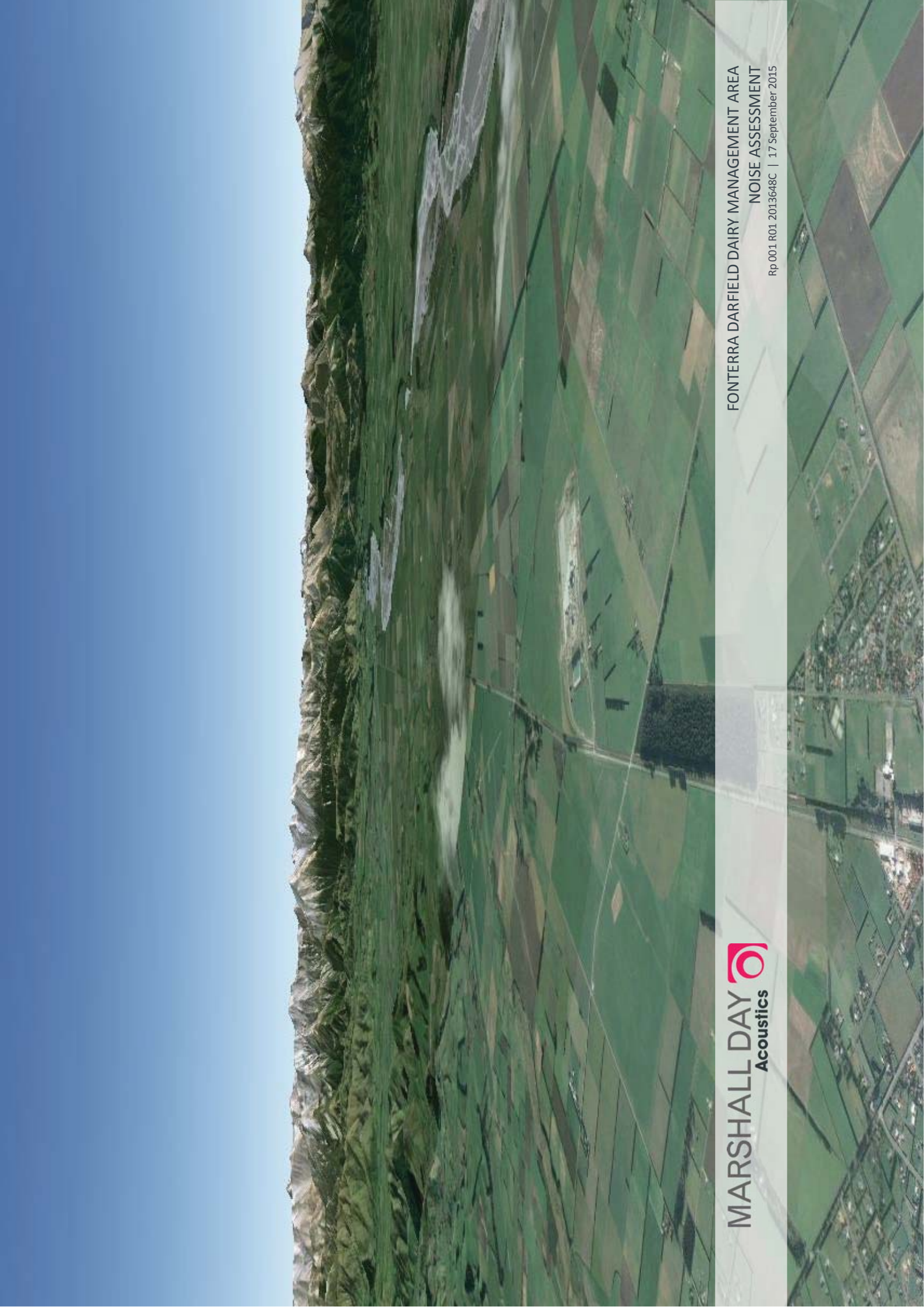


APPENDIX 6:

Acoustic Assessment Marshall Day Acoustics



Project: FONTERRA DARFIELD DAIRY MANAGEMENT AREA

Prepared for: Fonterra Co-operative Group Ltd
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Report No.: Rp 001 R01 2013648C

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EXECUTIVE SUMMARY

Fonterra seek the establishment of a Dairy Processing Management Area (DPMA) at their Darfield factory. Marshall Day Acoustics (MDA) has been engaged to perform a noise assessment and to assist in the development of an appropriate Noise Control Boundary (NCB) for the site.

