Appendix J

Human Environment

Appendix J1

Community Benefit Programme Leaflet

elementpower

Maighne Wind Farm

PUBLIC CONSULTATION

Using wind to generate electricity is saving Ireland €250million annually according to a new report from the Sustainable Energy Authority of Ireland. The saving accrues from not having to import fossil fuels and a reduction of two million tonnes in our CO2 emissions.

Another comprehensive report entitled 'The Value of Wind Energy to Ireland' finds that using wind energy to meet Ireland's 2020 renewables targets will help deliver €1.8 billion in new tax revenue to the Irish state at zero cost to the Irish consumer. This study takes into account all the costs of building new grid, balancing the variability of wind and the PSO levy for support schemes.

Maighne Wind Farm will also help Ireland meet its target of generating 40% of its electricity from renewable sources by 2020 thereby avoiding huge fines which would have to be paid by the Irish state.

Introduction

Element Power is a renewable energy company that develops, acquires, builds, owns and operates a portfolio of wind and solar power generation facilities worldwide. The company is active in 16 countries, with more than 9,280MW of projects in development and a number of operating assets already sold.

With offices in Tullamore and Cork, Element Power Ireland conducts the Group's Irish operations and is directly responsible for a growing development portfolio which it manages across nine counties including Waterford, Donegal, Tipperary and Cork.

The company is proposing the development of a wind farm in Maighne in North County Kildare and South County Meath.

The Project

Element Power Ireland is considering the development of a stand-alone wind energy project in Maighne which would supply renewable energy to the Irish grid.

The company is considering the development of up to 51 wind turbines spread over a large geographical area. If successful, North Kildare and South Meath could reap the benefits of wind energy with the employment, local rates and rental payments which would accrue to the area.

Element Power has commenced pre-application consultation with An Bord Pleanála under the Strategic Infrastructure planning process and will be guided by the authority.

All cabling would still run underground for this project which has an overall capacity to generate 125MW. Grid connection has also been secured into the existing electricity grid with no new overhead lines required.

The benefits locally could also be very significant with Element Power proposing a number of funding streams for the local area under a Community Benefit Programme to include a Near Neighbour fund, grants for third-level education, local enterprise and sports clubs as well as the upgrading of local roads.

The Element Power team looks forward to further engagement with the local community over the following months to discuss details of the proposed project.

Job creation

Element Power estimates that 225 jobs would be created during the construction phase of its project. Once developed, the wind turbines would sustain 30 jobs directly and a further 30 jobs indirectly.

The turbines would measure 169 metres to blade tip and the company intends to develop up to 51 machines in total. Element Power will fully comply with all planning guidelines.

Personnel with the following skills will be required during pre-construction and during construction:

- Road builders, quarry contractors, digger drivers and lorry drivers to develop kilometres of road networks allowing access to the turbines and crane pads
- Surveyors, formwork and shuttering crew, concrete providers as well as steel suppliers and fixers will be part of the process of putting the foundations in place
- Haulage companies, crane drivers, site foremen and ground/support staff will be required to put transport and erect the turbines in position
- Civil and structural engineers, electrical and power engineers, geotechnical experts, transport and traffic engineers, wind assessment specialist, wind analysts, monitoring and mast erection crews
- An electrical network has to be installed underground to take the power produced by the turbines to the electrical substations requiring electrical contractors as well as a substantial amount of excavation work and machinery
- Logistics, travel, lodging and material supply generate significant additional local revenue over the construction period meaning a spin-off for local shops, hotels, garages, construction companies, haulage firms, plant-hire operators and many other service providers.

Rate payments

Rate payments to Kildare and Meath County Councils would amount to between €800,000 and €1,000,000 per annum.

Rates are typically used to fund public lighting; street cleaning; roads and footpath upkeep; fire services; parks and open spaces; environmental protection; water supply and sewerage; libraries; heritage, tourism, public amenities and the arts as well as community support and initiatives.

This funding would be paid annually to the local authorities over the 30 year lifespan of the project.

Community Benefit Programme

Element Power has consulted with various community groups, voluntary associations and other stakeholders in North Kildare/South Meath and is continuing that process. The company is presently drawing up a Community Benefit Programme which will see more than €3.5million spent on local projects and initiatives over the lifetime of the project.

These include community projects, grants for third level education and local enterprise supports.

In addition to this, the company is also committed to a 'Near Neighbour Fund' which would see grants of up to €5,000 payable to all homes located within one kilometre of a turbine. This can be used directly to pay electricity bills or to have upgrading works carried out such as improved insulation, smart-metering or rainwater harvesting.

Element Power believes that the funds should benefit the specific regions and communities where wind farms are located while the views of local communities in North Kildare/South Meath would be pivotal in establishing a model which works to best effect in each area. To this end, the company is actively encouraging all potentially suitable community groups to contact the company through our local representatives.

Environment:

Unlike some other major infra-structural projects such as public road-building, developing a wind farm requires landowner consent. The landowner has the right to determine his/her own land use and where interested, landowners obtained professional advice after which they signed the option agreements. Studies are then carried out to assess the suitability of a site before deciding if it is suitable for a turbine.

A wide range of criteria is used to select potentially suitable locations including:

- Compliance with Department of the Environment, Community and Local Government wind farm planning guidelines
- Review County Development Plans to identify areas which are deemed suitable, unsuitable or undesignated
- Exclude areas which have been designated under the EU Habitats and Birds Directive (Natura 2000 sites)
- Exclude any existing or proposed designated Natural Heritage Areas

- Apply minimum setback distances from roads, waterways, transmission lines and dwellings
- Landowner engagement and consent
- Engage with adjacent neighbours
- Analyse road and cable access
- Analyse environmental constraints and ground conditions
- Public consultation to inform final site selection.

An Environmental Impact Assessment (EIA) is a statutory process involving an in-depth study of the possible impact that a proposed project may have on the environment, considering the environmental, social and economic aspects.

