HANSON CEMENT

Acoustic Camera Assessment of Site Noise Levels

Padeswood Works, Flintshire

MAY 2013

File reference number: 02049

NORTHUMBRIAN WATER
Scientific Services

Northumberland Dock Road,
Wallsend, Newcastle-upon-Tyne, NE28 0QD, UK
Telephone: (0870) 320 4567 Fax: (0191) 296 8560
www.nw-ss.co.uk

NORTHUMBRIAN WATER
Scientific Services

Report issue:	Final Issue 1
Date of Issue:	May 2013
File reference number:	02049
Issuing office:	Newcastle-upon-Tyne

Originator: .....

J Hood	Consultant Acoustics & Air Quality	June 2013

Approved by: .....

B Anstee	Consultant Acoustics & Air Quality	June 2013

CONTENTS

1.0 INTRODUCTION 2

2.0 INSTRUMENTATION 2

3.0 METHODOLOGY 3

4.0 FFT RECEPTOR MEASUREMENTS 6

5.0 ACOUSTIC CAMERA MEASUREMENTS 10

6.0 SUMMARY OF FINDINGS 17

1.0 INTRODUCTION

The basis of this assessment was to revisit areas were remedial work has been completed and to assess any areas where further practical noise reduction can be implemented. The main areas assessed during this campaign were the cooler stack, clinker cooler building stack fan and kiln cooler fans. The FFT data taken at receptor locations has been used as a guide to highlight target frequencies on site.

2.0 INSTRUMENTATION AND METHODOLOGY

Acoustic camera

The acoustic camera allows visual represent the level of sound approaching the camera from different directions. Recordings can then be made of the sounds measured from a chosen direction.

The operation is based on signals coming from 256 individual microphones mounted on a 1.05m dish. Due to the propagation delay of sound, sound form different directions will reach each microphone on the dish at different times. By analysing the delays and comparing them to the sound from different directions, it is possible to indicate the level of sound from a given direction.

The microphone dish also has a wide angle optical camera for recording live video images. The visual representation of sound levels can be superimposed over the top of the optical picture.

Measurements can be taken from 0.5m to infinity although resolution reduces as distance increases. The high number of microphones allows for low level noise sources to be measured.

3.0 METHODOLOGY

Principle of Operation

The output of the acoustic camera is generated by combining the signals from each individual microphone on the array, according to the applied beamformer. Beamforming is a signal processing technique used in sensor arrays for directional signal reception. The most commonly used beamformer is delay and sum beamformer (DAS). DAS algorithm uses time delays to phase align sensor signals. This is called steering and is done by only using spatial information about sensor positions and the direction of interest. When delays corresponding to the selected direction are applied, the sensor signals are summed in phase and therefore amplified, while signals from other directions are summed out of phase and therefore attenuated.

Directional Information

The DAS beamformer spatial response has a uniform weighting. The spatial response gets better or narrower the higher the frequency and is common for sensor arrays. The spatial response is a function of array size. So to improve the lower frequency response would require a larger array.

Specifications

Number of microphones: 256

Max sound level (re 20upa):110dB

Noise Level, A-weighted 10dB

Microphone Frequency range: 20Hz - 20 KHz

Sample Frequency: 44.1 KHz

Focal distance: 0.5m to infinity

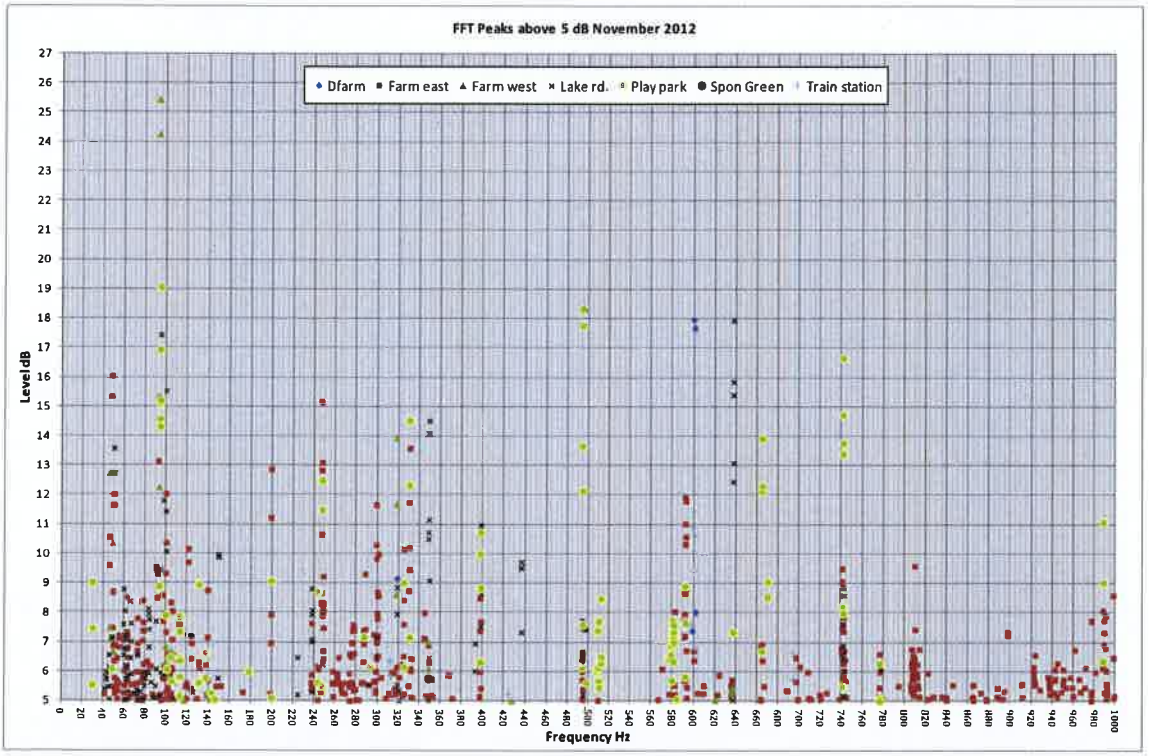
Optical/acoustic covering angle: ± 70° horizontal,± 52° vertical

5

4.0 FFT Measurements

FFT measurements were taken during the monthly boundary assessment when conditions were suitable and the site was audible. Frequencies between 0- 1000Hz were measured with 6400 line resolution. The individual FFT measurements have been overlaid on scatter graphs so any dominant or reoccurring frequencies can be highlighted.

Receptor FFT Measurements November 2012

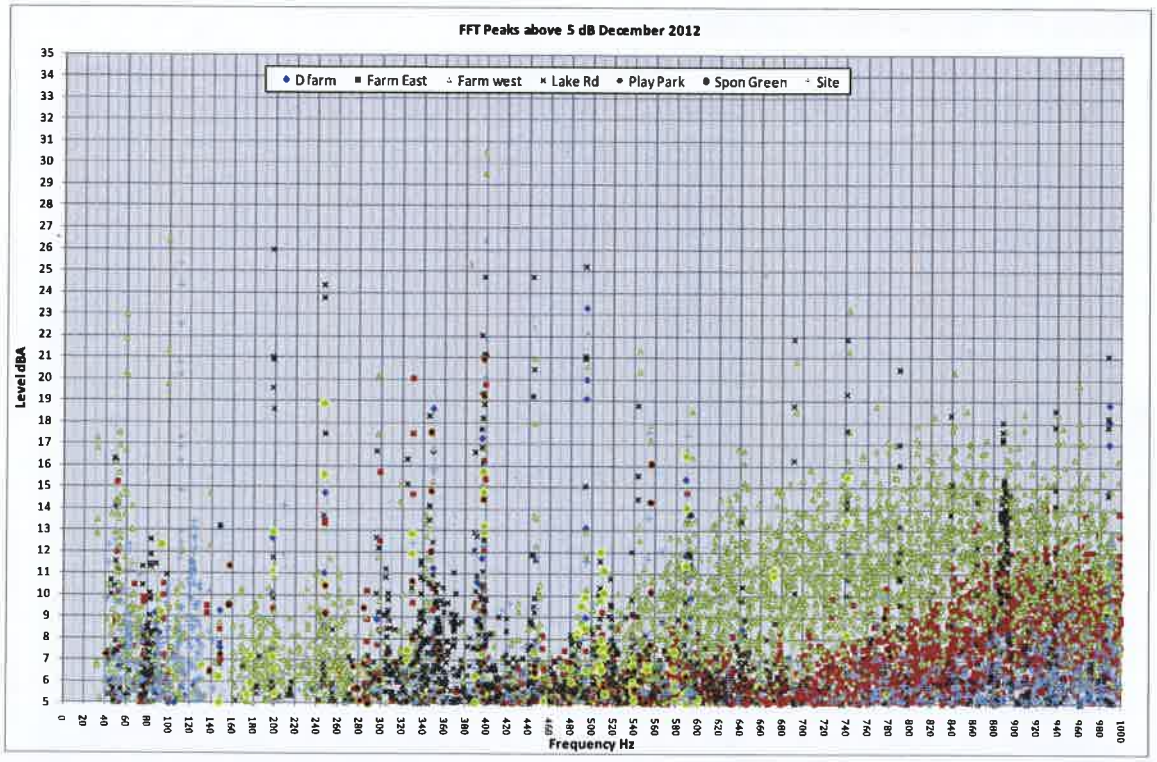


Measurements were taken during the night of 7th-8th November 2012. The weather conditions at the time of measurement were still at ground level with a slight breeze blowing stack gas the east towards the centre of Pen-y-fford.

