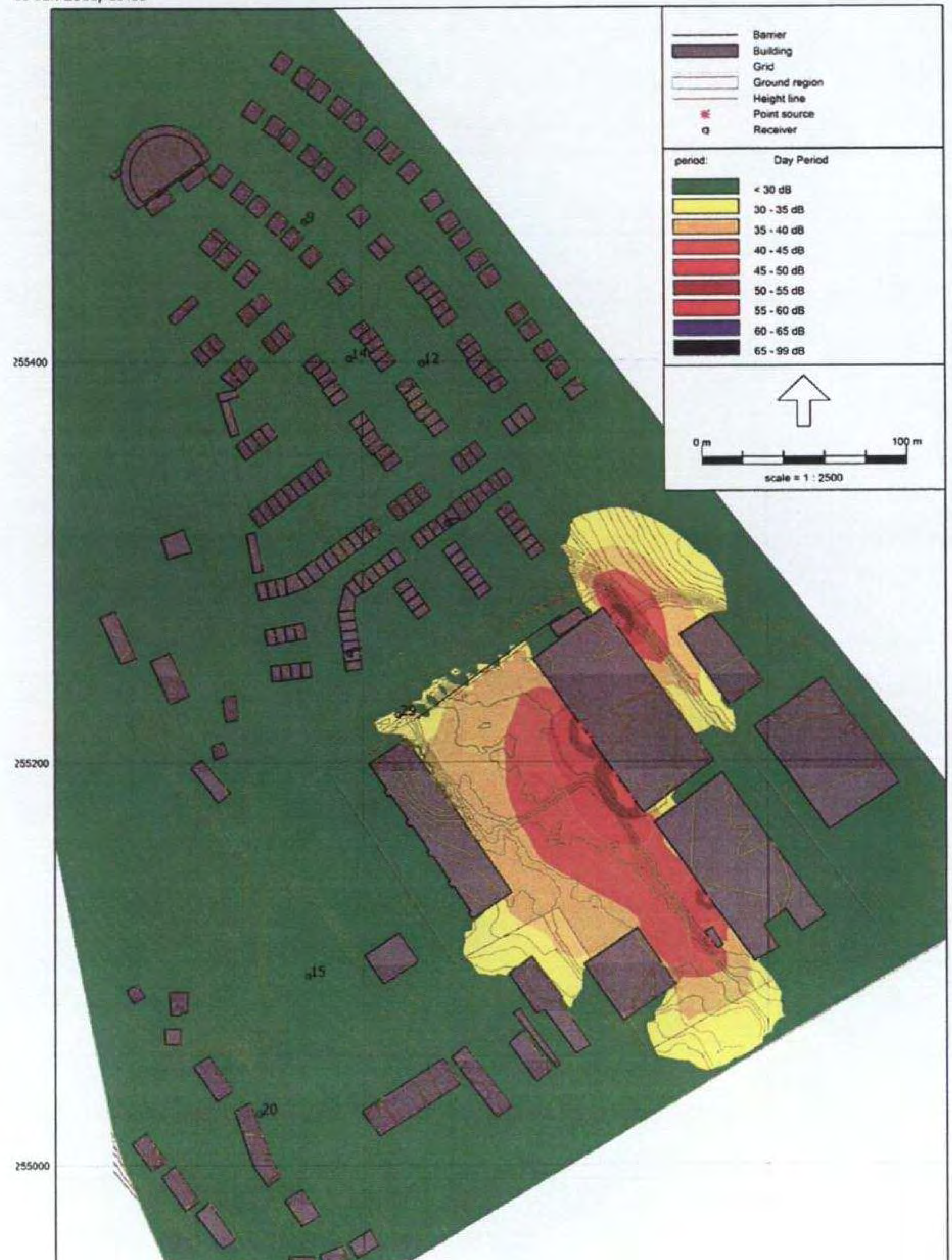
15 Jan 2011, 19:52

Industrial noise - ISO 9613.1/2, [version of Area - Scenario 7] , Predictor V8.00

Figure 5: Noise Model 5 Attenuated Noise Sources & 4.5m Barrier, (4m Contour Height)

Scenario 6

15 Jan 2011, 19:53



Industrial noise - ISO 9613.1/2, [version of Area - Scenario 6] , Predictor V8.00

7. CONCLUSIONS

Three Spires Acoustics Ltd have undertaken an environmental noise assessment at Polytec-Holden Plastic Factory, Bromyard, Herefordshire. The assessment has determined the extent that noise emissions from Polytec site affect a proposed residential development located adjacent to the factory and also determined the current effect of factory noise on existing residential properties in close proximity to the factory.

A site survey has been undertaken and established the existing ambient and background noise at the proposed development site and at existing residential properties within the vicinity of the factory, with and without the factory in operation.