To enable the EIA to be undertaken for this project, an EIS must be prepared. This involves carrying out a full suite of studies in the project areas to include the following study areas:

- Human environment
- Landscape and visual impact (including shadow flicker studies)
- Ecology (ornithology, bat surveys, fish surveys, flora and fauna)
- Cultural and archaeological heritage
- Air and climate
- Soils, geology and hydrology (geology, hydrology, hydrogeology and peat hazard studies)
- Traffic
- Telecommunications and aviation
- Noise
- Civil engineering and roads
- Health and safety
- Material assets (existing manmade features in the receiving environment such as infrastructure).

Element Power

At Element Power, we view project landowners as our partners. Strong relationships are built on mutual respect and trust, and we work hard to develop lasting relationships with our landowner partners, from initial contact through operations.

We communicate regularly with our landowners to keep them informed and answer questions they may have. We also understand the importance of good stewardship of the land and strive to respect owners' wishes as we develop, build and operate successful projects.

Visit a wind farm for yourself

Onshore, Irish wind represents one of the most cost-effective low-carbon energy resources in Europe. In terms of electricity generation, wind energy is one of the safest technologies around and has zero fuel risk compared to other higher risk operations such as nuclear power plants.

The Irish Wind Energy Association's website, **www.iwea.com** gives a list of all the wind farms which are operating in Ireland today amounting to more than 1,300 turbines. Time spent researching the subject for yourself by watching and listening to a wind turbine up close will help you make up your own mind regarding wind energy.

Wind turbines located on lower lands have much less of a visual impact on the landscape than those located on higher ground. The constant, low-medium wind speed sites identified in North Kildare/South Meath are preferable to strong, gusty sites and are perfectly suited to renewable energy generation. On very flat land at Lisheen in Tipperary, there is a 30 turbine wind farm with machines of 140 metres in height where the local community is very positively disposed to wind energy having had reservations at the outset. This development began in 2007.

Element Power has produced numerous videos where neighbours of wind turbines are interviewed, these can be viewed on Maighne Wind Farm's YouTube channel. The company invites the public to take time to visit a wind farm and speak to the thousands of people who live beside the 1,400 wind turbines already operating in Ireland. This will enable people to see and learn for themselves how wind energy and local communities can co-exist harmoniously.

People have nothing to fear from wind energy. In addition to the 1,400 onshore turbines operational in Ireland, there are more than 225,000 machines located in 79 countries across the globe.

Did you know

1. *Wind energy provides electricity without emitting greenhouse gases or air pollutants, and uses no fresh water to generate electricity – creating a healthier environment for people and wildlife. Onshore wind farms provide energy security, and contribute to the local and national economy. Using wind to generate electricity is saving Ireland €250million annually.*

2. *Wind energy is one of the fastest growing major sources of new electricity on the planet. Every developed country in the world is pursuing a pro-wind energy policy. In 2012 alone, global wind energy capacity grew by 19 per cent. Here in Ireland, we have one of the best wind resources in Europe.*

Appendix J2

Maighne EMF Study

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Client:	Review of:
Element Power **Unit C Building 4200,** **Cork Airport Business Park,** **Cork,** **Ireland**	**EMF study for cables associated with the Maighne Wind Farm**

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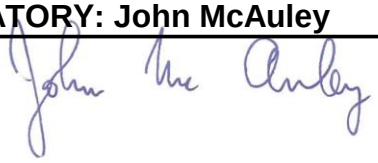


1. Human Health including Electromagnetic Fields (EMF)

Introduction

1.1 The study area for this assessment includes a distance of 50 metres either side of the line.

1.2 Extremely low frequency (ELF) electric and magnetic fields (EMF) surround all things that:

- Generate (e.g. generators);
- Transmit (e.g., Substations, power lines and wiring); or
- Use electricity (e.g., appliances and other devices).

1.3 Thus, exposure to electric and magnetic fields are common in modern life. These fields will be generated in the vicinity of the proposed cables.

1.4 International guidelines for ELF-EMF were set in 1998 by the International Commission on Non-Ionizing Radiation Protection (ICNIRP), a formal advisory agency to the WHO. The ICNIRP 1998 guidelines subsequently formed the basis of the European Union (EU) guidelines in 1999. The WHO monograph recommended that policy-makers establish guidelines for ELF-EMF exposure for both the general public and workers, and the best source of guidance is the ICNIRP guidelines. In 2010 ICNIRP issued updated guidelines, which reviewed the research since the 1998 report and replaced previous recommendations given by ICNIRP for this frequency range. The proposed cables comply with the ICNIRP guidelines.

1.5 Thus, according to international authoritative agencies, the cumulative body of evidence indicates that ELF-EMF from power lines does not have any adverse effects on health at the levels below ICNIRP guidelines. None of these scientific agencies considered it necessary or appropriate to limit the construction of electric facilities or recommend exposure standards below the ICNIRP limits.

1.6 We draw your attention to the following guidelines:

- International Commission on Non-Ionising Radiation Protection (ICNIRP) Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300GHz). Health Physics 74 (4): 494-522; 1998
- EU Council Recommendation on the limitation of exposure of the general public to electromagnetic fields (0Hz to 300GHz) 1999/519/EC
- ICNIRP Guidelines for limiting exposure to time varying electric and magnetic fields (1Hz–100kHz) Health Physics 99(6):818-836; 2010
- Directive of the European Parliament and of the Council on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields) 2013/35/EU
- Electromagnetic fields and public health - Exposure to extremely low frequency fields - Fact sheet N°322, June 2007.