Measurement locations and stack gas direction

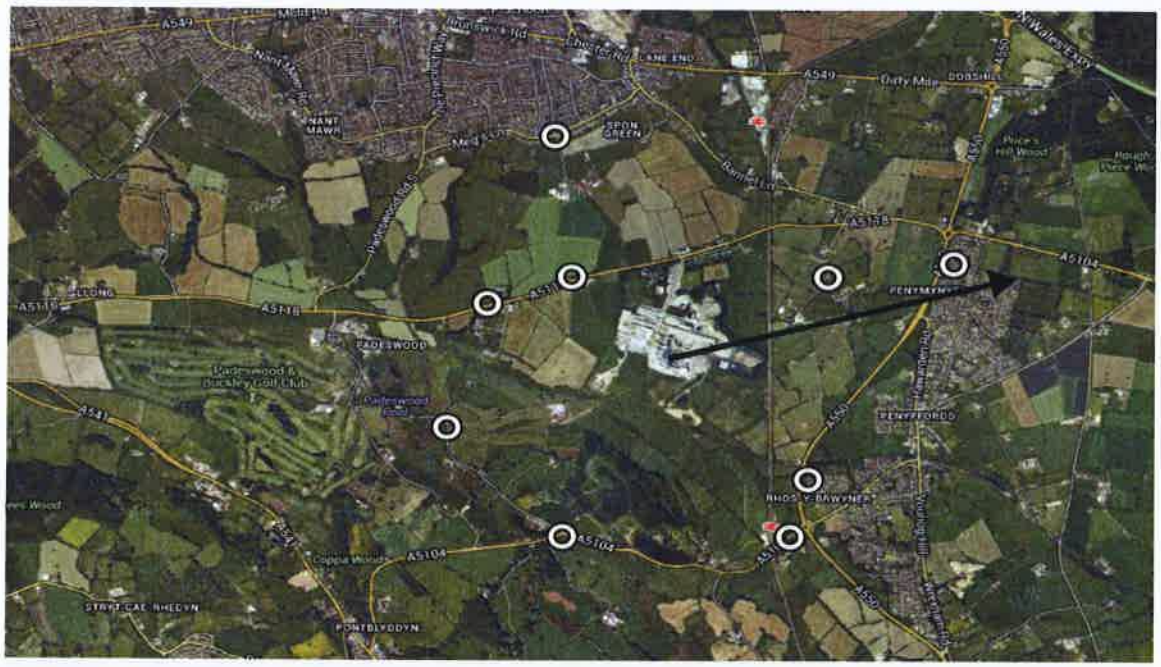
6

Receptor FFT Measurements December 2012



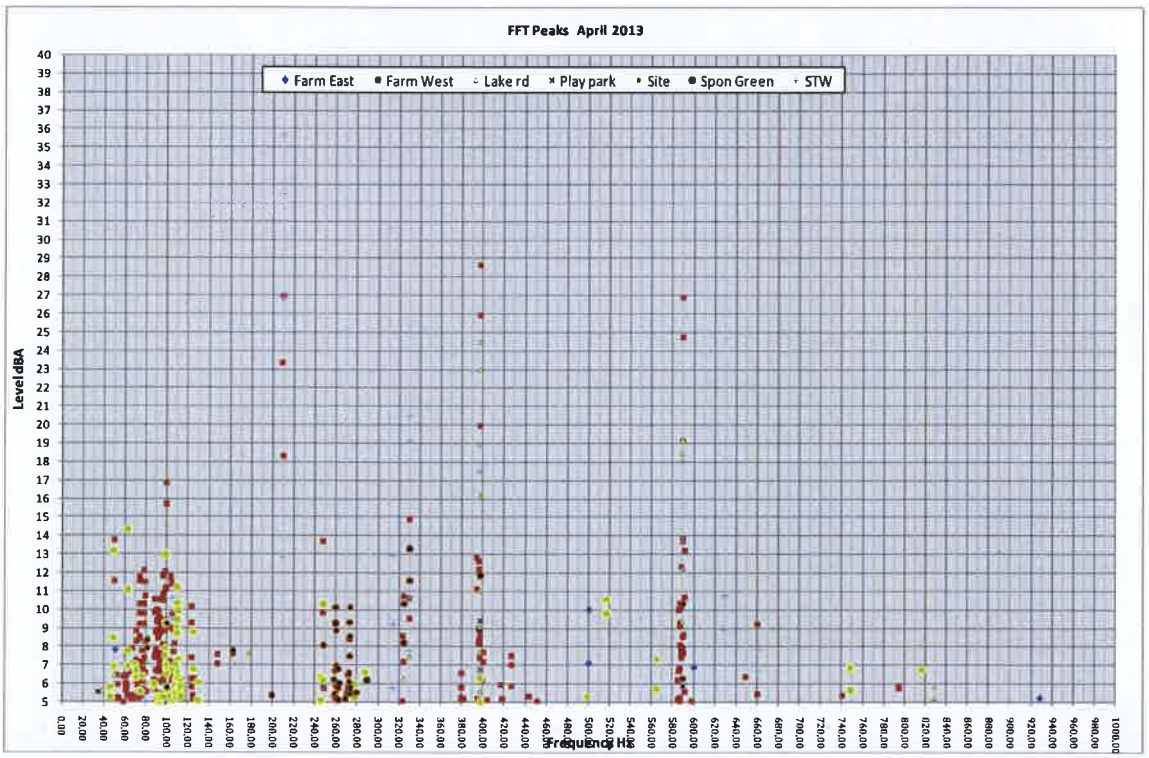
Measurements were taken during the night of 5th-6th December 2012. The weather conditions at the time of measurement were cold and still at ground level with a slight breeze blowing stack gas the east towards the layby area in Pen-y-ffordd.

Measurement locations and stack gas direction



7

Receptor FFT Measurements April 2013

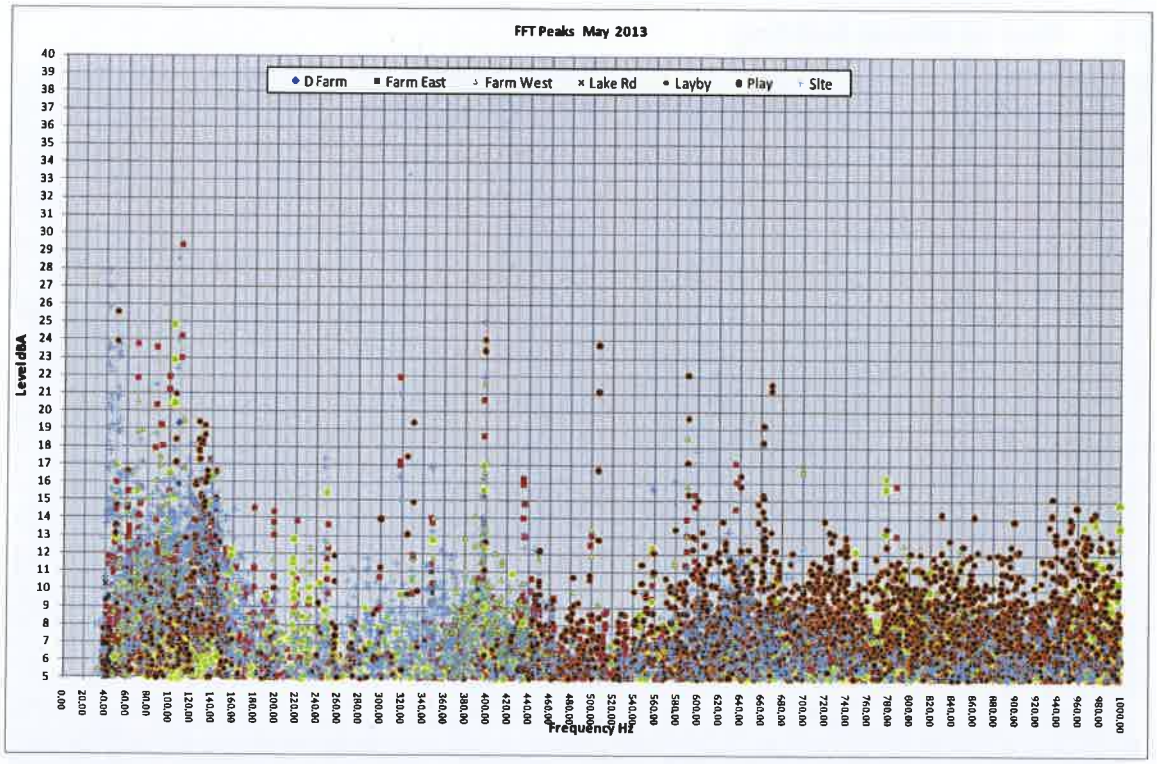


Measurements were taken during the night of 9th-10th April 2013. The weather conditions at the time of measurement were cold and still at ground level with a slight breeze blowing stack gas from the SSE direction towards the Spon green area.

Measurement locations and stack gas direction

8

Receptor FFT Measurements May 2013



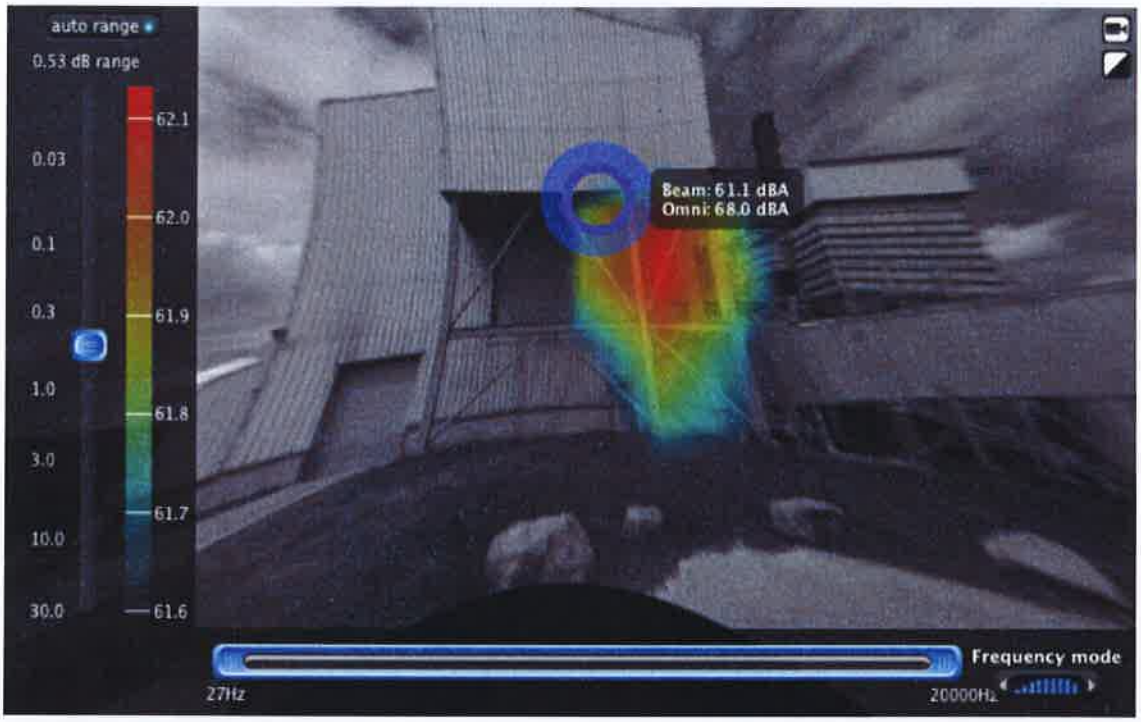
Measurements were taken during the night of 15th-16th May 2013. The weather conditions at the time of measurement were cold and still at ground level. There was a slight breeze blowing stack gas from the WNW towards the Lay-by area.