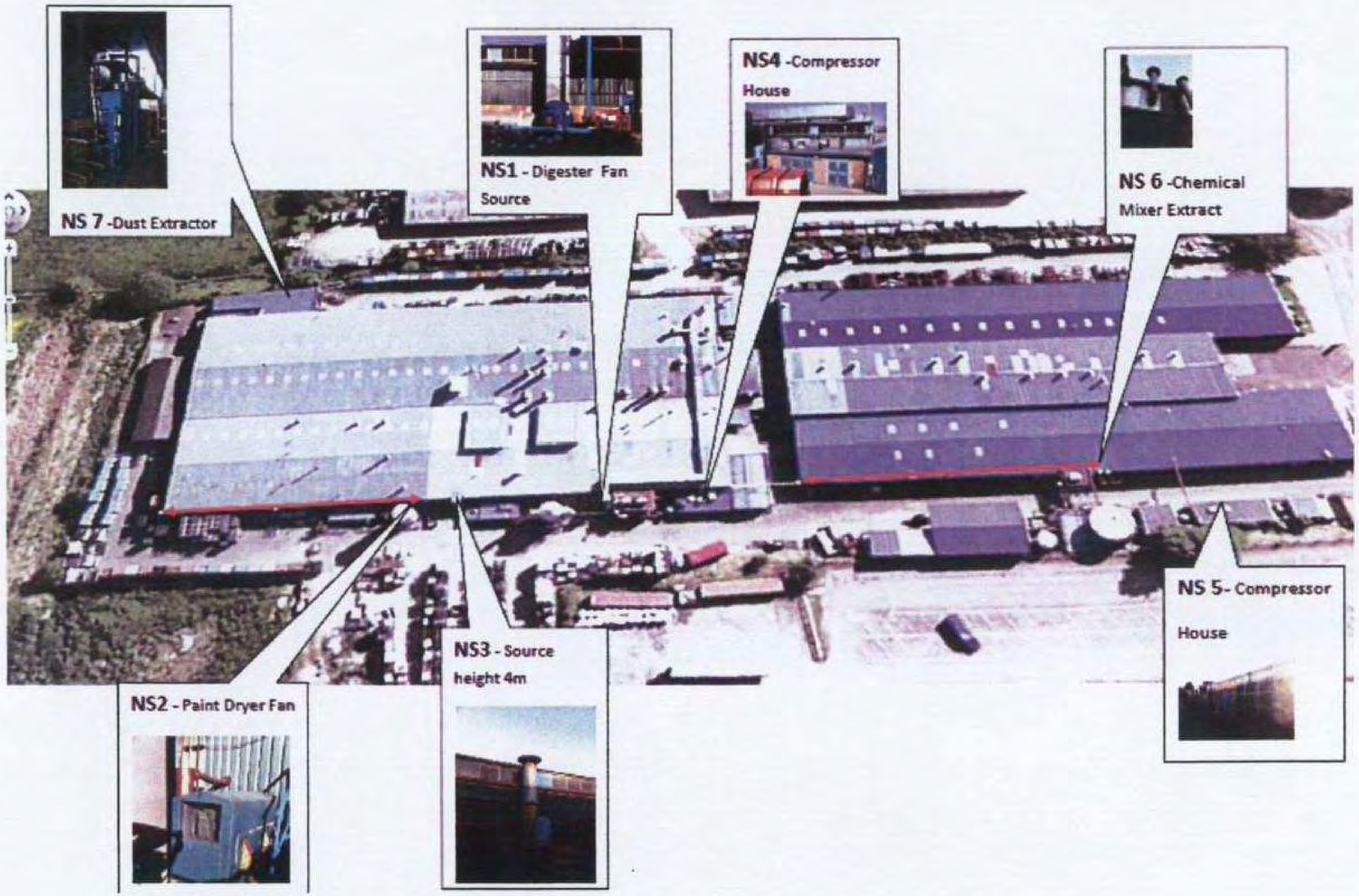
The noise survey has also identified the principal noise sources within the factory site, which contribute to offsite noise levels.

Noise control engineers have been consulted to recommend noise mitigation measures for each noise source in order that offsite limits may achieve a maximum boundary level of 40dB(A) and a level within the development site of below 35dB(A).