Currently the factory consists of two whole milk powder (WMP) dryers, two boilers, a fleet of 37 milk tankers and the associated plant equipment and facilities that go with this. The site currently produces approximately 46 tonnes of WMP per hour, with an annual production of 220,000 tonnes. Coal, packaging and finished product are largely transported by rail, with a small amount being handled by heavy goods vehicles. Under the expansion scenario all activity on-site would approximately double.

We propose the following noise limits at the NCB:

- Night-time (2000 – 0700) 45 dB $L_{Aeq}(15\text{ min})$ and 70 dB L_{AFmax}
- Daytime (0700 – 2000) 55 dB $L_{Aeq}(15\text{ min})$ and 85 dB L_{AFmax}

These limits would apply to all activities within the DPMA, except for construction noise and rail movements.

Construction and demolition would be subject to New Zealand Standard NZS 6803: 1999 “Acoustics - Construction Noise”.

Noise from rail movements has been assessed and any adverse noise effects that would arise at nearby dwellings are predicted to be less than minor in nature. Any adverse noise effect that may arise would be adequately controlled by restricting the number of rail events, rather than through the application of a noise limit. For the purpose of this application we suggest that an appropriate restriction would be no more than two night-time events and an unlimited number of daytime rail events.

Based on the proposal we conclude that the proposed NCB would result in certainty for all parties; and would also ensure that no dwellings received noise levels in excess of those already foreseen and allowed under the existing consent while a number would be assured of lower noise levels.

Overall, any adverse noise effects arising from this application would be less than minor.

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1.0 INTRODUCTION

Fonterra seek the establishment of a Dairy Processing Management Area (DPMA) at their Darfield factory. Marshall Day Acoustics (MDA) has been engaged to perform a noise assessment based on an assumed future expansion scenario and to assist in the development of an appropriate Noise Control Boundary (NCB) for the site.

This report addresses:

- The existing noise compliance framework;
- The major noise sources;
- The assumed expansion scenario; and
- The proposed noise compliance framework.

A glossary of acoustic terminology is provided in Appendix A.

2.0 SITE, ACTIVITY & CONTEXT

The Fonterra Dairy Factory near Darfield is described in greater detail by others. The relevant aspects of the site and surroundings when considering noise are the scale of the activity and its location relative to surrounding noise sensitive receivers.

Currently the site consists of two whole milk powder (WMP) dryers, two boilers, a fleet of 37 milk tankers and the associated plant equipment and facilities that go with this. We understand that the site currently employs around 230 staff and produces approximately 46 tonnes of WMP per hour, with an annual production of 220,000 tonnes of milk powder. Coal, packaging and finished product are largely transported by rail, with a small amount being handled by heavy goods vehicles.

MDA was involved in the design, consenting and commissioning of both dryer 1 (16 tonne/hr) and dryer 2 (30 tonne/hr). While having input into the design and location of the site a significant consideration for MDA was to allow for at least four dryers (or equivalent sound power level plants) to operate at the site without breaching the District Plan noise limits. As the operation of the bulk of the plant produces a fixed noise level regardless of the time of day, it is the night-time noise level that ultimately controls the acoustical design.

The production site lies within extensive landholdings owned or under contract to Fonterra (totalling approximately 680 Ha), all of which carry Rural Zoning in the Selwyn District. At the time of the dryer 1 gaining consent the nearest non-Fonterra dwelling was 'the Oaks B&B'. This property was subsequently purchased by Fonterra prior to dryer 2 being consented. Despite owning the Oaks, Fonterra has opted to keep compliance at the Oaks as a design goal, thus ensuring that noise effects at other non-Fonterra properties would be consistent with previous statements.