Measurement locations and stack gas direction

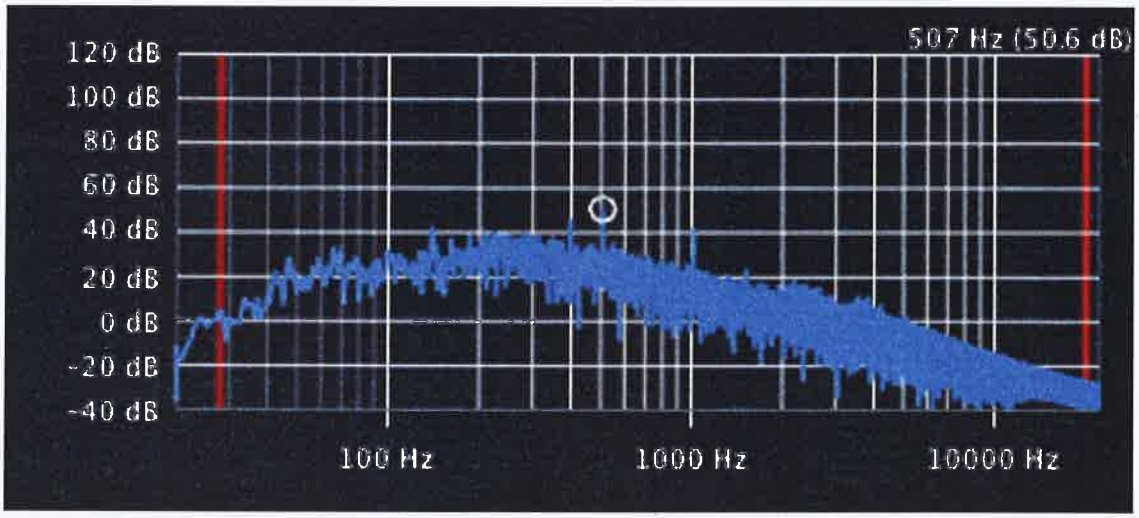
9

5.0 Acoustic Camera Measurements

5.1 Rear of clinker building

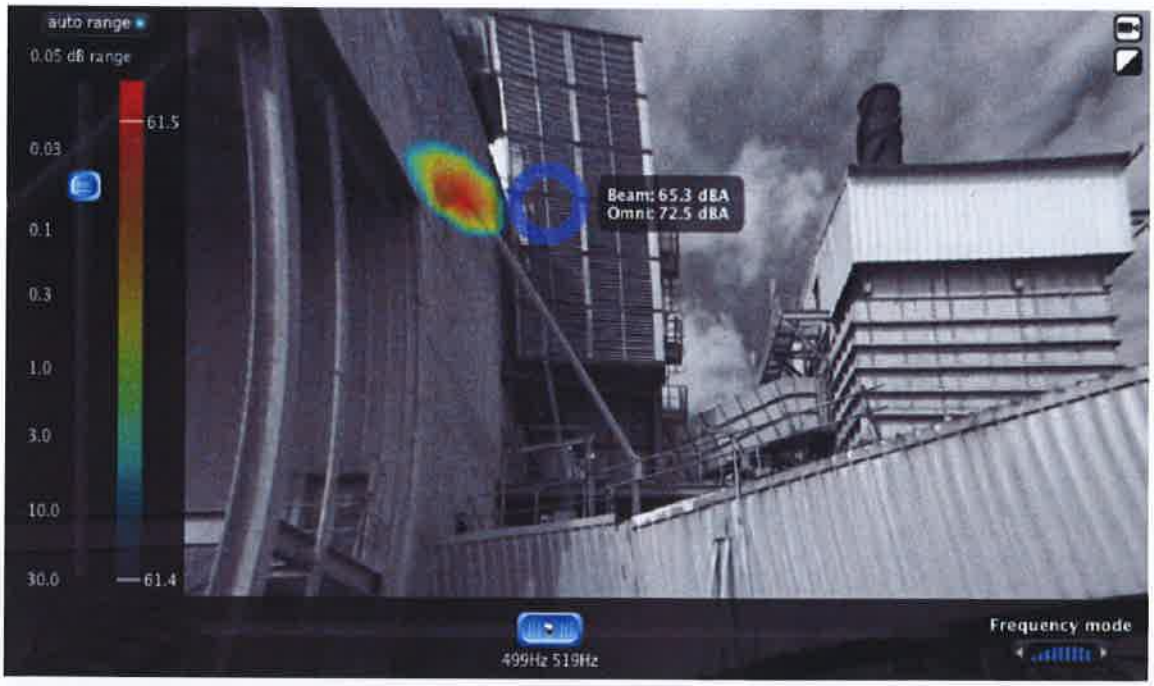


FFT measurement

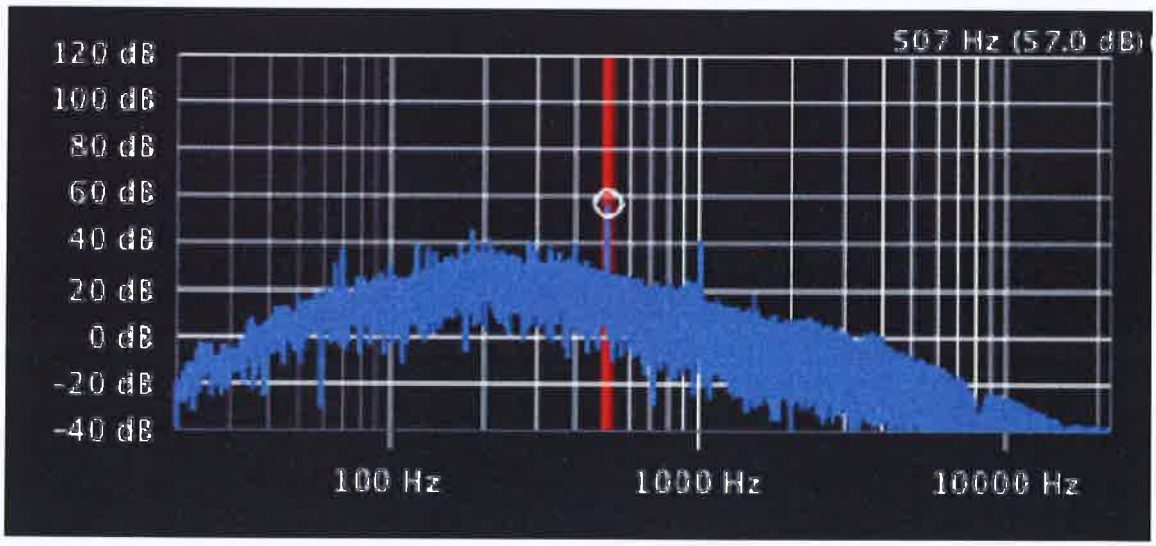


The red lines highlight the measurement range on the plot above. In this plot a broadband measurement (The whole frequency range) was taken and highlights the area where the majority of the noise is coming from. 507Hz is also highlighted as the dominant tonal frequency.

10

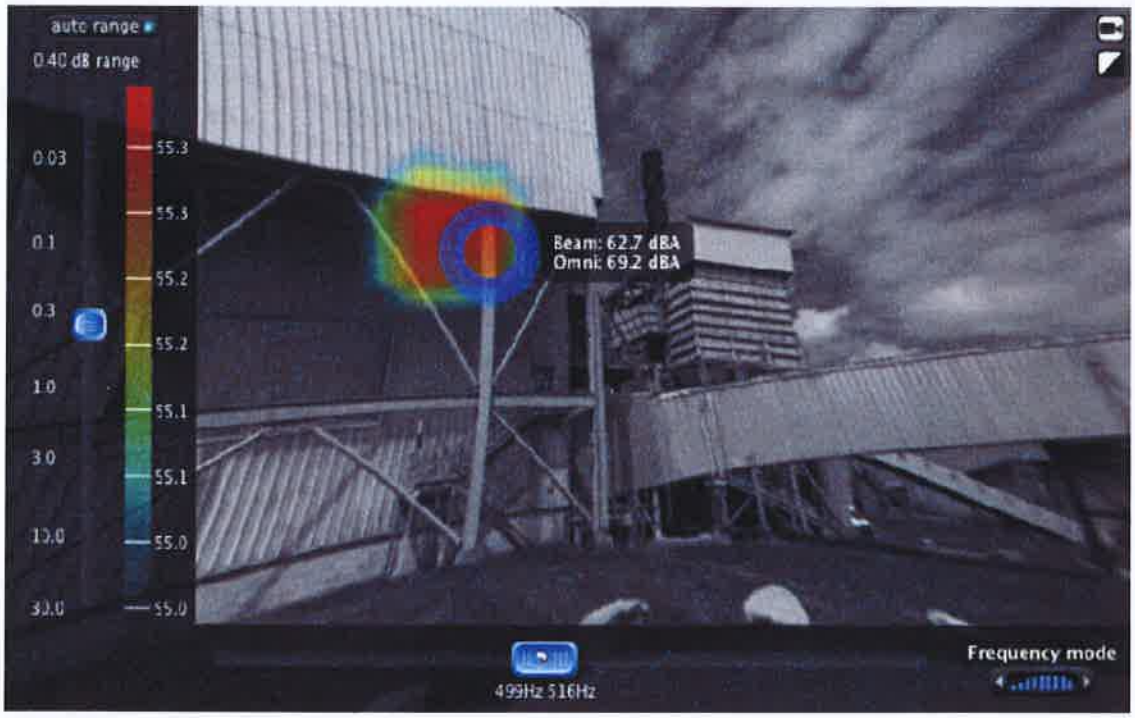


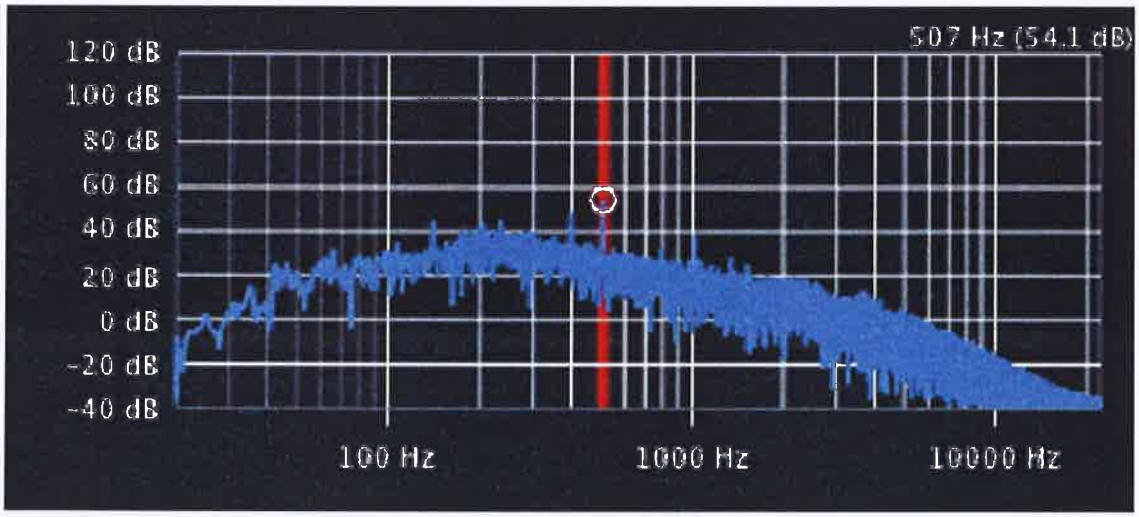
FFT measurement



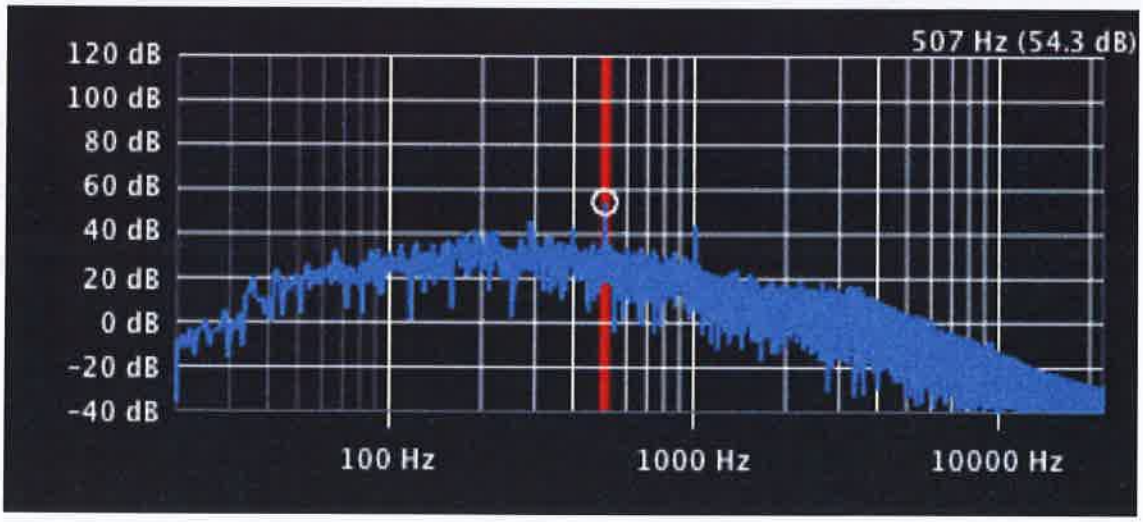
The source of the 507Hz tone was found to be a pipe protruding from the clinker building and dropping down to the clinker conveyor.

11





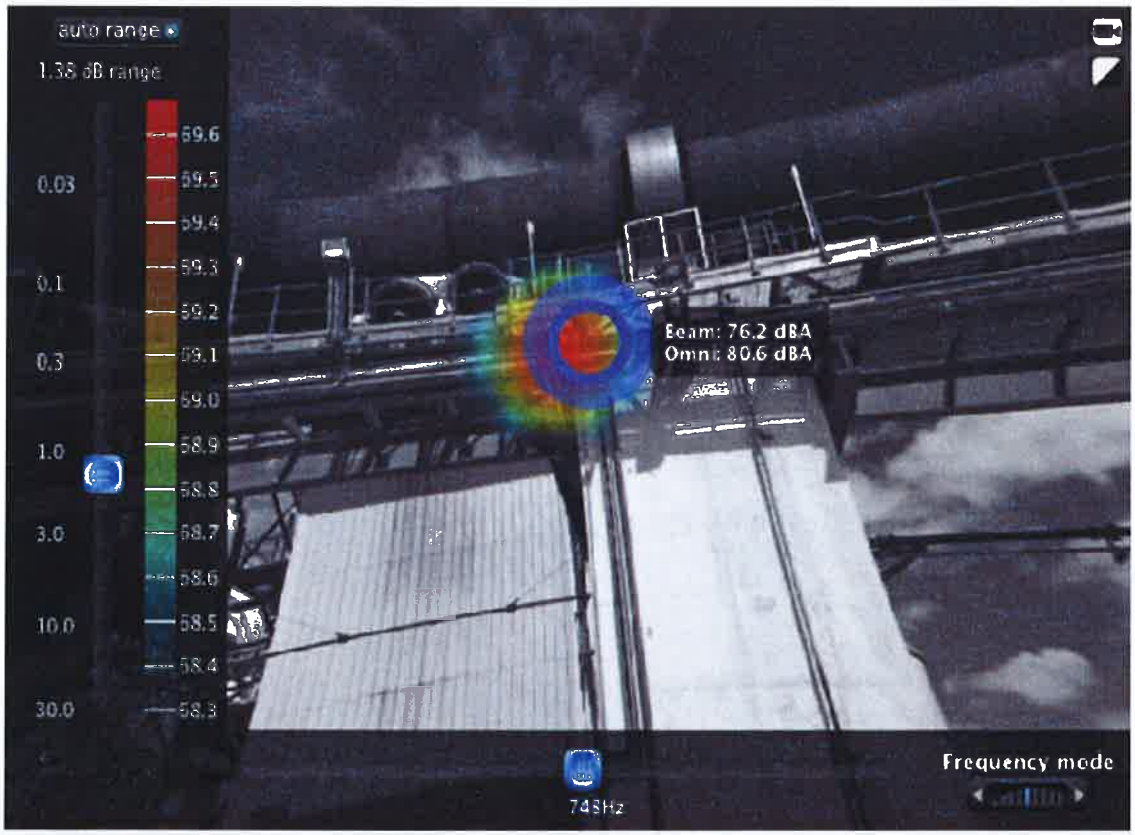
The 507Hz tone is also evident from the rear upper floor of the building and may indicate that the source is located within the building and could also indicate structural transmission.