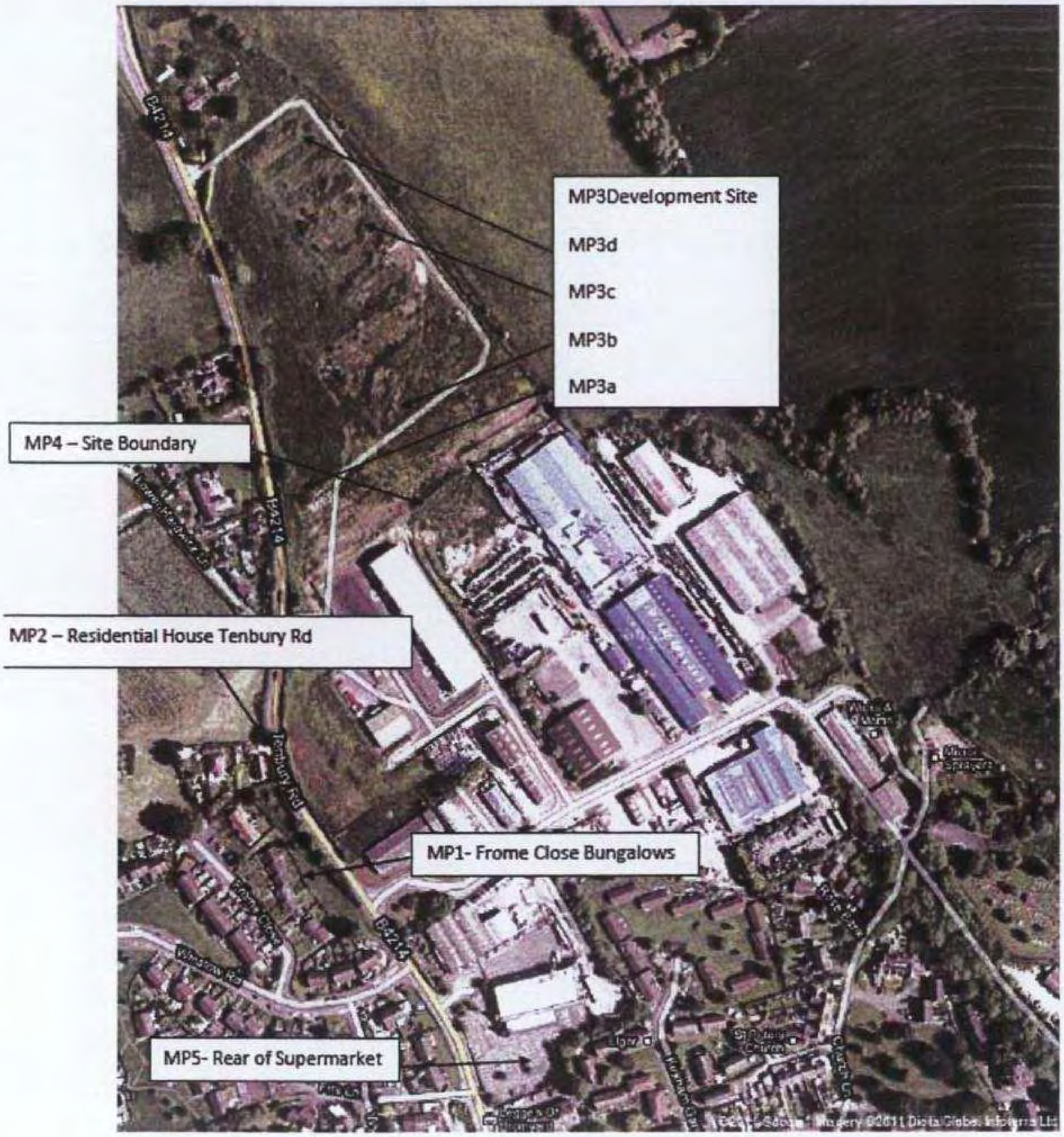
Noise modelling predictions have been undertaken using Bruel & Kjaer Predictor 7810 software. Noise models have been created for the current situation and for situations with proposed mitigation measures in place.

The models demonstrate that if the proposed noise control measures are implemented this may achieve a site boundary level of 30dB(A) with the majority of the development lying within the less than 30dB(A) contour region. The models also indicate that the level of noise from the factory at the existing closets residential properties will be reduced by up to 22dB(A).

APPENDIX A1 – AREIAL PHOTOGRAPH WITH LOCATIONS OF PRINCIPAL NOISE SOURCES



APPENDIX A2: ARIEL PHOTOGRAPH WITH OFFSITE MEASUREMENT LOCATIONS



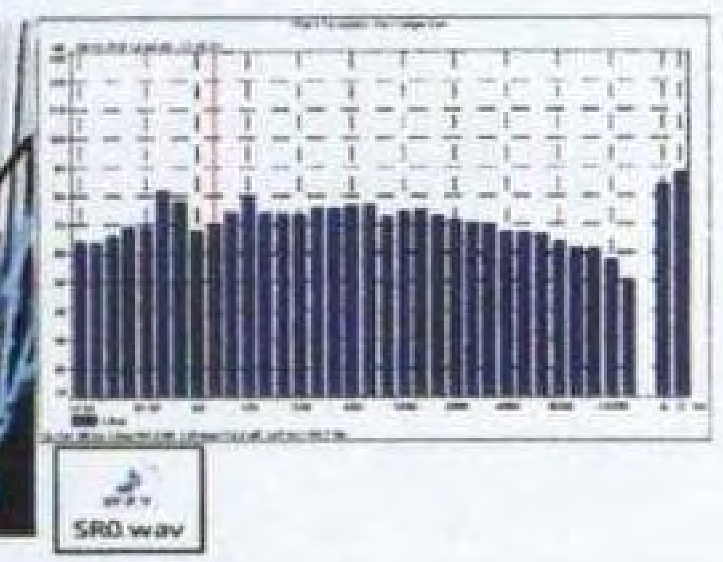
APPENDIX B – RESULTS

Sound Power Calculations for Principal Noise Sources

LW=LP+20Log r+11-D

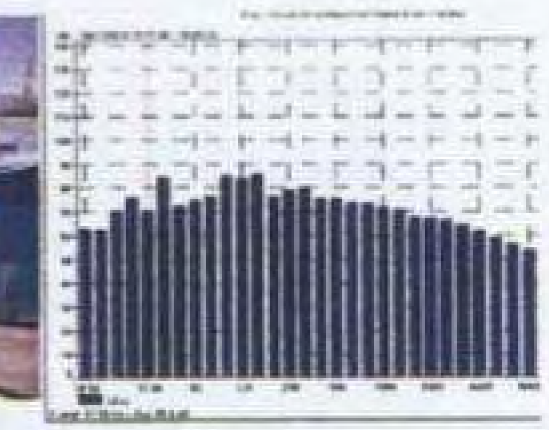
Digestor Fan	Unit	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000	LAeq [dB]
Third Ocatve		76.0	78.0	81.0	77.1	79.3	77.5	76.6	84.0	79.8	74.4	76.6	72.7	75.3	69.4	66.0	63.9	64.2	67.9	65.3	64.5	67.1	67.3	64.7	64.0	83.0
Octave			83.6			82.8			85.9			79.6			76.6			70.5			70.5			70.4		
Distance 20log r +11	2.6 19		19.3			19.3			19.3			19.3			19.3			19.3			19.3			19.3		
Reverberant Adjsutment Q= 2	3		3.0			3.0			3.0			3.0			3.0			3.0			3.0			3.0		
LW			99.9			99.1			102.2			95.9			92.9			86.8			86.8			86.7		106.2
A Weighting			-26.2			-16.1			-8.6			-3.2			0.0			1.2			1.0			-1.1		
LW(A)			73.7			83.0			93.6			92.7			92.9			88.0			87.8			85.6		99.0