A map showing the Fonterra-owned properties is provided in Appendix B.

3.0 APPLICABLE NOISE LIMITS

3.1 District Plan

The District Plan noise limits applying generally in the area are set out in Rule 9.16.1 Table C9.3 of the Selwyn District Plan dated 29 May 2009.

The District Plan provides that any activity shall be conducted so as to comply with the following noise limits assessed at the notional boundary of any dwelling, rest home, hospital, or classroom in any educational facility except where that dwelling, rest home, hospital or classroom is located within a Living zone.

- Daytime (7:30am – 8:00pm) 60 dB $L_{A,10}$ & 85 dB $L_{A,FMAX}$
- Night-time (8:01pm – 7:29am) 45 dB $L_{A,10}$ & 70 dB $L_{A,FMAX}$

3.2 Consent Conditions

The site as it currently exists is subject to a number of noise related consent conditions as detailed in the commissioners' decision dated 31 January 2012 (RC1151199).

Condition 42 controls noise emissions from the plant. In summary this condition requires that all activities on-site (other than construction) shall not exceed the following limits at the notional boundary of any non-Fonterra owned dwelling:

- Daytime (7:30am – 8:00pm) 60 dB $L_{Aeq,15min}$ & 85 dB $L_{A,FMAX}$
- Night-time (8:00pm – 7:30am) 45 dB $L_{Aeq,15min}$ & 70 dB $L_{A,FMAX}$

Condition 43 b (iv) specifies that noise measurements are undertaken using NZS 6801:2008 and noise assessment is undertaken according to NZS 6802:2008.

The Resource Consent noise limits ensure that an acceptable level of amenity is maintained at nearby dwellings consistent with the nature of the surroundings, while still enabling Fonterra the ability to not only operate the existing dairy factory, but also to expand the site in the future as had been indicated during the consent hearings.

3.3 Demonstration of Compliance

As a matter of record MDA has performed compliance monitoring at the site as required under condition 43. The most recent assessment undertaken is summarised in our report (Rp 006 2014521C) dated 10 November 2014. The key noise assessment locations are shown in Figure 1.

Figure 1: Key noise assessment locations



The calculated noise levels at the assessment positions (derived from measurement locations close to the site as detailed in our November 2014 report) are provided in Table 1. Table 1 also summarises the noise level predicted at these locations during the consenting of dryer 2.

Table 1: Noise levels at nearby dwellings

No	Dwelling	Calculated Noise Level at Notional Boundary (dB L _{Aeq,15 minutes})	
		At Dryer 2 Consent	November 2014
1	Buttle	28	27
6	Francis – House	25	31
7	Francis – Cottage	25	31
8	The Oaks ¹	33	38
11	Seaward	24	29
12	Haselden	29	28
14	Nieuwenhuize	29	30

1. Property owned by Fonterra.

The noise levels at the Buttle, Nieuwenhuize and Haselden properties are within 1dB of the noise levels that were predicted during the dryer 2 consent. Noise levels at the Oaks and the Seaward and Francis properties are around 5dB higher than was predicted during the dryer 2 consent. This is due to the unidentified noise source in the vicinity of dryer/Dryer 1. This noise source was not present in previous two boundary noise surveys or our multiple detailed site commissioning visits. Based on all of our observations we have a high level of confidence in the modelled noise contours for the site and regard that single event as an aberration.

4.0 EXPANSION SCENARIO & RESULTING NOISE LEVELS

Fonterra seek to establish a Dairy Processing Management Area (DPMA) around the Darfield factory. The DPMA will permit modification and/or expansion of the site as needed from time to time without the requirement for a resource consent for each project. In order to control a range of effects that may arise from any future expansion, an Outline Development Plan (ODP) has been prepared for the site.