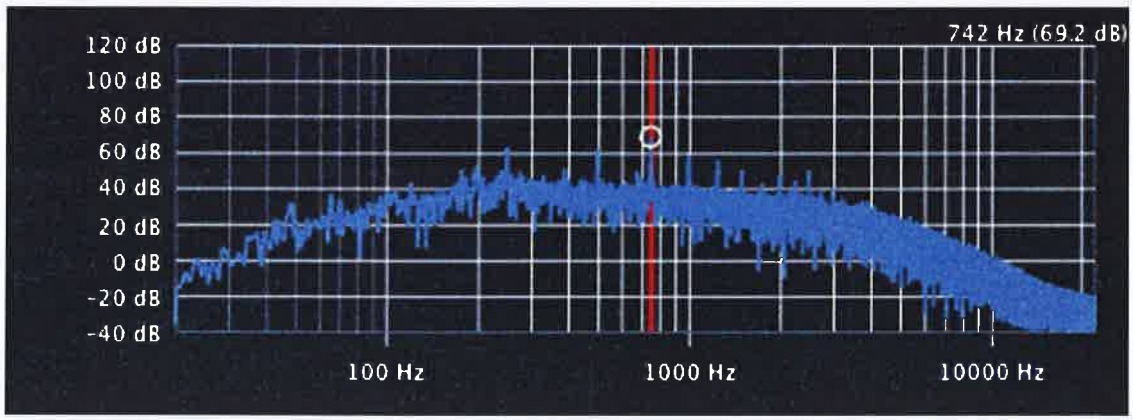


This plot highlights that the dominant 507Hz tonal source is from the protruding floor above.

13

5.2 Kiln Cooler Fan

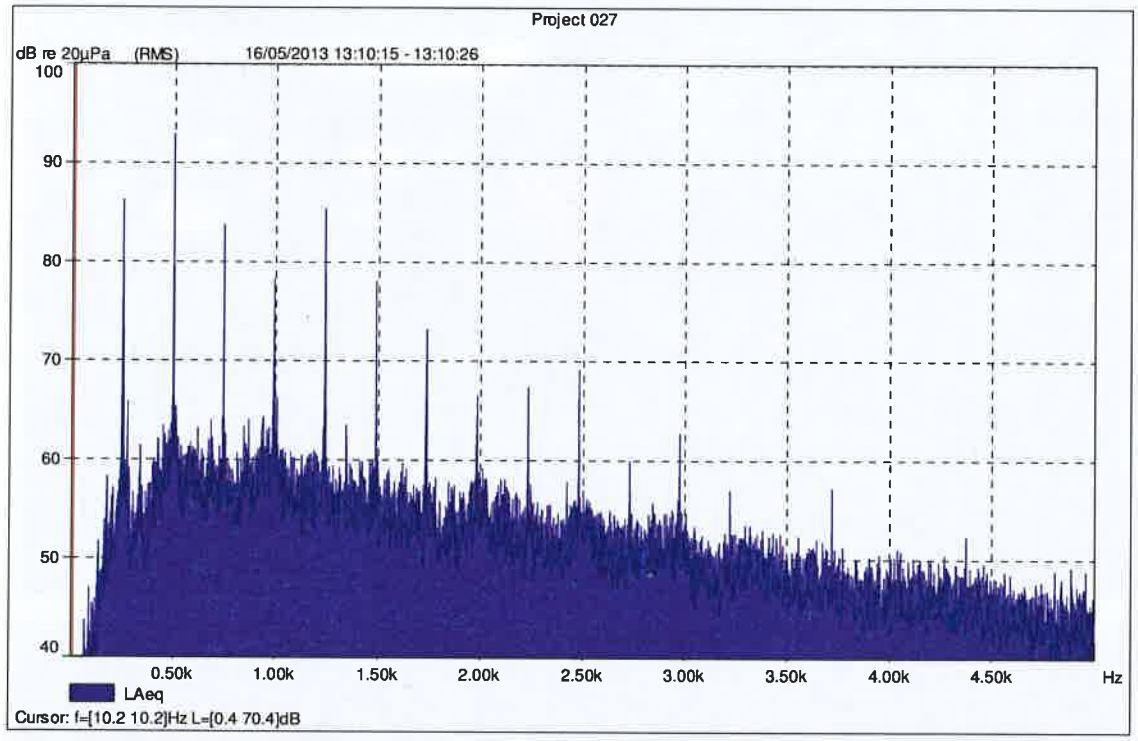




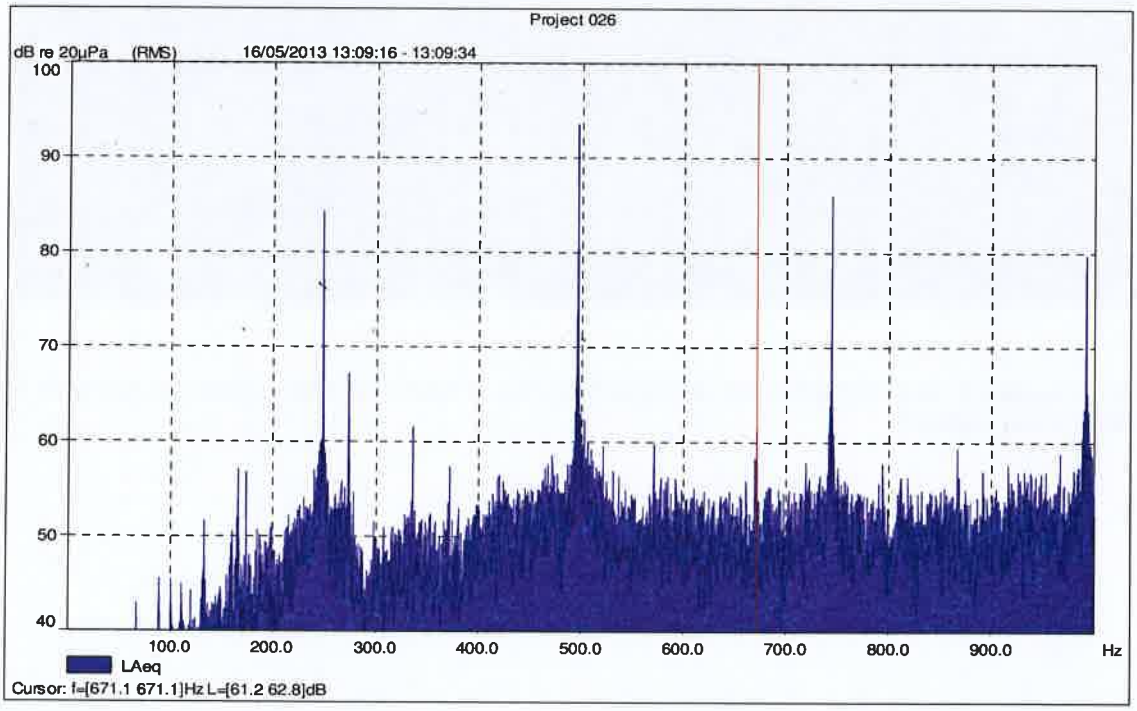
Kiln cooler fan has a number of tonal elements and harmonics. The 742Hz peak is dominant at distance but the 495Hz is dominant at source. It is thought that the 742Hz is from the exhaust and the 495Hz is from the motor/fan.

14

FFT measurements @ 1m from inlet



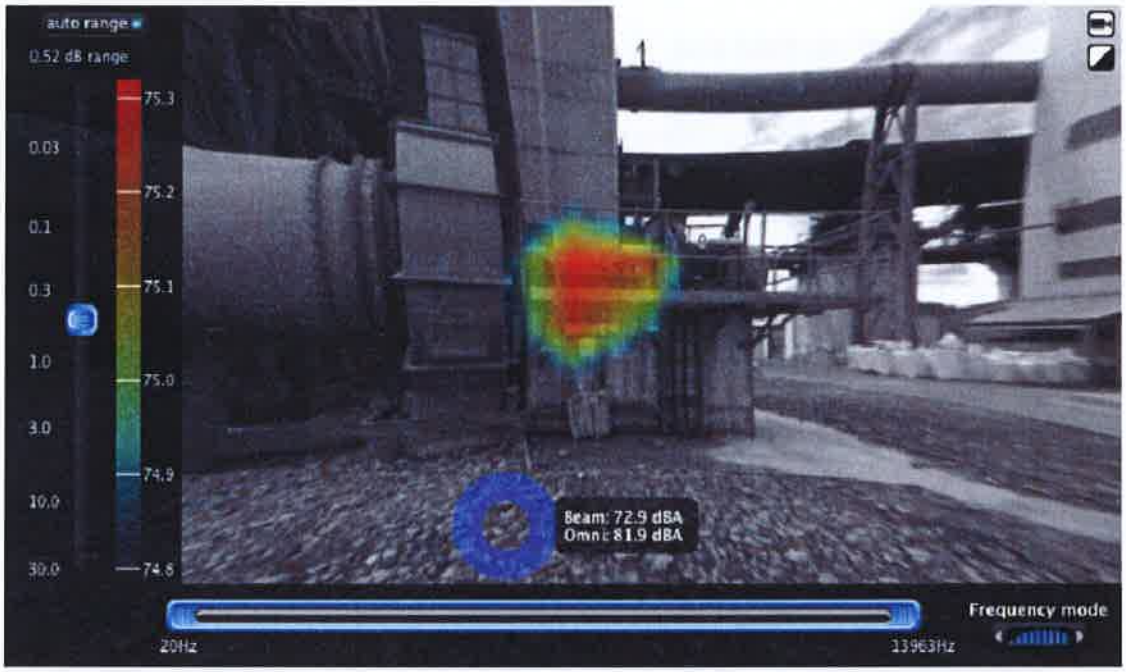
A number of resonant frequencies can be seen but the low frequencies are most likely to be seen at receptor locations.