Paint Dryer Fan	Unit	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000	LAeq [dB]
Third Ocatve																										
Octave			78.0			80.0			78.0			79.0			78.0			77.0			73.0			69.0		83.0
Distance 20log r +11	3.3 21		21.4			21.4			21.4			21.4			21.4			21.4			21.4			21.4		
Reverberant Adjustment Q= 4	6		6.0			6.0			6.0			6.0			6.0			6.0			6.0			6.0		
LW			93.4			95.4			93.4			94.4			93.4			92.4			88.4			84.4		101.9
A Weighting			-26.2			-16.1			-8.6			-3.2			0.0			1.2			1.0			-1.1		
LW(A)			67.2			79.3			84.8			91.2			93.4			93.6			89.4			83.3		98.6

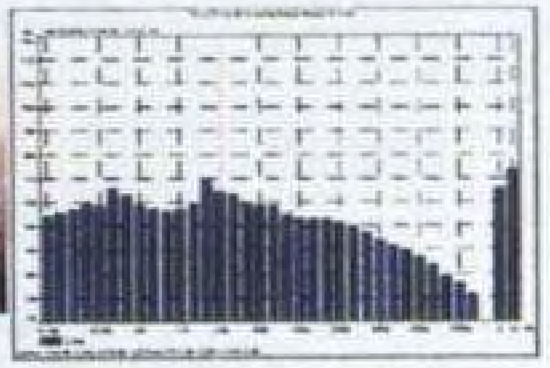


Extract nxt to Paint Dryer Fan	Unit	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000	LAeq [dB]
Third Ocatve																										
Octave			78.0			85.0			84.0			82.0			82.0			77.0			71.0			62.0		85.0
Distance 20log r +11	2 17		17.0			17.0			17.0			17.0			17.0			17.0			17.0			17.0		
Reverberant Adjustment Q= 2	3		3.0			3.0			3.0			3.0			3.0			3.0			3.0			3.0		
LW			92.0			99.0			98.0			96.0			96.0			91.0			85.0			76.0		104.1
A Weighting			-26.2			-16.1			-8.6			-3.2			0.0			1.2			1.0			-1.1		
LW(A)			65.8			82.9			89.4			92.8			96.0			92.2			86.0			74.9		99.6

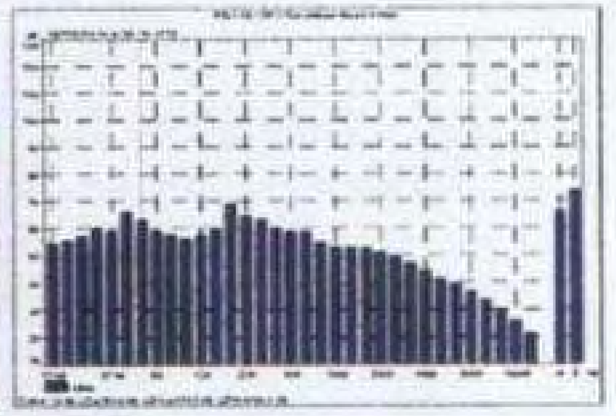
Compressor House B	Unit		50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000	LAeq (dB)
Third Ocatve			74.9	74	77	85	84	85	79	80	80	77	76	75	76	73	72	69	69	67	66	63	59	56	55	54	
Octave				80.3			89.1			84.6			81.0			78.5			73.5			68.3			60.2		84.0
Distance 20log r +11	2.5	19		19.0			19.0			19.0			19.0			19.0			19.0			19.0			19.0		
Reverberant Adjustment Q= 2		3		3.0			3.0			3.0			3.0			3.0			3.0			3.0			3.0		
LW				96.2			105.1			100.6			96.9			94.4			89.4			84.3			76.1		107.5
A Weighting				-26.2			-16.1			-8.6			-3.2			0.0			1.2			1.0			-1.1		
LW(A)				70.0			89.0			92.0			93.7			94.4			90.6			85.3			75.0		99.6