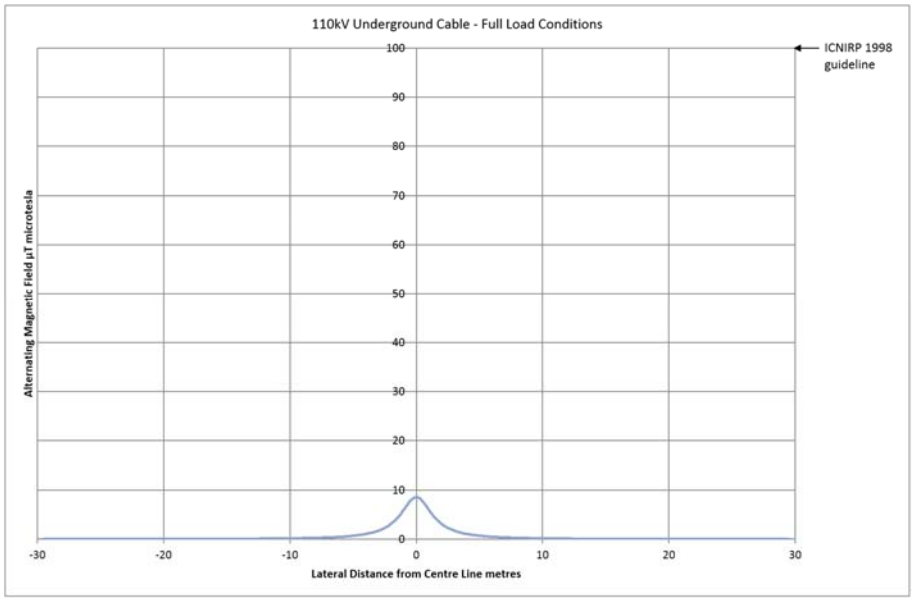
1.7 Magnetic flux densities for AC magnetic fields are reported using units of microtesla (μT) and electric fields in kilovolts per metre (kV/m).

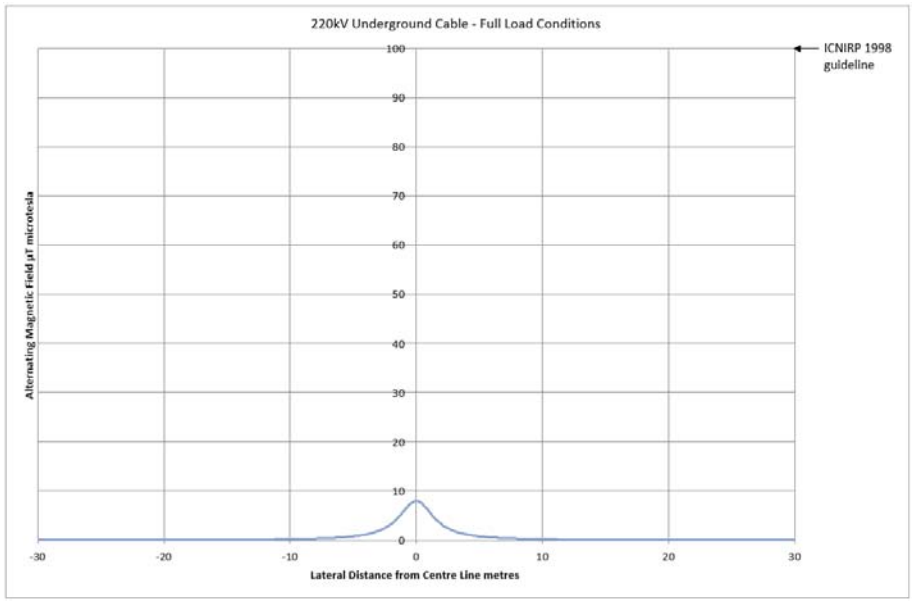
1.8 The ICNIRP guidelines formed the basis of the EU guidelines for human exposure to EMF (EU, 1999). In November 2010, the ICNIRP updated their guidance in this frequency range. The 2010 document introduced new Reference Levels (i.e. guidelines) based on the latest exposure dosimetry techniques.

Table Health Guidelines

Exposure Characteristics	Electric Field Strength kV/m	Magnetic Flux Density, µT
ICNIRP		
-1998 General Public Reference Level	**5**	**100**
-2010 General Public Reference Level	**5**	**200**

1.9 The magnetic fields from underground lines decrease quickly with distance. For underground powerlines the fields decrease with the square of distance. The electric field emissions from underground cables are negligible as the ground absorbs the field.





1.10 As the proposed cables do not pass below housing, the exposure levels are extremely low. Most homes have average magnetic field levels in the range 0.2 µT to above 0.4 µT,

attributable to low voltage sources (i.e. wiring, appliances, and distribution circuits) (Mastanyi et al, 2007). For a 110 kV cable the magnetic field levels will be less than 0.4 μT at distances greater than 6.5m on full load and at a distance of 3.7m on typical loads. For a 220 kV cable the magnetic field levels will be less than 0.4 μT at distances greater than 7m on full load and at a distance of 4m on typical loads.

1.11 In dwellings and other properties which have electricity the levels will not exceed the ICNIRP guidelines by a significant margin.

1.12 Based on the predictions of the magnetic flux density values from the proposed development there will be no impact on residential properties at any distance from the proposed development as the ICNIRP guidelines are not exceeded at all relevant distances including directly above the cables.

Overall Conclusions

1.13 The current scientific consensus, as expressed most recently by the WHO, is that the research does not suggest that ELF-EMF causes any health effects at the levels typically encountered in our environments. Authoritative scientific organisations have not recommended exposure limits at these levels or steps to reduce our exposures.

The electric and magnetic fields expected to be associated with the operation of the proposed cables fully comply with the ICNIRP and EU guidelines on exposure of the general public to ELF-EMF.

1.14 References

International Commission on Non-Ionising Radiation Protection (ICNIRP), “Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300GHz)” 1998 Available from: <www.icnirp.de>

European Commission (EC), “EMF Recommendation 1999/519/EC”, Available from: <http://ec.europa.eu/enterprise/sectors/electrical/files/lv/rec519_en.pdf >

ICNIRP Guidelines for limiting exposure to time varying electric and magnetic fields (1Hz–100kHz), :2010 Available from: <www.icnirp.de>

Directive of the European Parliament and of the Council on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields) 2013/35/EU

Electromagnetic fields and public health - Exposure to extremely low frequency fields - Fact sheet N°322, June 2007.

Appendix J3

Studies on Impacts on Horses

Protecting horses from excessive music noise – a case study

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ABSTRACT

When Flemington Racecourse, the site of Australia's most famous horse race – the Melbourne Cup – became the proposed venue for Australia's largest touring music festival – the Big Day Out – there was concern expressed by the owners of the thoroughbred race horses stabled at the racecourse that the horses may react badly to the potentially excessive music noise, and Marshall Day Acoustics was commissioned to assess the likely impact on the horses.