The assumed expansion scenario we have used as a basis for our consideration is an approximate doubling of the capacity of the plant. This would entail:

- The construction of two additional WMP dryers of the same design and capacity as dryer 2;
- Two additional boilers of the same design and capacity as boiler 2;
- A doubling of all ancillary mechanical services;
- A doubling of dry store space; and
- A doubling of the number of tanker and rail movements.

We have selected WMP dryers as the likely expansion scenario partly as a result of advice from Fonterra that this would be a likely option, and partially because it has been MDA’s experience that the noise footprint created by this type of plant is also likely to encompass any other type of dairy processing plant that might be considered.

As a part of the ODP, a Noise Control Boundary (NCB) will be established. The intention is that the NCB would replace the existing consented noise limits relating to compliance at the notional boundary of any residential dwelling.

When considering potential future noise effects it is important to understand the likely noise sources, their location and the duration and time of day of operation.

4.1 Dominant Noise Sources

The dominant noise sources at dairy factories are:

- Major production facilities (WMP dryers etc);
- Boilers;
- Other fixed mechanical plant (cooling towers, workshops, cleaning and sanitising facilities etc);
- Product load out, coal and milk reception facilities;
- Tanker routes on-site; and
- Rail spurs.

4.2 Location of Future Noise Sources

Fortunately, the Darfield factory has been designed with future expansion in mind. Rail spurs and tanker routes are already in place, as is the milk reception facility (which is designed to accommodate expansion as required). Similarly, there are logical locations at which to construct new production facilities, boilers and mechanical services all of which are closely situated with existing facilities of similar nature.

While these future facilities are described in greater detail by others, the general locality of both existing and new facilities can be understood by reference to the draft ODP discussed below.

4.3 Timing & Duration of Activity

No change is envisioned to the seasonal or daily operations of this site. As a result no new assessment of effects arises from this matter. However, future expansion of the site would lead to both an increase in tanker numbers/movements and an increase in rail movements carrying finished goods away from the site. This increase in tanker and rail movements does have the potential to increase noise emissions from the site.

The Darfield factory is served by the Midland rail line which is the busiest rail line in the country. It is likely that any future expansion of the site would result in some night-time rail operations for network scheduling reasons. Therefore, while the noise generated during a single rail event on-site would not change compared to the current scenario, the activity would now occur outside the current the early morning and daytime periods.

Doubling the number of milk tankers on-site has the potential to double the peak hour noise level generated by the tankers, should the existing shift arrangement continue. This would impact the size of the noise contour in close proximity to the main site access (as the contour here is dominated by tanker movements at peak hour). We are advised by Fonterra that for traffic management reasons the preferred solution is to stagger work shifts at the site. This results in no increase in peak hour noise generation (as the maximum number of tanker movements in any one hour will not change), but instead extends the duration of time over which the peak occurs. However, as the noise effects of the current tanker peak hour have been assessed and the extension of peak remains in the daytime, we have not considered this point further.

4.4 Predicted Noise Levels

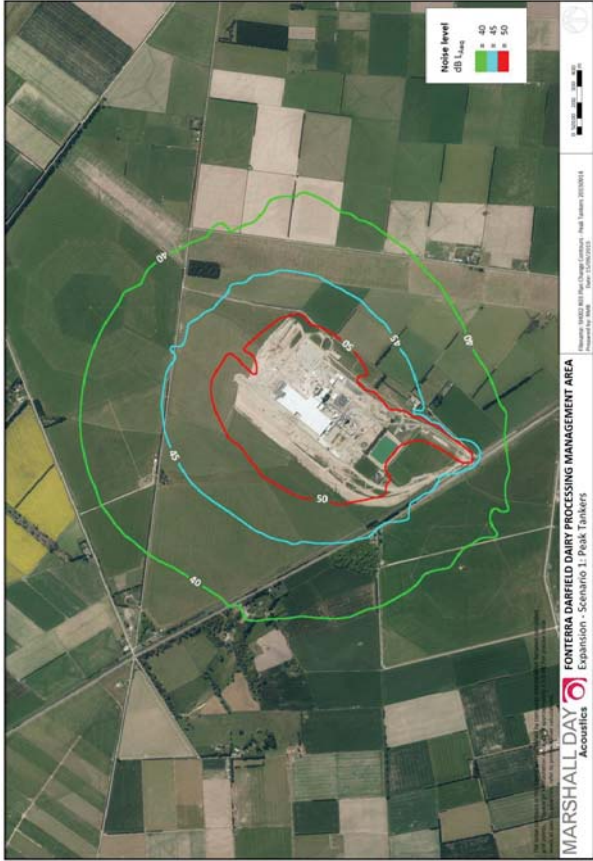
We have predicted noise levels arising from two aspects of the proposed expansion scenario:

1. Noise level during the peak period of tanker activity and all dryers, boilers and other mechanical plant running, on-site movement of coal from stockpile to boilers, product load out occurring and milk reception in operation.
2. Noise level during a rail movement with all dryers, boilers and other mechanical plant running, on-site movement of coal from stockpile to boilers, no product load out, milk reception and normal hour tanker movements all occurring.

Rail movements cannot practically occur at the same time as product load out and peak hour tanker movements because the train crosses the site access road.

Predicted noise levels for these scenarios are provided in Figure 2 and Figure 3 respectively. Larger versions of these figures are provided in Appendix D.

Figure 2: Full Expansion – Peak Hour (No Rail)



4.5 Resulting Noise Effects - Operational Noise

These predicted noise contours for the peak hour scenario is entirely consistent with the requirements of the existing land use consent (RC115199), specifically condition 42. No non-Fonterra owned dwelling would receive noise levels greater than 45 dB $L_{Aeq,15min}$ and the activity would therefore comply with the consented noise limits during both the daytime and night-time.

As expansion of the factory was mooted during the dryer 2 consent hearing, and the assessment of noise effects was based on a night-time limit of 45 dB $L_{Aeq,15min}$ at non-Fonterra dwellings being acceptable for the protection of sleep amenity, we see no need to consider any potential operational noise effects further.

We note that should Fonterra sell the Oaks B&B in the future, the highest operational noise level at this location is still consistent with condition 42.

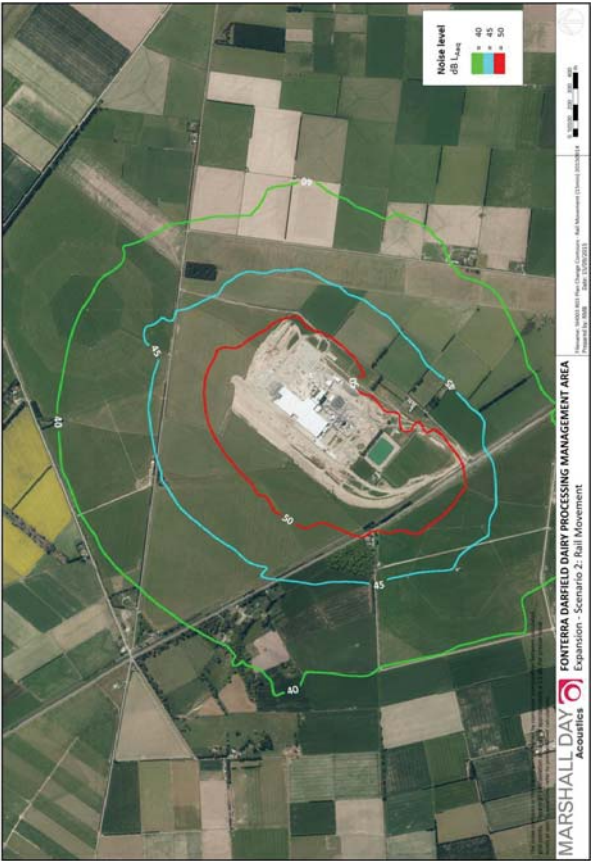
4.6 Resulting Noise Effects - Rail Noise

Again the predicted noise contours for the factory during rail movements demonstrate compliance with consent condition 42.