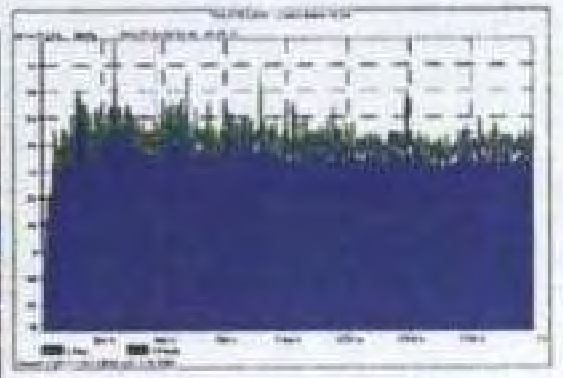
Compressor House A (rear)	Unit		50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000	LAeq (dB)
Third Ocatve			63	58.7	57	55.9	57.1	59.3	68.7	64.5	63	59.7	58.4	58.5	54.7	52.86	52.58	52.49	51.05	49.43	46.85	44.01	41.2	39.54	36.56	33.45	
Octave				65.2			62.4			70.9			63.7			58.3			55.9			49.4			42.0		66.0
Distance 20log r +11	5	29		29.1			29.1			29.1			29.1			29.1			29.1			29.1			29.1		
Reverberant Adjustment Q= 2		3		3.0			3.0			3.0			3.0			3.0			3.0			3.0			3.0		
LW				91.2			88.5			96.9			89.7			84.3			82.0			75.4			68.0		99.2
A Weighting				-26.2			-16.1			-8.6			-3.2			0.0			1.2			1.0			-1.1		
LW(A)				65.0			72.4			88.3			86.5			84.3			83.2			76.4			66.9		92.3



Chemical Mixer Extract	Unit		50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000	LAeq (dB)
Third Ocatve			67	62	63	62	64.8	70	71.4	65	63.9	64.3	58.2	59.1	58.3	59.3	61.8	58.6	56.01	55.07	52.46	49.33	45.46	42.09	38.48	35	
Octave				69.2			71.6			72.9			66.2			64.8			61.6			54.7			44.2		70.0
Distance 20log r +11	5	25		25.0			25.0			25.0			25.0			25.0			25.0			25.0			25.0		
Reverberant Adjustment Q= 0		0		0.0			0.0			0.0			0.0			0.0			0.0			0.0			0.0		
LW				94.1			96.6			97.9			91.2			89.8			86.6			79.7			69.2		102.1
A Weighting				-26.2			-16.1			-8.6			-3.2			0.0			1.2			1.0			-1.1		
LW(A)				67.9			80.5			89.3			88.0			89.8			87.8			80.7			68.1		95.1