The constraints of consulting allowed only a brief review of current knowledge regarding the effect of noise on horses, which provided useful background information, but, predictably, little guidance on criteria. Nevertheless, a recommendation was made that, if possible, noise levels not exceed 65dBA LAeq.

The noise exposure (LAeq,15 minutes) of horses during major race events was measured at 58-62 dBA in the stables (rising to 66-68 dBA during helicopter fly-overs), and 65-70 dBA in the stalls. The Clerk of the Course's horse was exposed to 76 dBA LAeq,6h at Randwick Racecourse during the New Easter Carnival and 85 dBA LAeq,6h at Flemington during the Melbourne Cup, although this second figure is difficult to reconcile with the measured noise levels at the various locations.

During the Big Day Out, the noise exposure (LAeq,15 minutes) of horses in the stables was measured at 54-70 dBA. The horses generally showed little response to the music noise except when the noise was associated with visible stimuli, or when the noise was of an alarming character such as short bursts of high-pitched singing.

INTRODUCTION

Flemington Racecourse, in Melbourne, Australia, is a major horse racing venue. It is best known as the venue for the Melbourne Cup, a race for which a public holiday is declared in Melbourne and which is famously known to 'stop the nation'. Because of its large size (1.3 square kilometres) and its relative isolation from noise-sensitive land uses, the racecourse is also sometimes used as a venue for outdoor concerts.

The Big Day Out is a one-day touring music festival held annually in various cities in Australia and New Zealand. The 2008 Big Day Out event for Melbourne was held at Flemington Racecourse, and featured 72 bands playing at 8 stages, including 2 main stages adjacent to each other, with the major acts alternating between the two stages. The main stages were the loudest, and were located approximately 200m from the horse stables, facing away from the stables. The main stages were approximately 300m from the nearest residence.

When it was proposed to hold the Big Day Out at Flemington Racecourse, the owners of the thoroughbred race horses stabled at Flemington expressed some concern that the music noise levels in the stables would be excessive and that the horses may react badly.

Marshall Day Acoustics (MDA) was commissioned by the Victoria Racing Club, the trustees of Flemington Racecourse, to review current knowledge regarding the effect of noise on horses, to measure the noise exposure of horses during a race event, to

provide an opinion on the likely effect of the noise on the horses, and to measure music noise levels in the stables during the 2008 Big Day Out.

This paper describes the investigations and findings of the study undertaken by MDA, but also looks at some of the difficulties encountered when the results of a somewhat obscure field of study are to be applied to the management of noise impacts on animals.

CURRENT KNOWLEDGE

The budget for this project allowed only 8 hours for a review of current knowledge concerning the effects of noise on horses. The actual time spent was 12 hours.

Understandably, the review was broad-brush, consisting of:

- A search of the MDA library (including ICBEN and other conference proceedings)
- Posting of queries on the MDA discussion forum (which brought out some previous MDA projects where effects of noise on animals was considered, and which led to discussions with the flora and fauna experts involved in those previous studies)
- Google searches, including Google Scholar
- Discussions with horse handlers and the equine veterinarians at the racecourses
- Correspondence with Professor Rickye Heffner from the University of Toledo (Ohio, USA) Department of Psychology.

The findings were similarly broad brush, consisting mostly of a discussion of issues such as chronic versus acute exposure, energy conservation in wild animals, and habituation. There was some information gathered that turned out to be of practical benefit, or at least relevant to the manner in which the noise exposure of the horses was ultimately managed, namely:

- That horses may be startled by noise is common knowledge. One of the basic guides to horse care and management published by the Equine Centre in Werribee, Victoria, entitled *Horse Health Care – Management: Safety around Horses*, states that when approaching a horse, “you should be aware that horses are most easily scared by sudden movements or loud noises, particularly outside of the animal's field of binocular vision. Quick movements or loud noises in these areas will trigger fear reactions such as spinning or bolting…”
- Discussions with flora and fauna experts have indicated that many animals are more likely to be concerned (ie, interrupt feeding or resting activity) about noise that is associated with visual stimuli.
- It appears that noise can be more unsettling when associated with unfamiliar situations. One comment from Rickye Heffner was that “horses (and other species) can be disturbed by anything new in their environment – after all, if things are going well and there is a change, that could signal a change for the worse; change is usually a bad thing until proven otherwise.”
- The United States National Park Service's *2004 Sheep Report* provides a comprehensive review of the likely effects of aircraft fly-over noise on animals, with particular emphasis on wildlife. The report differentiates between chronic exposure, for which the major concerns are related to the animals’ energy conservation, and acute exposure, such as startle and panic behavior. The report states

that "acute responses… occur in most wildlife species evaluated at noise levels greater than 95 dBA."

- One other factor to consider is habituation. If the noise is familiar and not associated with danger, the animals' response will become moderated. This is most evident in the (often ineffectual) use of scare guns to remove pest species such as cockatoos from crops or seagulls from airports.
- A review of research into the relative hearing ability of a wide variety of animals (in *Comparative Psychology: A Handbook* by Greenberg and Haraway) found that the hearing threshold of horses was 5-15 dB higher than humans – that is, horses are somewhat deaf compared to us.
- Discussions with the handlers at Randwick Racecourse in Sydney and Flemington and the equine veterinarian at Flemington indicated a widely-held opinion that thoroughbred horses are likely to be sensitive to noise but without any indication of how much noise would be acceptable. However, most felt that loud bangs, such as that associated with fireworks, would not be acceptable.
- The connection between temperament and noise-sensitivity has been studied in cattle, with one study showing that cattle that were more flighty (faster gait, jerky movements, more vigilant) were more noise-sensitive.

These findings provided useful background information, but were of limited value in setting criteria for the exposure of horses to music noise. As with other reviews of the effects of noise on fauna undertaken by MDA, the information was lacking one or more of the aspects of the problem we were facing: the noise exposure was not quantified (eg, "high levels" or "loud bangs") or was of the wrong type (eg, aircraft noise rather than music noise); the species was wrong (eg, orange-bellied parrots); or the information was not particularly well-supported, amounting to little more than expert speculation in some cases.