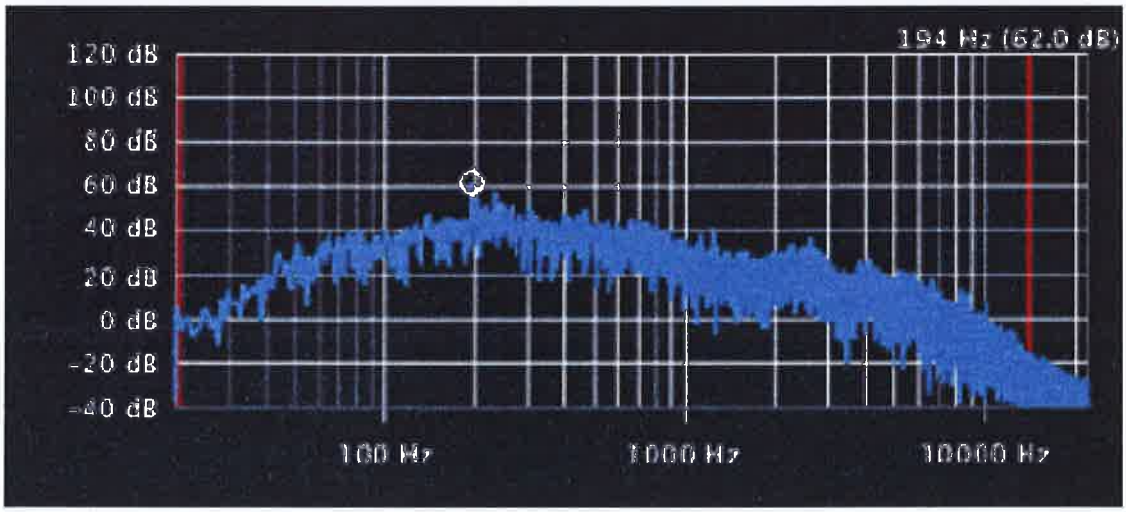


FFT measurements taken with sound level meter highlights the 247,495 and 742Hz

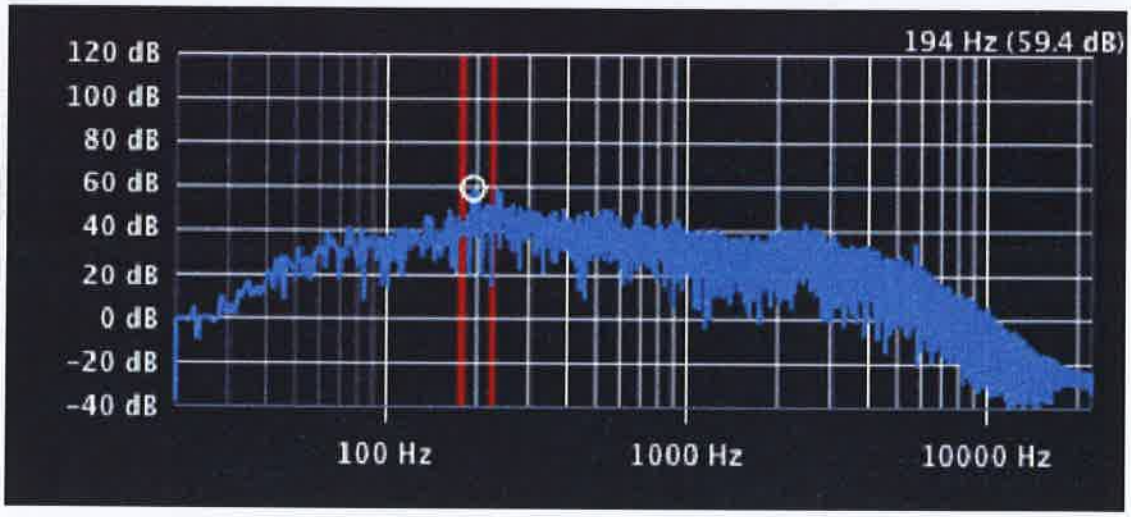
15

5.3 Cooler Stack Area

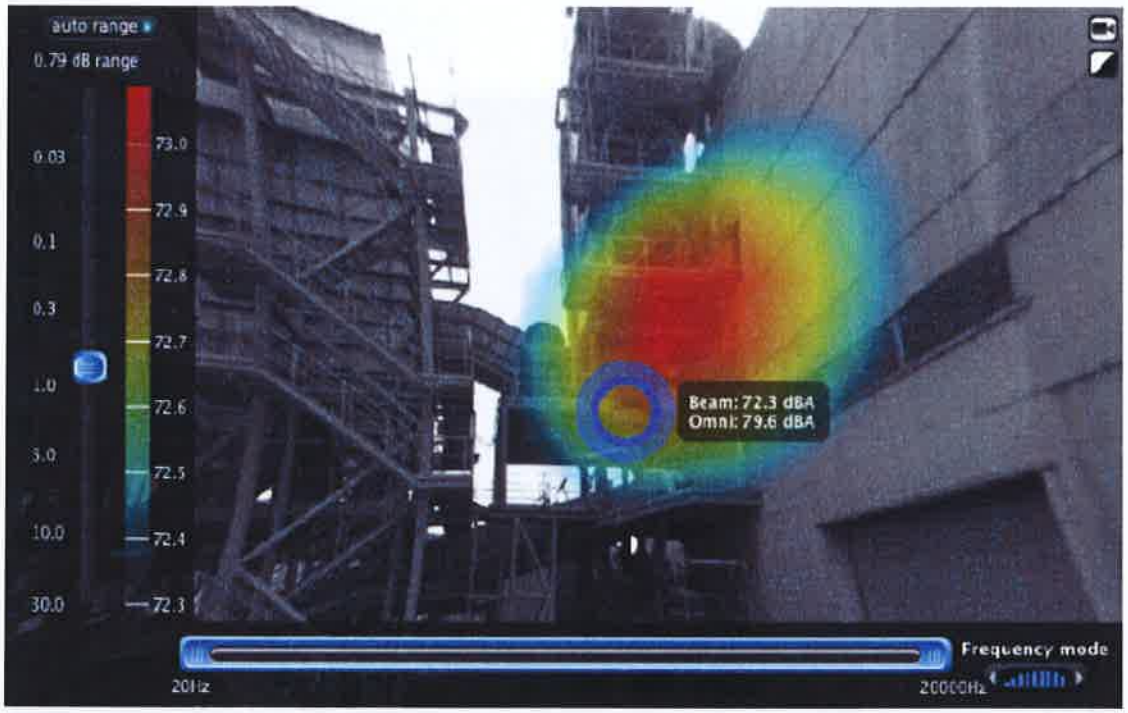


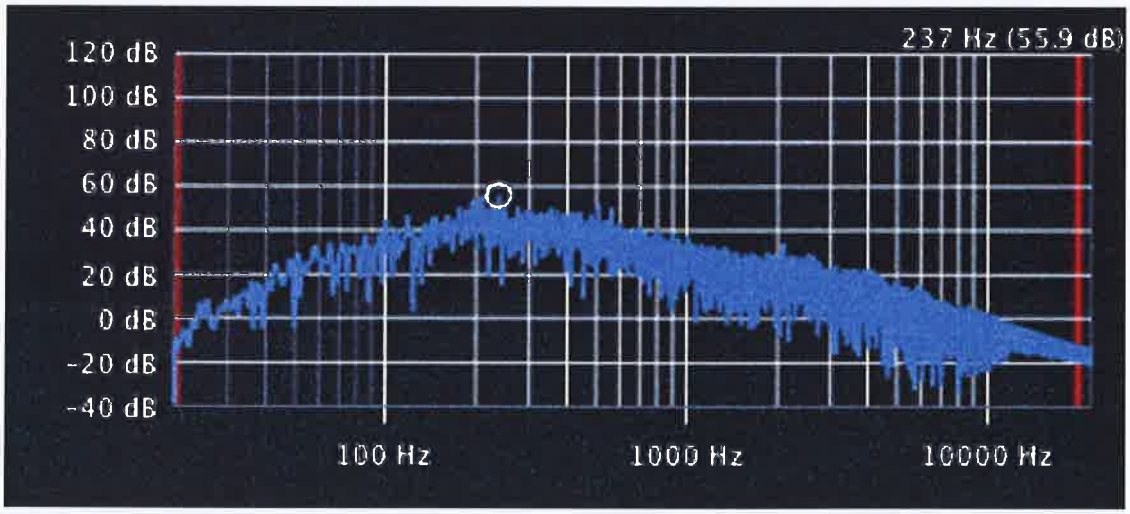


This broadband plot highlights the dominant source is from the motor drive source with a 194Hz tonal element.

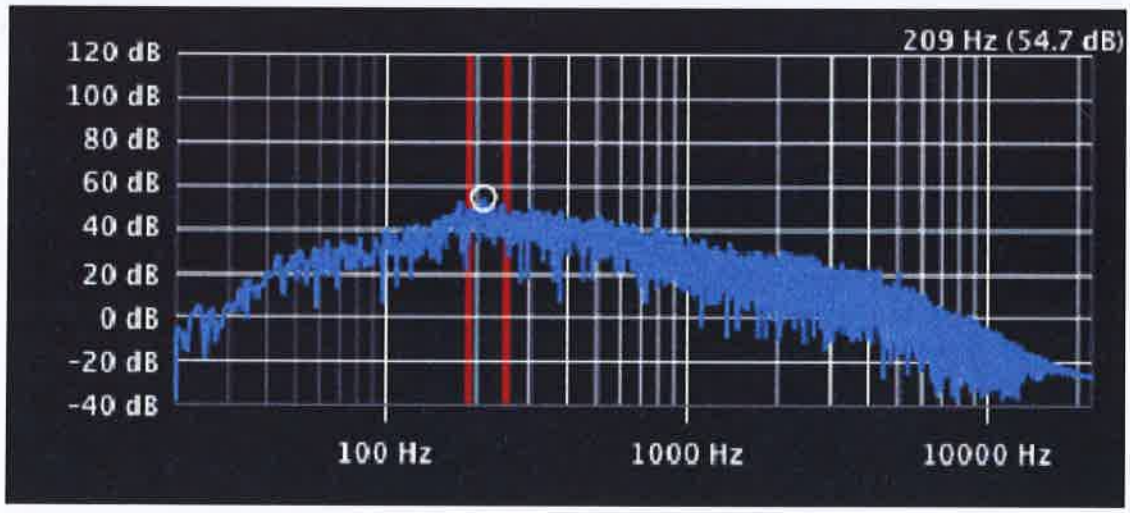


This plot highlights the 194Hz frequency as the dominant tone associated with the motor drive.

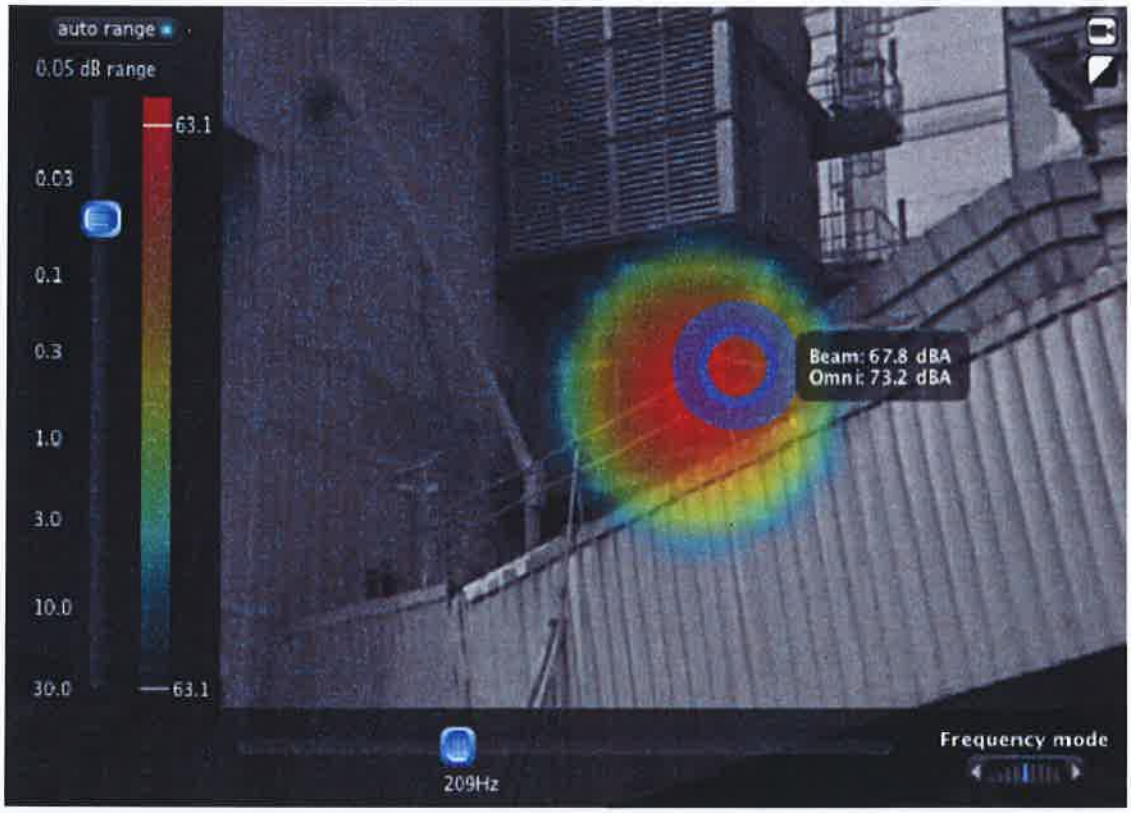




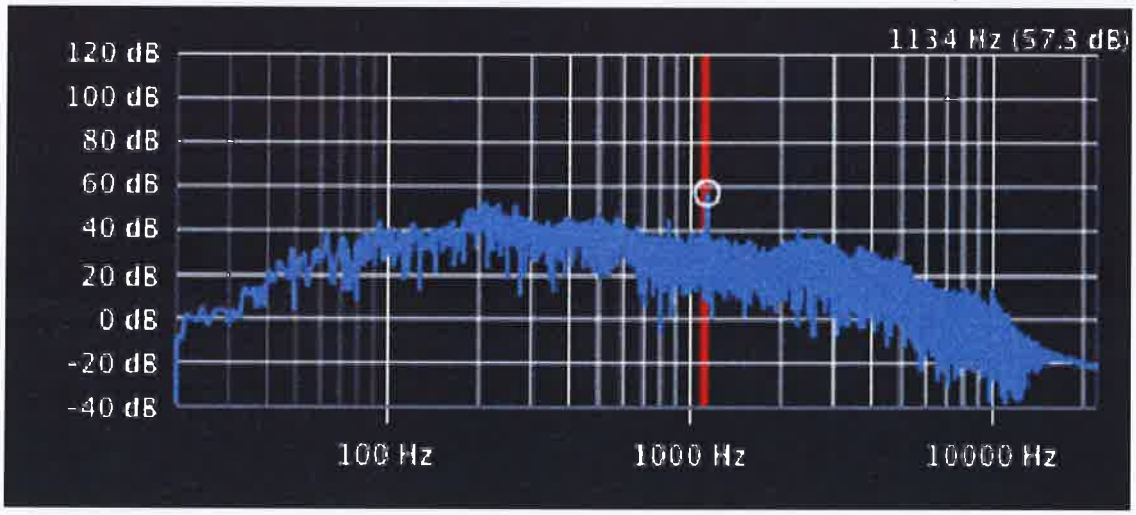
Broadband highlights dominant area as the base of the three cooling fans.