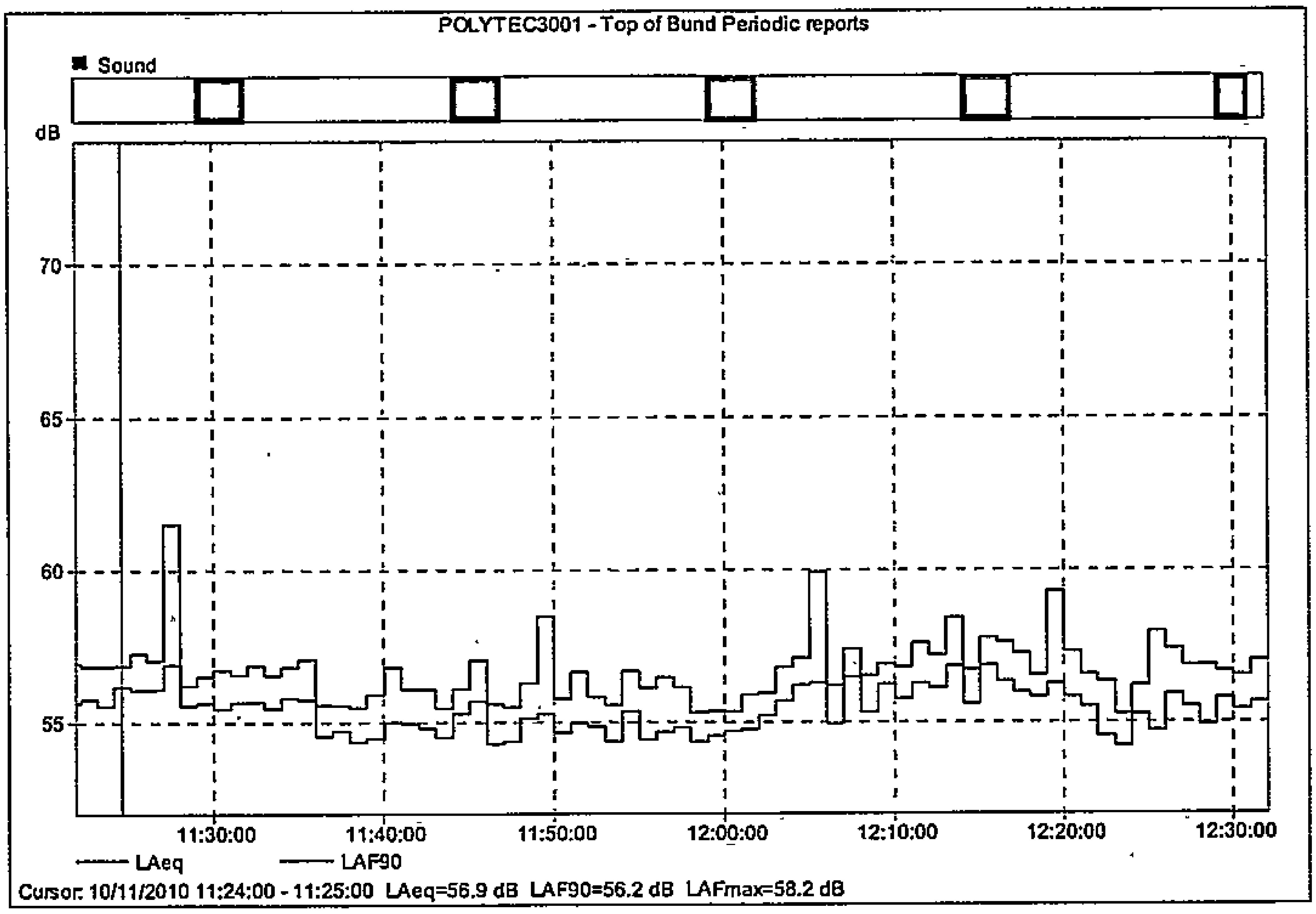


Dust Extractor	Unit		50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000	LAeq (dB)
Third Ocatve																											
Octave				76.1			81.6			84.6			75.2			70.4			68.5			63.2			53.5		80.0
Distance 20log r +11	4.2	23		23.5			23.5			23.5			23.5			23.5			23.5			23.5			23.5		
Reverberant Adjustment Q= 4		6		6.0			6.0			6.0			6.0			6.0			6.0			6.0			6.0		
LW				93.6			99.1			102.1			92.7			87.9			86.0			80.7			71.0		104.7
A Weighting				-26.2			-16.1			-8.6			-3.2			0.0			1.2			1.0			-1.1		



OFF SITE MEASUREMENTS – FACTORY OPERATIONAL

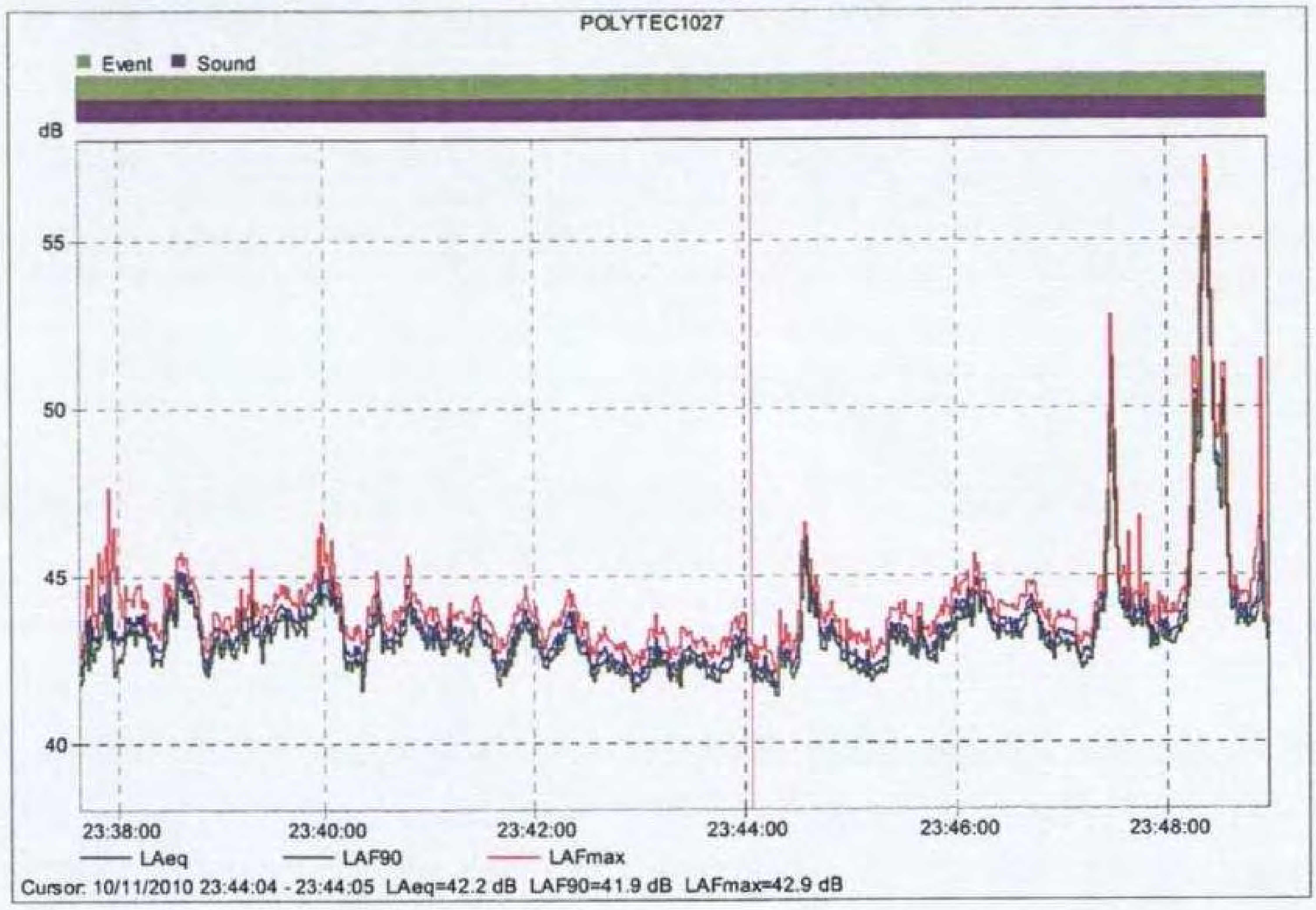
Time History Chart - Site Boundary- Top of Bund