NOISE EXPOSURE AT RACE EVENTS

Overview

During race events, the horses are kept in stables until it is close to the time for the horse to race. The horses are then led to the stalls, where they are saddled up. A few minutes before the race, the horses are led to the pre-mounting yard to be lightly exercised, then to the mounting yard, and then onto the race track.

Noise levels were measured using several noise indices, including L_{Amax}, L_{Aeq}, L_{Amin} and various L_{An}. Results were reported almost exclusively in L_{Aeq}. Although the results of the review of current knowledge indicated that startling noises may be of most concern – indicating that L_{Amax}, or at least some form of L_{max} – would be appropriate, it was considered that L_{Amax} would be 'poorly behaved' – that is, it would not always be clear during any particular sample period whether there were repeated noisy events or just one or two noisy events. The L_{Aeq}, on the other hand, would show some increase in level if there were repeated events and would give an indication of noise dose. Also, it was considered that reporting of the results would be more easily understood if only one noise metric was used.

New Easter Carnival – Randwick Racecourse

The first set of noise measurements during a race event was conducted during the 2006 Easter Carnival at Randwick Racecourse in Sydney on 15 April 2006. Noise

levels were not measured in the stables, but there were noise monitors at several fixed locations about the venue, noise dosimeters attached to two of the Clerk of Course horses and on the consultant undertaking the measurements, and spot measurements at various locations during the event. Post-event analysis showed that the most useful information was obtained by the noise monitor in the stalls and the dosimeter attached to Yotis, one of the Clerk of Course horses.

Figure 1 shows the measured noise levels in the stalls. Noise levels ($L_{Aeq,15\ minutes}$) were in the range 64-70 dBA.

Figure 1: Measured noise levels in the stalls

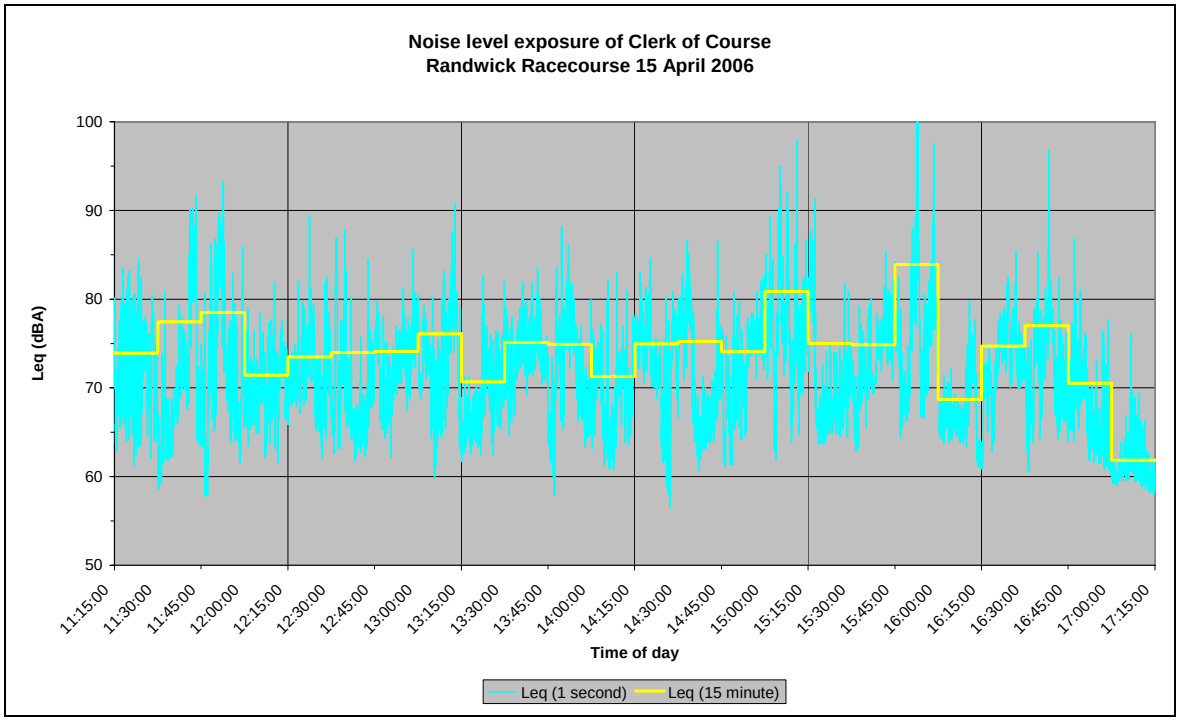

Figure 2: Noise exposure of Yotis, a Clerk of the Course horse

Figure 2 shows the noise exposure of Yotis, the Clerk of Course's horse, moving between stalls, the pre-mounting yard, the mounting yard and the race track for the whole event. Noise levels ($L_{Aeq,15\ minutes}$) were in the range 69-84 dBA. The $L_{Aeq,6h}$ noise level for the whole of the measurement period was 76 dBA.

Melbourne Cup Carnival – Flemington Racecourse

Noise measurements at Flemington during the 2007 Melbourne Cup Carnival consisted of:

- Noise monitors situated near stables and on the roof of the stalls. These were in place during 3-12 November inclusive, taking in all of Derby Day, Melbourne Cup Day, Oaks Day and Stakes Day, as well as several non-race days
- A noise dosimeter attached to Subzero, the Clerk of the Course's horse, on Melbourne Cup Day
- Spot measurements at various locations on Melbourne Cup Day.

Figure 3 shows the measured noise levels at various locations on Melbourne Cup Day. Note that the race at 15:00 is the Melbourne Cup. This is the race that 'stops the nation'.