Should Fonterra sell the Oaks B&B, in the future the predicted noise level during a rail movement would be 50 dB $L_{Aeq,15min}$. This would exceed the night-time limit in condition 42 by 5 dB. Even if this were to occur, the resulting noise levels would not be unreasonable or lead to a significant reduction in sleep amenity. With windows ajar for ventilation an external noise level of 50 dB will result in a noise level inside bedrooms of 35 dB. This still provides a satisfactory level of sleep amenity, particularly when the location of the Oaks close to the State Highway and main rail line, and the short duration and sporadic nature of the rail activity is considered.

In our view the proposal to add night-time rail movements would result in noise effects that are less than minor at all properties including the Oaks B&B.

Figure 3: Full Expansion – Rail Movement



9.0 COST OF ENHANCED COMPLIANCE

Others are better placed to comment in detail on the additional costs incurred in replicating the noise control, sound insulation and general mitigation by management already provided on-site across the proposed expansion. It is our estimate that buildings and noise control measures similar to those already constructed at Darfield cost significantly more than the typical minimum-cost constructions often observed in other dairy processing developments that take a shorter term view. These additional costs would add into the millions of dollars at a site such as Darfield.

Primarily these increased costs include:

- Buildings constructed from thick concrete or concrete-composite materials;
- Enhanced use of attenuators and acoustic louvres;
- Selection of quieter (more expensive) fans and motors;
- Increased use of flexible connections and vibration isolating mounts; and
- Enhanced electronic control equipment to control induced tonality.

In order for Fonterra to internalise noise effects completely (for the proposed NCB not to extend beyond Fonterra land), all of these noise control measures would require significant additional performance. In addition the following significant mitigation would be required:

- An enclosed rail tunnel (steel cladding) extending perhaps 500 metres from the site entrance;
- An enclosed tunnel on the main site road access, again covered with steel cladding and extending 400-500 metres into the site;
- A concrete-composite milk reception fully enclosed with acoustically rated rapid action doors at each end of each bay and acoustically treated mechanical ventilation;
- Major reductions to noise from cooling towers (we are not sure if this is in fact practicable); and
- Future boilers to be constructed in heavy concrete rather than concrete composite cladding.

Even with the above mitigation measures implemented, as the existing 45 dB L_{Aeq} crosses the proposed DPMA, complete internalisation would not be achieved.

The likely costs of such treatment would extend into the tens of millions of dollars in our estimation.

There are also potential costs for new dwellings constructed within the NCB in order to achieve the required outdoor to indoor sound level difference. As any standard new dwelling will be able to achieve 20 dB $D_{r,2m,rnw}$ with windows closed, any additional costs would be associated with providing sufficient fresh air to bedrooms. The design of ventilation systems is outside our area of expertise, but we understand that passive ventilation options are available that add very minimal cost to the overall construction. The most expensive solution is likely to be a full mechanical ventilation system, which we understand to be in the order of \$5,000 to \$10,000¹.

10.0 CONCLUSIONS

The Fonterra Darfield factory has been designed with future expansion in mind. Based on the proposed expansion scenario and layout guidance provided by Fonterra we reach the following conclusions:

- The planned maximum expansion scenario can be undertaken while still complying with the noise limits in condition 42 of the existing consent;
- No existing non-Fonterra dwellings would suffer a decrease in amenity as a result of such expansion that is not already foreseen by the existing conditions of consent;
- Constructing new dwellings within the Noise Control Boundary will still be a permitted activity subject to meeting a minimum outdoor to indoor noise reduction for bedrooms, much of which will largely be achieved through compliance with the New Zealand Building Code;
- The proposed Noise Control Boundary would result in certainty for all parties; and would also ensure that no neighbours receive noise levels in excess of those already foreseen and allowed under the existing consent while a number would be assured of lower noise levels;
- Noise effects arising from night-time train movements will be less than minor at all dwellings, including the Oaks B&B (currently Fonterra owned). Any adverse noise effect can be controlled by restricting the number of night-time train movements, rather than by applying a noise limit to train movements. The number of train movements is also easily and cheaply verified; and
- Overall, any adverse noise effects arising from this application are less than minor.