Time History Table - Site Boundary- Top of Bund

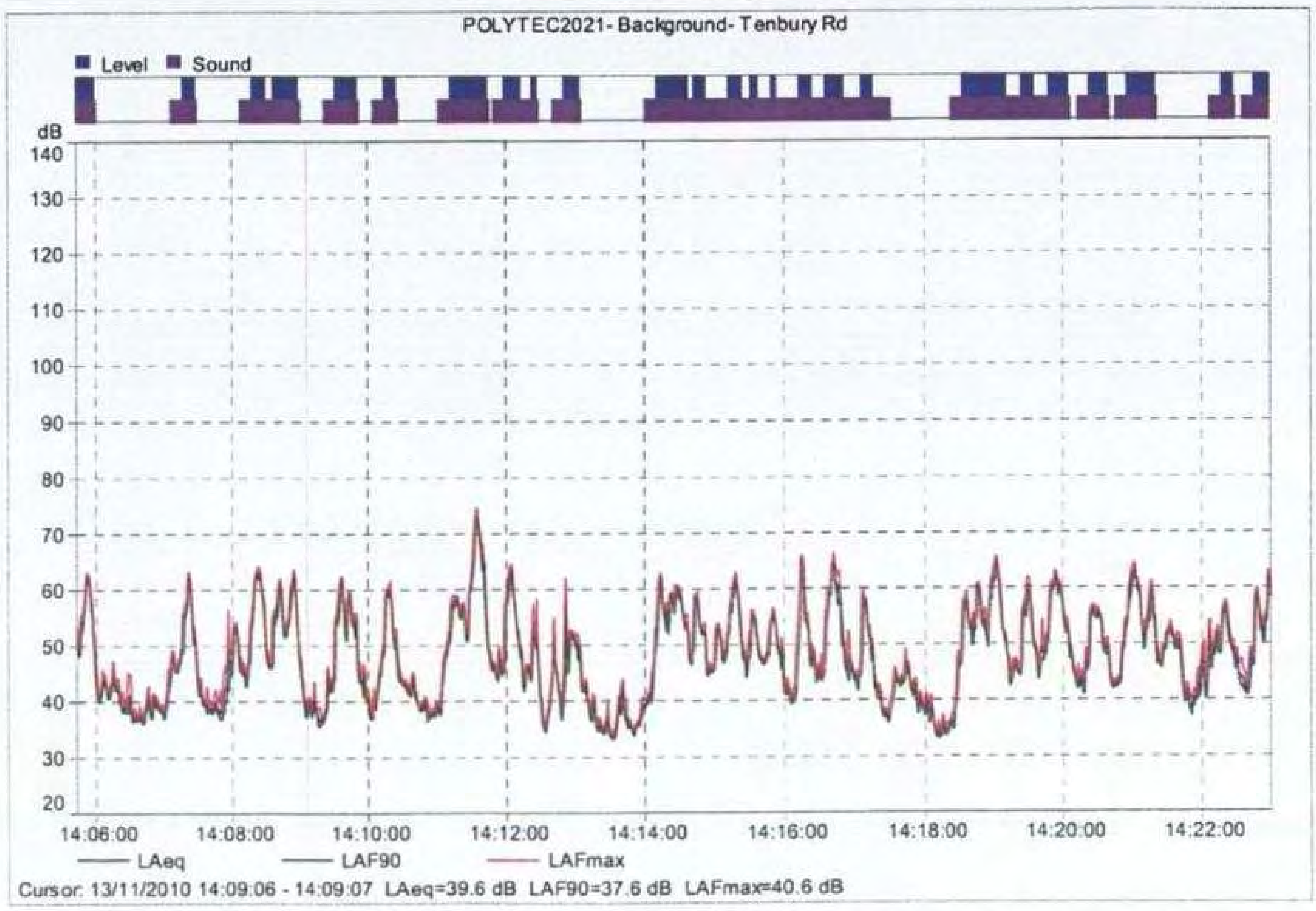
Start date	Start time	LAeq	Start time	LAeq	Start time	LAeq
10/11/2010	11:21:41	56.93	11:45:00	57.02	12:09:00	56.89
10/11/2010	11:22:00	56.82	11:46:00	55.6	12:10:00	56.8
10/11/2010	11:23:00	56.84	11:47:00	55.47	12:11:00	57.56
10/11/2010	11:24:00	56.85	11:48:00	56.26	12:12:00	57.18
10/11/2010	11:25:00	57.25	11:49:00	58.45	12:13:00	58.39
10/11/2010	11:26:00	57.02	11:50:00	55.77	12:14:00	56.71
10/11/2010	11:27:00	61.47	11:51:00	56.65	12:15:00	57.73
10/11/2010	11:28:00	56.2	11:52:00	55.81	12:16:00	57.6
10/11/2010	11:29:00	56.5	11:53:00	55.56	12:17:00	57.22
10/11/2010	11:30:00	56.7	11:54:00	56.67	12:18:00	56.51
10/11/2010	11:31:00	56.55	11:55:00	56.11	12:19:00	59.26
10/11/2010	11:32:00	56.86	11:56:00	56.46	12:20:00	57.28
10/11/2010	11:33:00	56.53	11:57:00	56.13	12:21:00	56.54
10/11/2010	11:34:00	56.8	11:58:00	55.29	12:22:00	56.3
10/11/2010	11:35:00	57.03	11:59:00	55.34	12:23:00	55.24
10/11/2010	11:36:00	55.56	12:00:00	55.33	12:24:00	56.18
10/11/2010	11:37:00	55.54	12:01:00	55.88	12:25:00	57.95
10/11/2010	11:38:00	55.46	12:02:00	55.94	12:26:00	57.38
10/11/2010	11:39:00	55.9	12:03:00	56.8	12:27:00	56.84
10/11/2010	11:40:00	56.8	12:04:00	57.07	12:28:00	56.85
10/11/2010	11:41:00	56.07	12:05:00	59.9	12:29:00	56.65
10/11/2010	11:42:00	56.07	12:06:00	56.2	12:30:00	56.51
10/11/2010	11:43:00	55.44	12:07:00	57.38	12:31:00	57.01
10/11/2010	11:44:00	56.08	12:08:00	56.52		