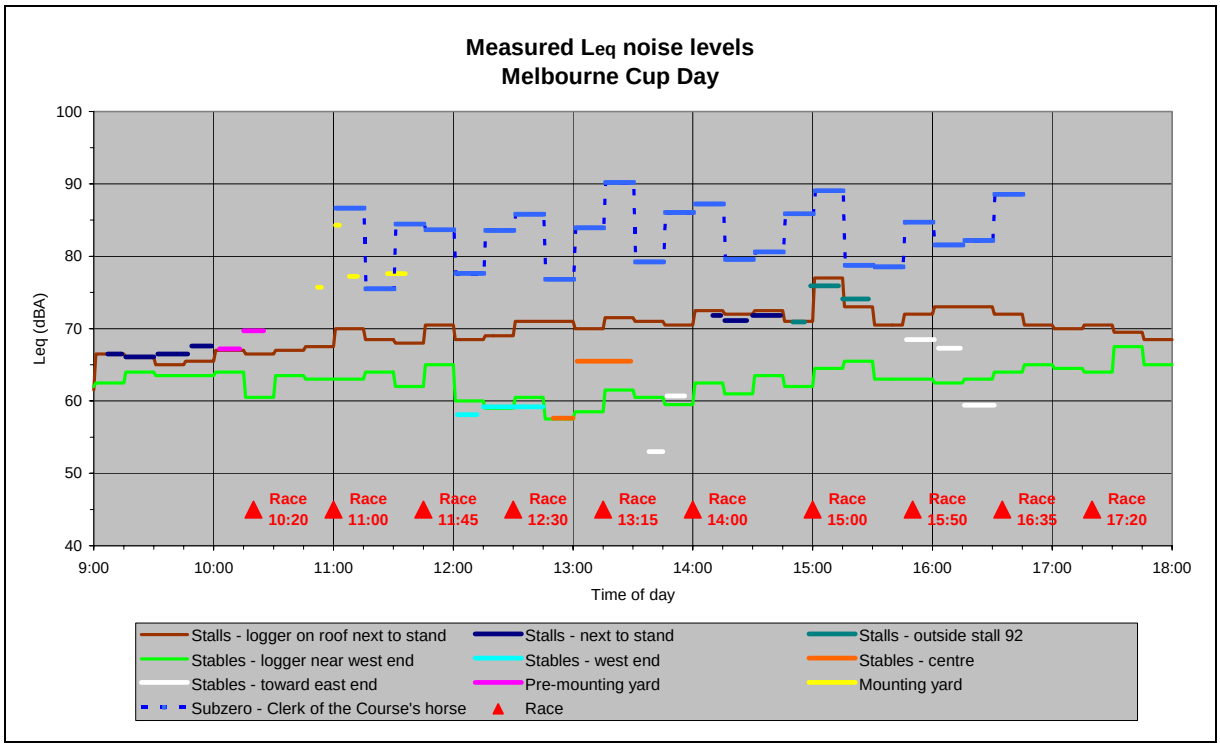

Figure 3: Measured noise levels – Melbourne Cup Day

Stables

Results of the noise monitoring near the stables showed that on non-race days, the $L_{Aeq,15\ minutes}$ noise levels were in the range 50-65 dBA during the day. On race days, noise levels were about 51-68 dBA.

The handheld measurements on Melbourne Cup Day showed similar noise levels to those at the monitoring position, except during helicopter arrivals and departures. Noise from helicopter arrivals and departures were measured at:

- 66 dBA at the centre of the stables, about 8-14 dBA higher than at the monitoring position (which was at the west end of the stables, closer to the grandstand but further from the helipad) at the same time
- 67-68 dBA at the east end of the stables, about 10 dBA higher than at the monitoring location at the same time.

Table 1 provides a summary of the measured L_{Aeq} noise levels near the stables.

Table 1: Summary of measured noise levels – stables

	L_{Aeq} noise levels, dBA
Noise monitoring position	
Non-race days	50-65
Race days	51-68
Centre and east end	
During helicopter movements (Melbourne Cup Day)	66-68

Horses participating in races

Results of the noise monitoring at the stalls showed that L_{Aeq} noise levels during the day were generally in the range 55-70 dBA on non-race days. On race days the noise levels were about 9 dBA higher than non-race days.

Melbourne Cup Day

Handheld measurements were undertaken at several locations around the stalls. Noise levels were similar to those at the noise monitor.

In the mounting yard, L_{Aeq} noise levels were 76-78 dBA while there were horses in the yard. During Race 2, when there were no horses in the yard, the L_{Aeq} noise level was 84 dBA. The mounting yard is located in front of the grandstand and is exposed to high levels of noise from the crowd and the public address system.

A dosimeter was attached to the collar of Subzero, a Clerk of the Course horse, from 11:00am until 4:45pm. He was exposed to L_{Aeq} noise levels of 75-90 dBA. The $L_{Aeq,6h}$ noise level for the whole of the measurement period was 85 dBA.

Table 2 provides a summary of the measured noise levels.

Table 2: Summary of measured noise levels. Horses involved in race events – Melbourne Cup Day

Location	**L_{Aeq} noise levels, dBA**
Stalls	55-70
Mounting Yard	76-78
Clerk of the Course	75-90

Observations at the time of the measurements indicated that the noisiest area was the mounting yard, and that the major part of Subzero's noise dose would be accumulated there. However, the $L_{Aeq,15\ minutes}$ at Subzero's collar during Race 2 and during the noisy period prior to Race 3 was higher than the L_{Aeq} measured in the mounting yard. It appears that either Subzero was exposed to noise from other sources not apparent at the time, or that the dosimeter results are not reliable.

Comparison with Randwick Racecourse

Table 3 compares the measured noise levels at Randwick and at Flemington.

Table 3: Comparison of measured noise levels

Location	L_{Aeq} noise levels, dBA	
	Randwick	Flemington
Stalls	64-70	55-70
Clerk of the Course	69-84	75-90

This provides further evidence that the Clerk of the Course noise measurements at Flemington may be in error. However, the result is reported here as it may be accurate; there were no problems with instrument calibration and mounting of the microphone.

RECOMMENDATIONS

In our report to the client, it was recommended that the following matters be considered:

- That the circumstances of the exposure to concert noise would be somewhat unfamiliar
- That the people who worked with the horses felt that they were likely to be noise-sensitive, and that loud bangs should be avoided
- That the noise would not be associated with any danger and if there is any initial startle responses, habituation may occur quickly
- That the horses at the two race events investigated were exposed to "average" noise levels of 65-70 dBA in the stalls and 70-90 dBA when moving in and out of the stalls.