Plot with dominant frequencies highlighted. 209 Hz was the highest observed



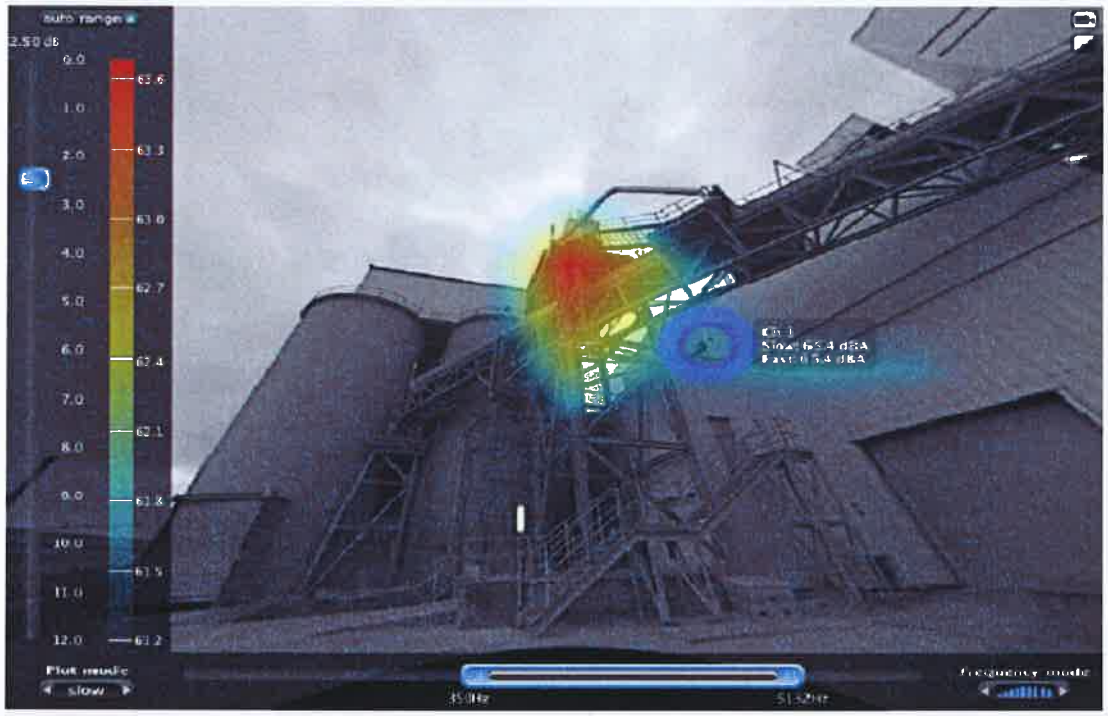
209 Hz was also measured from the rear of the building.

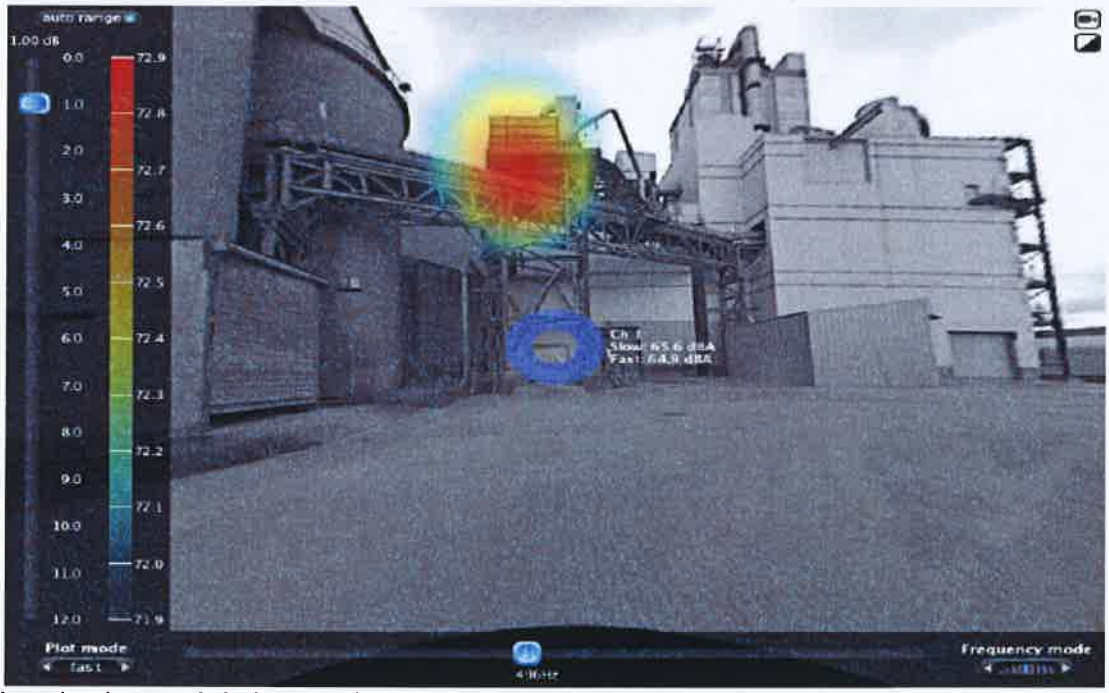


1134 Hz tone was highlighted on the inlet of the cooler stack. This has not been identified during the FFT measurements as 0-1000Hz measurement range was set to identify lower frequency sources. It is thought unlikely that this Frequency will be seen at receptor locations but a 0-2000Hz range will be used in any future FFT assessments to identify if this is the case.

5.4 RAW MILL ELEVATED CONVEYOR

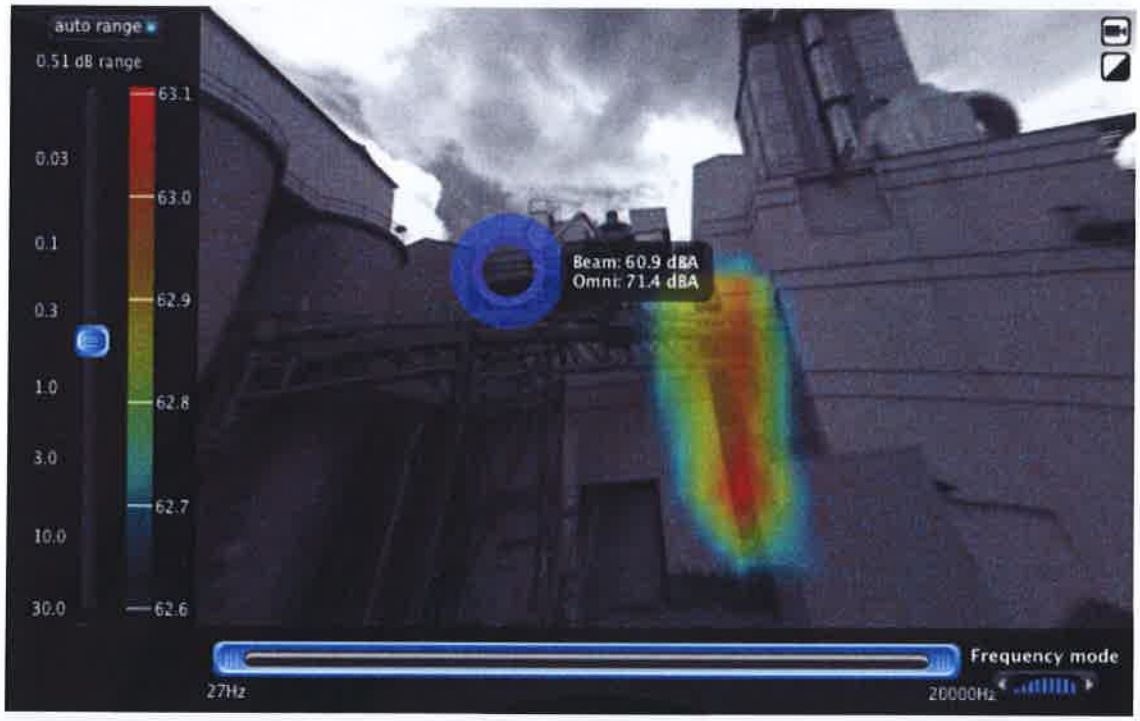
Data from assessment in August 2012 highlighting a high level source.

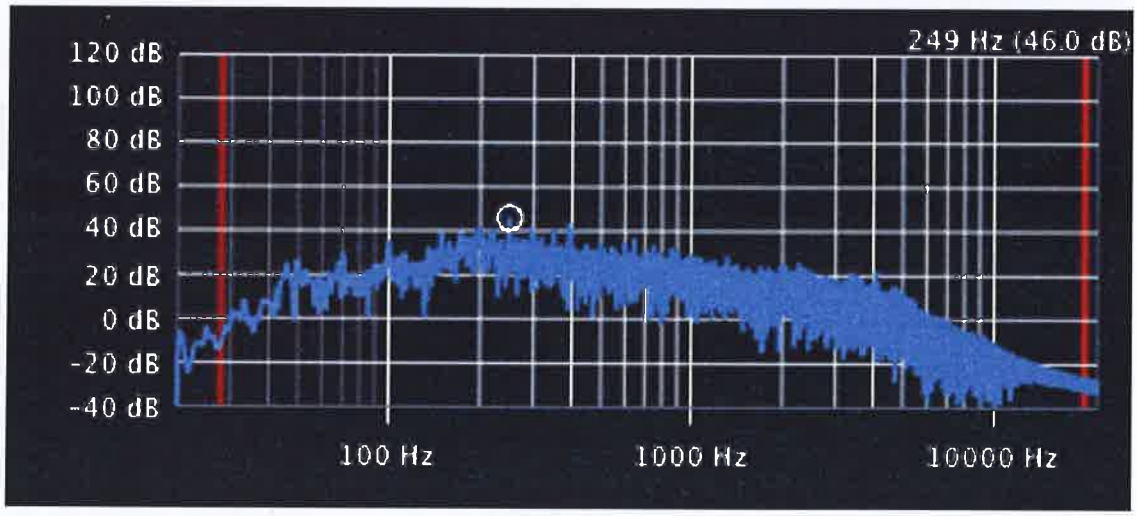




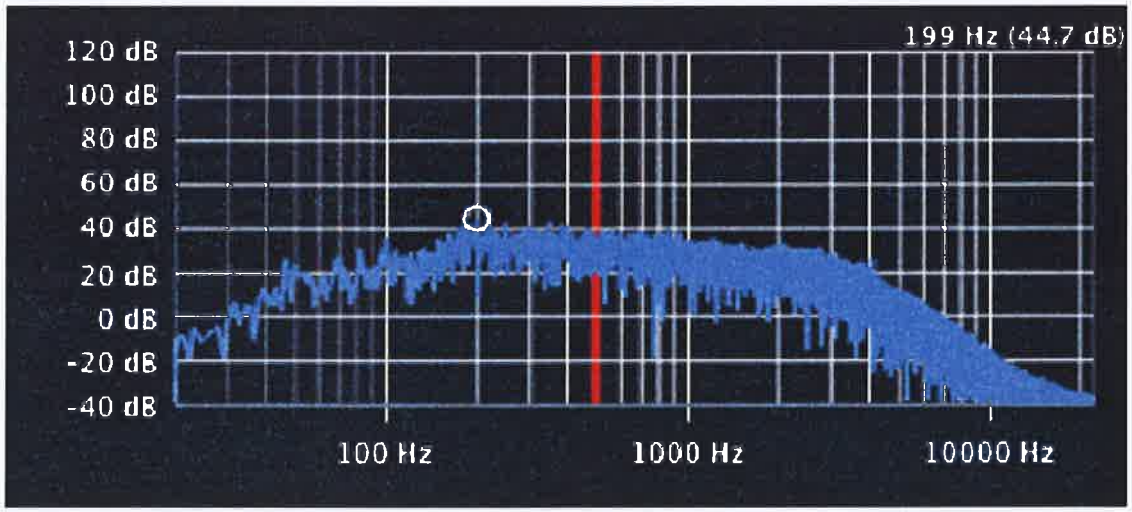
Levels observed during previous assessment identified high level noise source with a tonal element at 496Hz.