Time History Chart, Frome Close Bungalows – Factory Operational



OFF SITE MEASUREMENTS – FACTORY CLOSED

Frome Close Bungalows



APPENDIX C – GLOSSARY OF TERMS

The Decibel, dB

The unit used to describe the magnitude of sound is the decibel (dB) and the quantity measured is the sound pressure level. The decibel scale is logarithmic and it ascribes equal values to proportional changes in sound pressure, which is a characteristic of the ear. Use of a logarithmic scale has the added advantage that it compresses the very wide range of sound pressures to which the ear may typically be exposed to a more manageable range of numbers. The threshold of hearing occurs at approximately 0 dB (which corresponds to a reference sound pressure of 2 x 10-5 pascals) and the threshold of pain is around 120 dB. The sound energy radiated by a source canalso be expressed in decibels. The sound power is a measure of the total sound energy radiated by a source per second, in watts. The sound power level, Lw is expressed in decibels, referenced to 10-12 watts.

Frequency, Hz

Frequency is analogous to musical pitch. It depends upon the rate of vibration of the air molecules that transmit the sound and is measure as the number of cycles per second or Hertz (Hz). The human ear is sensitive to sound in the range 20 Hz to 20,000 Hz (20 kHz). For acoustic engineering purposes, the frequency range is normally divided up into discrete bands. The most commonly used bands are octave bands, in which the upper limiting frequency for any band is twice the lower limiting frequency, and one-third octave bands, in which each octave band is divided into three. The bands are described by their centre frequency value and the ranges which are typically used for building acoustics purposes are 63 Hz to 4 kHz (octave bands) and 100 Hz to 3150 Hz (one-third octave bands).

A-weighting

The sensitivity of the ear is frequency dependent. Sound level meters are fitted with a weighting network which approximates to this response and allows sound levels to be expressed as an overall single figure value, in dB(A).

Environmental Noise Descriptors

Where noise levels vary with time, it is necessary to express the results of a measurement over a period of time in statistical terms. Some commonly used descriptors follow. LAeq, T The most widely applicable unit is the equivalent continuous A-weighted sound pressure level (LAeq, T). It is an energy average and is defined as the level of a notional sound which (over a defined period of time, T) would deliver the same A-weighted sound energy as the actual fluctuating sound. LAE Where the overall noise level over a given period is made up of individual noise events, the LAeq, T can be predicted by measuring the noise of the individual noise events using the sound exposure level, LAE (or SEL or LAX). It is defined as the level that, if maintained constant for a period of one second, would deliver the same A weighted sound energy as the actual noise event. LA1 The level exceeded for 1% of the time is sometimes used to represent typical noise maxima. LA10 The level exceeded for 10% of the time is often used to describe road traffic noise. LA90 The level exceeded for 90% of the time is normally used to describe background noise.

Sound Transmission in the Open Air

Most sources of sound can be characterised as a single point in space. The sound energy radiated is proportional to the surface area of a sphere centred on the point. The area of a sphere is proportional to the square of the radius, so the sound energy is inversely proportional to the square of the radius. This is the inverse square law. In decibel terms, every time the distance from a point source is doubled, the sound pressure level is reduced by 6 dB. Road traffic noise is a notable exception to this rule, as it approximates to a line source, which is represented by the line of the road. The sound energy radiated is inversely proportional to the area of a cylinder centred on the line. In decibel terms, every time the distance from a line source is doubled, the sound pressure level is reduced by 3 dB.

Noise Monitoring measurements at the Premises of Polytec Holden Ltd

Measuring equipment

Precision grade Sound level meter of Type 1
Meter to be mounted with the microphone at a distance of 1.2-1.5m above the surrounding ground
The microphone shall be fitted with a windshield
Field calibrator suited to the meter in use.
Anemometer

Measurement procedure

Field calibration shall be carried out before and after each set of measurements. Any system drift of the calibration level shall be noted. Drift of more than 1dB will prohibit the use of the system without modification
The wind speed at the measurement position shall be measured and measurements shall not be made if in excess of 5m/s.
Measurements shall not be made if it is raining
Measurements shall be made at the designated position for each item of plant of the physical noise level in each octave band in $dB_{Lin.}$ $L_{eq,5min}$, over a five minute period with the plant at its operational level of activity. The results shall be noted with an accuracy of 0.5dB together with the time.

Personnel

Measurements shall be made by personnel who have obtained the Institute of Acoustics certificate of competence in environmental noise measurement , or Corporate Membership of the IoA or of an equivalent body.

Assessment of results

The measured levels for each plant, stated in whole values with 0.5 dB being rounded up, shall be compared with the specification levels. Excess noise greater than 1dB shall be taken as an indication that the performance specification for that item of plant has not been met.

Colin Waters
12 May 2011