Clearly, definite recommendations regarding criteria for the exposure of thoroughbred horses could not be provided. However, it was felt that some kind of threshold level would be useful, prompting the following statement in our report to the Victoria Racing Club:

… it appears that use of Flemington Racecourse as a concert venue would be acceptable provided that the L_{Aeq} noise level in the stables did not exceed 65 dBA.

This was combined with recommendations that:

- Fireworks or other activities causing loud bangs should not be permitted
- Noise levels should be monitored in the stables to confirm that the L_{Aeq} noise levels do not generally exceed 65 dBA
- At least one horse expert should be present at the first concert to observe the horses' behavior for signs of stress.

NOISE EXPOSURE AT THE BIG DAY OUT

Noise levels

Noise levels at the stables were monitored and manually measured during the 2008 Big Day Out at Flemington Racecourse. Personnel undertaking the measurements were to contact the event's management to report any times when the noise threshold of 65 dBA was exceeded. Measured $L_{Aeq,15\ minutes}$ noise levels are shown in Figure 4. The measurement locations are shown in Figure 5.

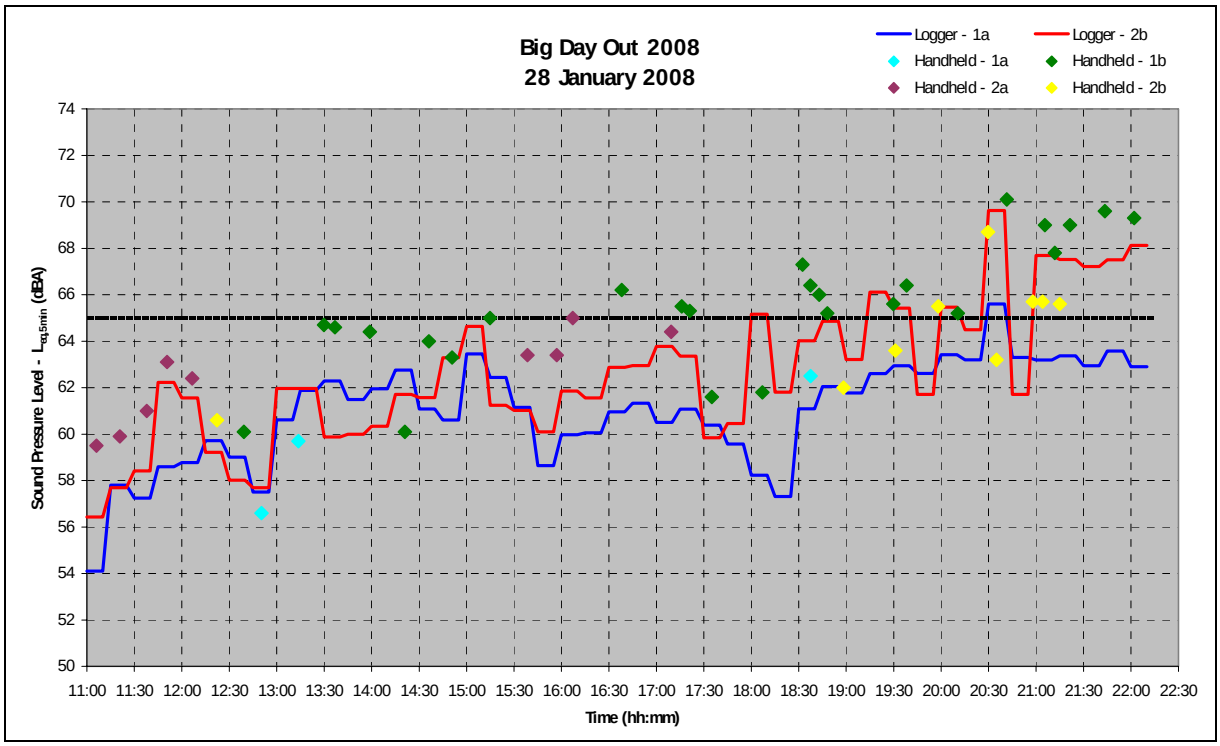

Figure 4: Noise levels in stables during the Big Day Out

Figure 5: Measurement locations

As shown in Figure 4, there were times when the 65 dBA threshold was exceeded. These exceedances were reported to management, who would then inquire as to the level of agitation being displayed by the horses. The horses' response is discussed below.

During the final hour or so, management were not able to respond to the reported exceedences, as they were having to deal with people climbing onto the roof of the bar – a temporary structure – located closest to the main stage, and evacuating the staff prior to the roof collapsing.

Horse behavior

Discussions with the equine veterinarian and MDA staff indicated that the horses were aware of the music noise, but generally showed only low levels of agitation. The exceptions were:

- Two horses were stabled where they could see two of the rides – a ferris wheel and a giant slingshot ride. These horses had elevated heart rates and were not eating. The horses became noticeably calmer and began to eat when shade-cloth was used to enclose the stables so that the visual stimulation was reduced. However, it was the vet's opinion that it was not just the visual stimulation that was the problem. The horses' state appeared to be due to a combination of the noise and the visual stimulation
- Some horses sometimes became noticeably agitated when the light-weight corrugated steel sheeting on the enclosure walls vibrated in response to excitation by low-frequency airborne noise
- During the second last act (approximately 20:00-21:45), several of the horses reacted to short bursts of high-pitched singing (squeals and screeches), even though these did not overly affect the $L_{Aeq,15\ minutes}$.

The equine veterinarian's overall opinion was that the impacts on the horses were acceptable, although there were concerns that the two horses that hardly ate may take a day or more to return to race-readiness. A recommendation has been made that, at next year's Big Day Out, horse managers be given the option of moving horses to stables at the rear of the stabling complex where there will be no visual stimulation associated with the music noise.

CONCLUSIONS

The findings of a brief literature review provided useful background, but little guidance on setting criteria. This is understandable given the likely significant effect of modifiers – such as visual stimulation – on the animals' response. The most useful recommendations arising out of the review of current knowledge – that startling noises and associated visual stimulation should be avoided – were consistent with the observed response of the horses to music noise during the Big Day Out. The equine veterinarian's recommendation to move horses to stables where there would be less visual stimulation appears to be worth implementing.