Measurements taken in May 2013 after maintenance on fan and system on platform





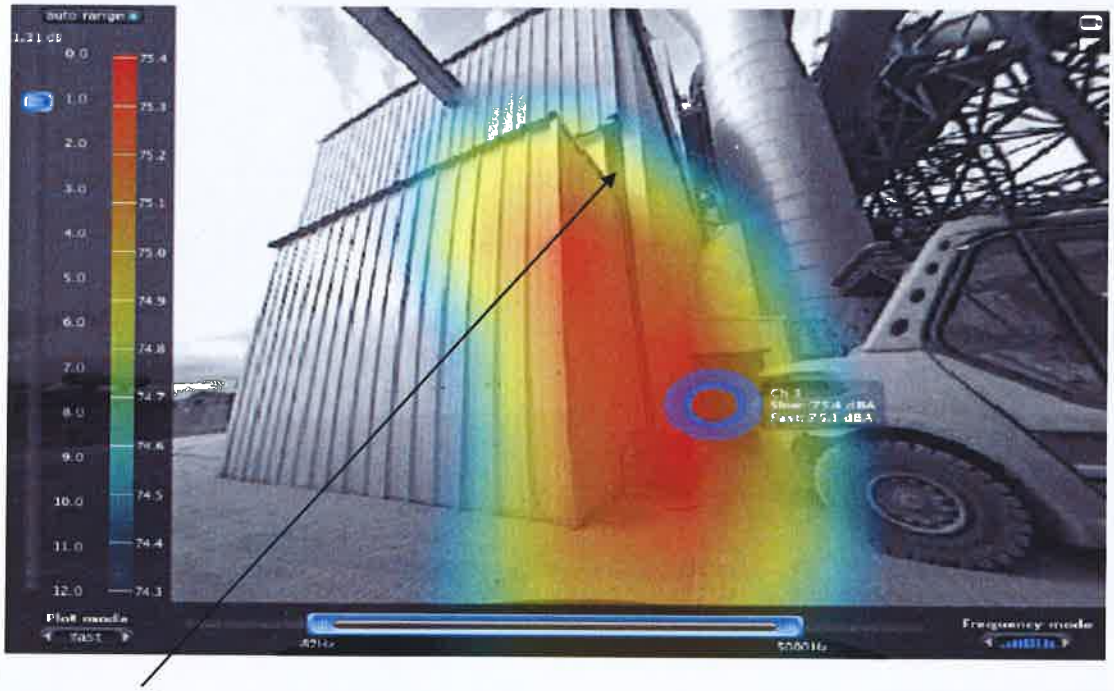
The broadband level identifies the dominant source of noise coming from the Coal mill area. Background noise levels are similar but the tonal element has been significantly reduced.



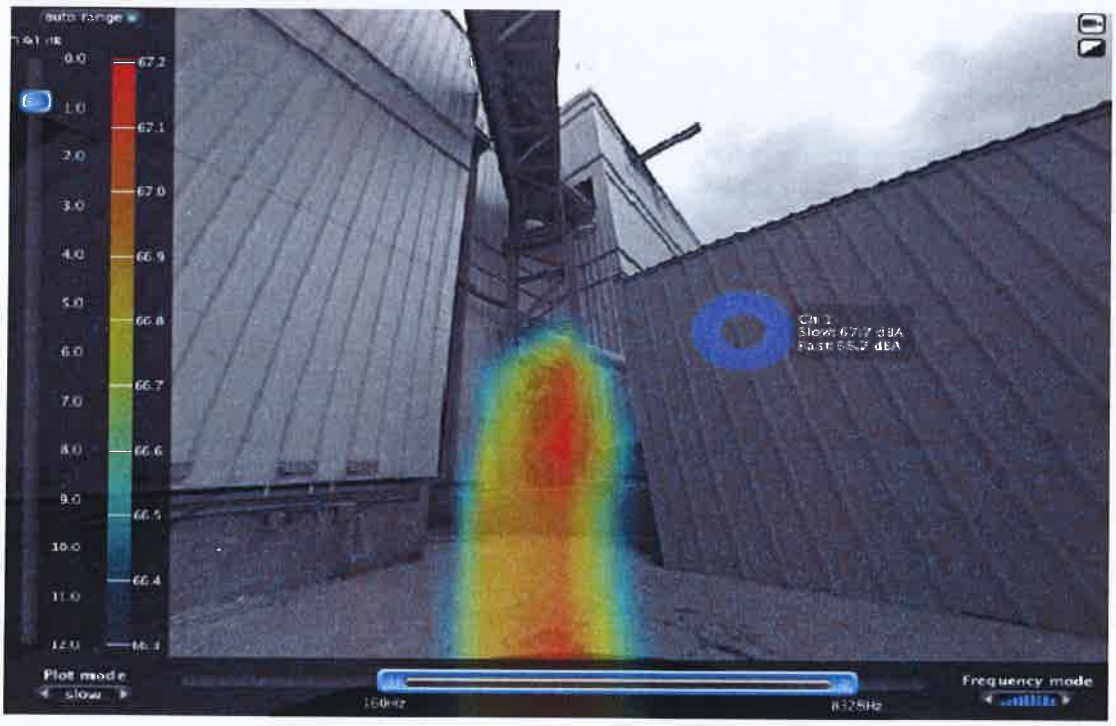
The dominant frequency observed from the platform is now not evident. The 496Hz in this plot is part of the general broadband noise coming from the coal mill. It can be assumed that the fan and motor at 496Hz are less than 50dB at his measurement location a significant reduction from 72dB before maintenance.

5.5 RAW MILL

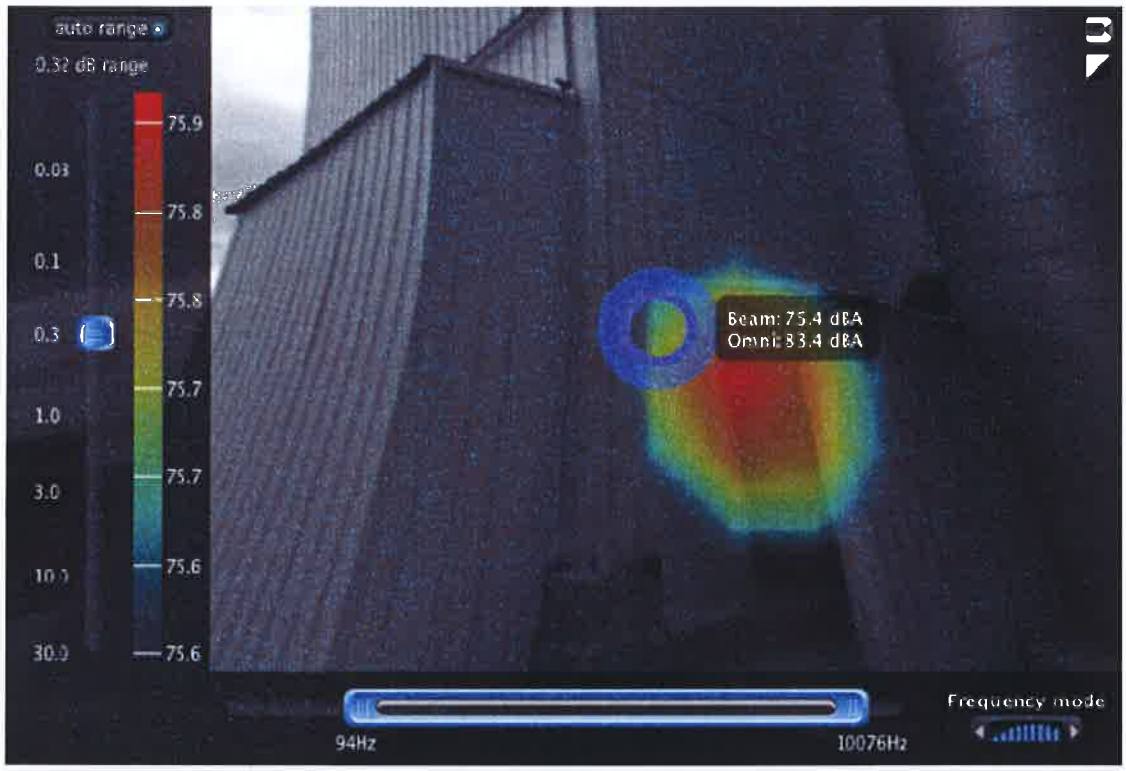
Noise breakout at areas where the façade is damaged measurements taken August 2012.



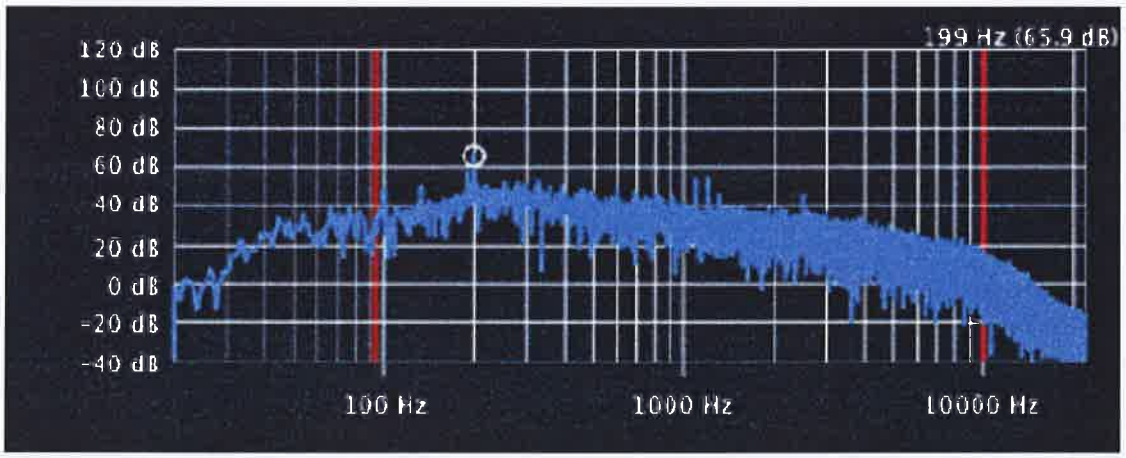
Missing panel on building



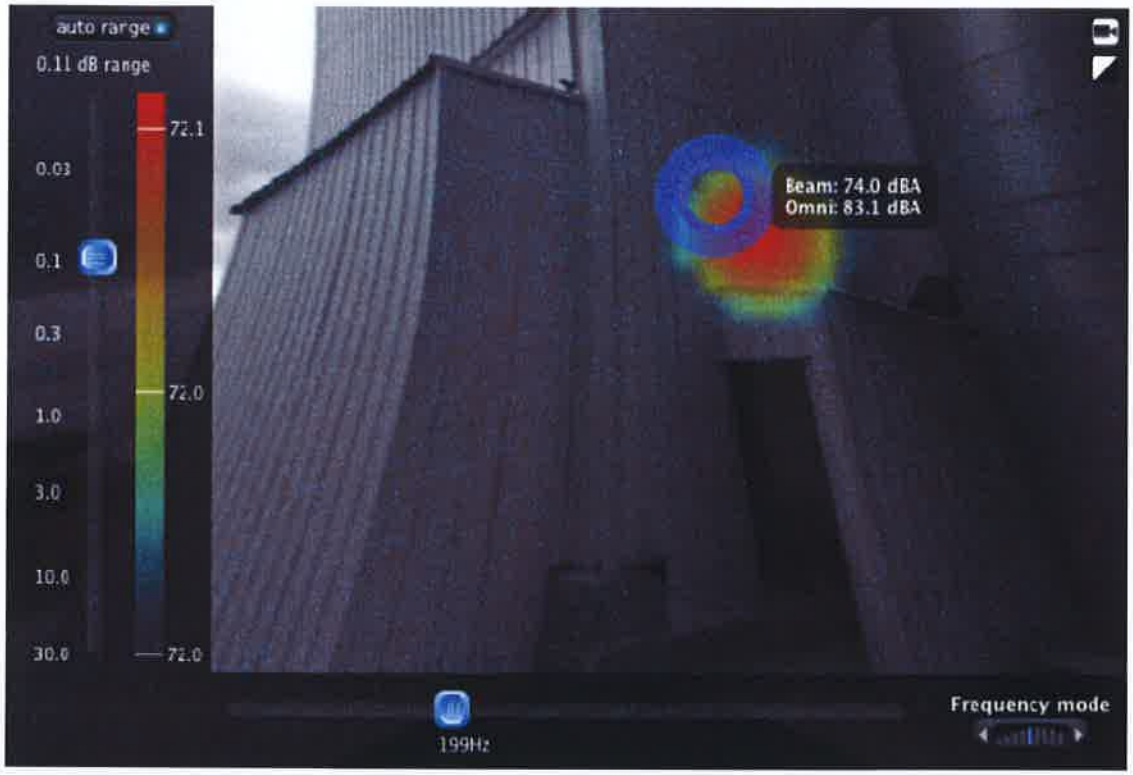
Noise breakout from damaged wall

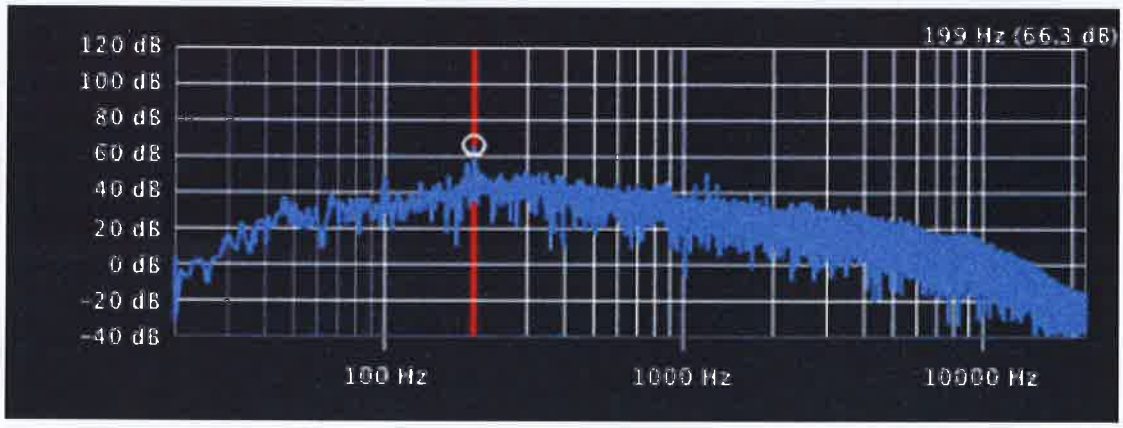


FFT Measurement

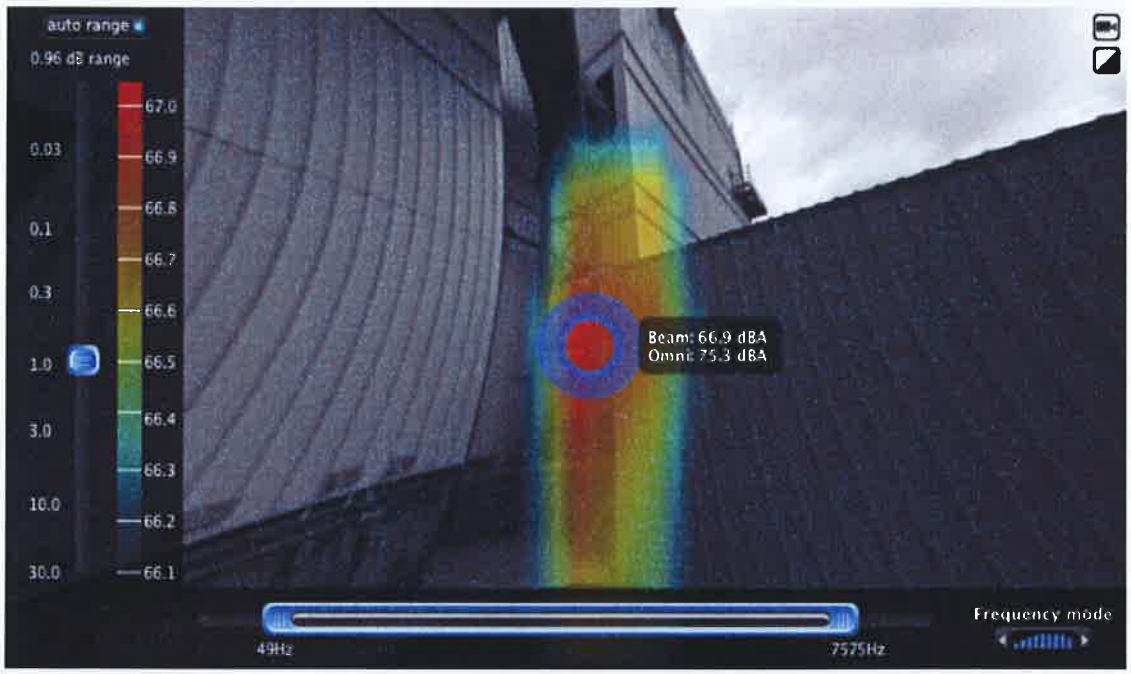


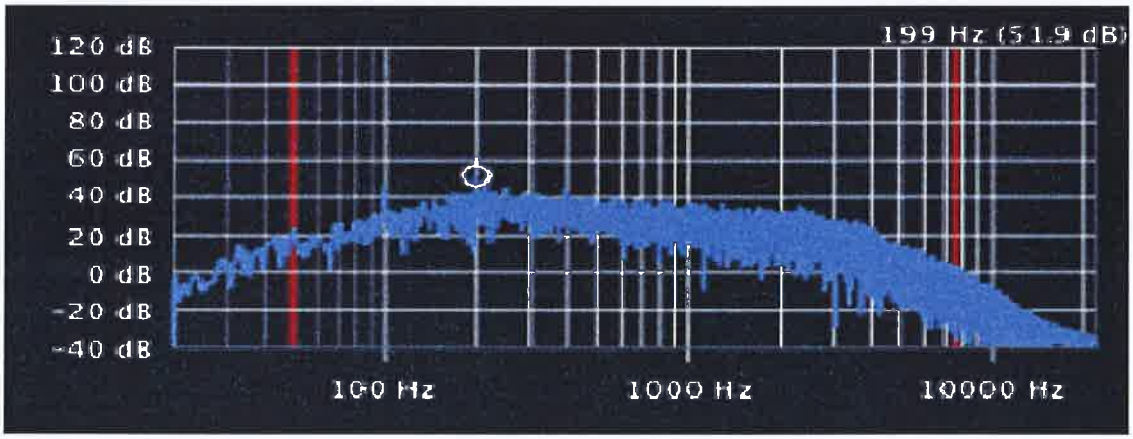
Panel replaced has had little affect on the overall noise level. Fitting a door on the building may reduce the high frequency noise breakout but will not have much impact on the dominant 200Hz tone from fan/motor within the building.





This plot highlights the dominant 200Hz tonal source. The 200Hz source within the building and is not contained by the structure. Further attenuation will be required to reduce the impact of this source.

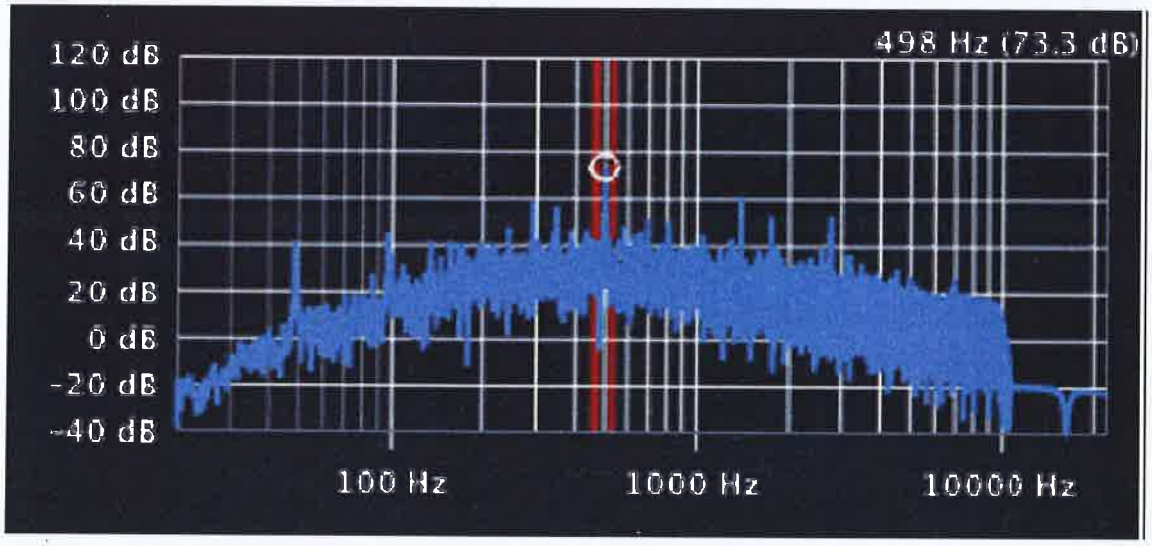




Noise breakout is still evident after new panels are fitted. Gaps in the façade for cables and conveyor will be the path for the noise breakout also the high level sources within the raw mill building may not be contained by the facade.

5.6 WATER PUMP IN TOWER

FFT Measurement



Water pump in the tower has a number of tonal elements. The dominant tonal element is the 498 Hz tone.

6.0 SUMMARY OF FINDINGS

The clinker building has a dominant tonal source at 507 Hz and a level of 57dB at the measurement location. The 507Hz peak was observed at the at the play park location during the FFT measurements taken during the boundary measurements in May 2013. The level of the 507Hz tone at the play park was 24dB. The 507Hz has been identified coming from the pipe exiting the rear of the building. The source of this tone may be from the fan/motor associated with the pipe. The tone was also observed braking out from the overhanging floor this may indicate that the unit is not isolated from the structure. Further investigation may be required within the building to identify the source. Remediation is recommended at source. If fans/motors attached to the pipe work within the building are found to be attached directly to the floor then this should be replaced with the appropriate rubber isolation mounts. Isolation can also be applied to the pipework if supports mounted directly to the structure. Fans and motors should also be well maintained and checked for any balance problems which could produce a tonal problem.

The mobile kiln cooler fans have several tonal elements, the dominant low frequencies which are most likely to be seen at receptor locations are 247,495 and 742Hz. From the FFT measurements taken at receptor locations these frequencies are observed at number of locations during the November and December 2012. Levels at 742Hz were observed up to 22dB at the lake rd. Toll Bar Location. Attenuation measures could be applied on the inlet and outlet of the fan but this may limit mobility.

The cooler stack area highlighted dominant sources at the cooler stack fan drive with a small 194Hz peak and the fan exit to the stack with a tonal peak at 1134Hz. A number of tonal sources have been observed on site around 200Hz and this is not thought to be the dominant source. The 1134Hz is evident as a whine close to the stack but is thought unlikely that the 1134Hz frequency will be seen at receptor locations. Any future FFT assessments a 0-2000Hz range will be used in to identify if this is the case. A tone at 209 Hz was also observed at the base of the three cooler fans and was observed braking out from both east and west directions. This 209Hz was observed at a number of offsite receptor locations during April 2013 FFT measurements with a level if 35dB measured at the STW/Dog kennel location. Insulation of duct work from clinker building to filter may reduce the impact of the 209Hz .Further investigation will be required to identify the source of the 209Hz tone which could be from a fan within the building.

The raw mill ID fan building façade repair has not reduced the overall noise impact. The doorway should be closed and will reduce the overall broadband/ high frequency noise level at source. The dominant tone from this area is the fan exit area within the building at 200Hz this tone can be seen at number receptor locations. Closing the doorway is unlikely to reduce the dominant 200Hz tone. The fan, motor and fan exit flue could be further insulated to reduce the noise level from source. Building insulation could also further reduce any noise breakout.

The water pump on the tower is an elevated source with a dominant tone at 498Hz. This was observed as a dominant tonal peak at the Farm East location during April and May 2013 FFT monitoring with levels up to 13dB. To reduce the noise impact the unit should be isolated from the structure and enclosed in an acoustic enclosure.

Measurements taken on the raw mill elevated conveyor platform in August 2012 showed a dominant tonal source at 496Hz. After remedial works on the fan and motor the tone is now not evident the noise level has been reduced from around 72dB to around 50dB at the monitoring location. The dominant source is now coming from the gaps in the coal mill façade located behind the platform.