Although the recommended 65 dBA L_{Aeq} criterion was somewhat arbitrary, it appears to have had value as a threshold for initiating action. However, the most effective action taken – to erect the shade-cloth to reduce visual stimulation – was done more as a response to the animals' behavior than the measured noise level and would probably have been done even if the threshold was not available as a trigger for action.

MEMO

MARSHALL DAY Acoustics

Project:	Noise effects on animals	**Document No.:**	Mm 00X		
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SUMMARY OF RESEARCH OF NOISE EFFECTS ON ANIMALS

A1 Introduction

The Effect of Noise on Wildlife: A Literature Review by A.L. Radle (1998) concludes "most researchers agree that noise can affect an animal's physiology and behaviour". However, a recent study by Warren et al (2006) points out that there is a "surprising dearth of research on the behavioural responses of animals to altered acoustic environments". One aspect of noise effects on animals which has been documented reasonably well is that noise has the greatest effect on wildlife which rely heavily on auditory signals for survival.

A2 Livestock

Cattle

The Memphis State University (1971) found that noise has little impact on livestock, and that there are no long term effects on either milk or meat production. The US Environmental Protection Agency reported in the same year that large livestock generally adapt well to consistent noise. Later research by Beyer (1983) supported the Memphis State University studies finding that during low-altitude flights over livestock, milk production and pregnancies of cows and heifers were not affected. Manci et al (1988) reports on studies which show that livestock are not affected by "normal" levels of noise—below about 80-90 dBA.

Our experience, and the report by Manci et al (1988), suggests that the only possible causes of disturbance for animals will be impulsive type noises such as blasting and pile driving. To ensure that any such effects of these activities are minimised, we recommend that noise levels are reduced to the criteria suggested for human exposure.

Horses

A case study by Huybregts from Marshall Day Acoustics observes that horses in stables exposed to $L_{Aeq,15min}$ of 54-70 dB generally show little response to music noise unless the noise is particularly impulsive. A noise criterion of 65 dB L_{Aeq} is recommended by Huybregts (2008). Le Blanc et al (1991) found that birth success of pregnant mares was not affected by F-14 jet aircraft noise. While the 'fright-flight' reaction was initially observed, the mares did adapt to the noise.

Race horses are known for being high-strung. However, Marshall Day Acoustics have observed horses grazing in paddocks directly under the main approach path of the Christchurch International Airport where noise levels are in excess of 90 dB (L_{Amax}) during an aircraft flyover. Although these horses are arguably "used to" the noise, there was generally little recognition by them of an aircraft passing, let alone any sign of disturbance. This tends to support the conclusions by Le Blanc et al (1991).

From the above information, we recommend a noise level criteria suggested for human exposure.

Poultry

A study by the U.S. Air Force 1994a suggested that the birds adapt fairly quickly to noise. Egg productivity was not badly affected by infrequent noise bursts, even at exposure levels as high as 120 to 130 dBA.

Pigs

Studies using simulated aircraft noise at levels of 100 dB to 135 dB found only minor effects on food intake, weight gain, and reproduction rates. Also, no injuries of inner ear changes were observed (Manci et al 1988; Gladwin et al 1988).

A3 Birds

In some respects, birds show that they are more adaptable to noise than humans. As an example, most bird scaring guns need to operate at random time intervals to avoid having birds perching on them between blasts. This is supported by a study by Pater et al (1999) on the response of woodpeckers to military training noise events such as artillery, small arms, helicopters and manoeuvre noise. The woodpeckers were observed to successfully adjust to these events.

The studies reported by Manci et al (1988) show that noise at levels around the human exposure criteria is extremely unlikely to cause startle or similar effects in birds, with blasting and pile driving the only likely causes of disturbance.

In 1995 and 1997, Marshall Day Associates studied the impact of noise on birds for the Avalon Air Shows at Avalon Airport near Geelong, Victoria. These studies found that the impact of noise on birds consisted primarily with the startle response following the initial transient signal, but a habituation to noise developed after continuous exposure to steady levels of noise.

The Avalon study indicated that for fixed wing aircraft and helicopters the chance of a response resulting in bird flight is rapidly increased when the maximum noise level exceeds 80 dBA. There was a 100% chance of flight when Lmax exceeded 90 dBA. Below 80 dBA there is a reduced chance of flight and with some degree of disturbance, such as looking or a break in feeding pattern, evident with noise levels as low as 60 dBA.

Dooling and Popper (2007) note that physical damage to birds' ears occur for single blasts of 140 dBA and 125 dBA for multiple blasts (both assumed to be L_{AFmax}, sound level descriptor not provided in study). The study also notes that birds' ears can suffer physical damage at continuous (>72 hours) exposure to noise above 110 dBA.

A4 Marine Wildlife

Fish

Fish do startle in response to low-flying aircraft noise. However they have been found to adapt to the sound of over flights (Gladwin, et al. 1988). EPCB guidelines state the threshold for behavioural response in fish is 120 dB ref 1 µPa. Other research has recommended a sound pressure level limit of 150 dB ref 1 µPa to ensure 'no harm' to fish (Hastings 1990).

A5 Reptiles

Researchers have summarised a few studies of reptile response to noise (Duflour 1980 and Manci, et al. 1988) under laboratory conditions. Following exposure to 95 dB for several minutes, these reptiles experienced at least temporary threshold shifts or hearing loss.

A6 Summary

Once animals become habituated to noise, especially when it is steady and associated with clearly non-threatening activity, they suffer very little adverse response.

It is therefore considered that noise levels up to 60 dBA do not result in negative or adverse response to impacted animals or livestock. Noise levels up to 80 dBA generate startle responses in birds and animals, and noise levels in excess of 90 dBA may cause negative impact. The response of birds, animals and livestock to noise will also depend on the character and duration of the sound and observations suggest that steady broad band noise will create less negative response than transient, intermittent, tonal sounds.

Loud, impulsive sounds such as blasting can damage birds' ears if exposed to multiple events above 125 dBA.

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