¹ NZTA State Highway Guide to Acoustic Treatment of Buildings Version 1.0, June 2015

APPENDIX A GLOSSARY OF TERMINOLOGY

Noise	A sound that is unwanted by, or distracting to, the receiver.
Ambient	The ambient noise level is the noise level measured in the absence of the intrusive noise or the noise requiring control. Ambient noise levels are frequently measured to determine the situation prior to the addition of a new noise source.
SPL or L_p	<u>Sound Pressure Level</u> A logarithmic ratio of a sound pressure measured at distance, relative to the threshold of hearing (20 μ Pa RMS) and expressed in decibels.
SWL or L_w	<u>Sound Power Level</u> A logarithmic ratio of the acoustic power output of a source relative to 10^{12} watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total sound power radiated by a sound source.
dB	<u>Decibel</u> The unit of sound level. Expressed as a logarithmic ratio of sound pressure P relative to a reference pressure of $P_r=20 \mu\text{Pa}$ i.e. $\text{dB} = 20 \times \log(P/P_r)$
A-weighting	The process by which noise levels are corrected to account for the non-linear frequency response of the human ear.
$L_{Aeq}(t)$	The equivalent continuous (time-averaged) A-weighted sound level. This is commonly referred to as the average noise level. The suffix "t" represents the time period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.
L_{Amax}	The A-weighted maximum noise level. The highest noise level which occurs during the measurement period.
NZS 6801:2008	New Zealand Standard NZS 6801:2008 "Acoustics – Measurement of environmental sound"
NZS 6802:2008	New Zealand Standard NZS 6802:2008 "Acoustics – Environmental Noise"
NZS 6803:1999	New Zealand Standard NZS 6803: 1999 "Acoustics - Construction Noise"
Sound Insulation	When sound hits a surface, some of the sound energy travels through the material. 'Sound insulation' refers to ability of a material to stop sound travelling through it.
Transmission Loss	The attenuation of sound pressure brought about by a building construction.
$D_{nT,w}$	<u>Weighted Standardised Level Difference</u> A single number rating of the sound level difference between two rooms. $D_{nT,w}$ is typically used to measure the on-site sound insulation performance of a building element such as a wall, floor or ceiling



APPENDIX B FONTERRA PROPERTY MAP

APPENDIX C NOISE MODELLING METHODOLOGY

The predicted noise contours in this report were calculated using the SoundPLAN v7.3 suite of noise modelling software. This software calculates noise propagation through 3-dimensional geometric ray tracing, implementing algorithms given in International Standard ISO 9613-2:1996 *“Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation”*.

This method has the scope to take into account a range of factors affecting the sound propagation including:

- The magnitude of the noise source in terms of sound power level;
- The distance between source and receiver;
- The presence of obstacles such as bunds, buildings and fences in the propagation path;
- The presence of reflecting surfaces;
- The hardness of the ground between the source and receiver;
- Attenuation due to atmospheric absorption; and
- Meteorological effects such as wind gradient, temperature gradient and humidity.

The effect of meteorological conditions is significantly simplified in ISO 9613-2:1996 by calculating the average downwind sound pressure level. The Standard adopts the conservative approach of assuming that wind is always blowing from the noise sources to the receiver locations. The equations and calculations for downwind propagation also hold for average propagation under a well-developed moderate-ground based temperature inversion, such as commonly occurs on clear, calm nights.

Source sound power levels in the noise model are predominantly based on noise level measurements of the existing equipment at Fonterra Darfield, supplemented by manufacturer's data and measurements at other similar industrial facilities around New Zealand.

APPENDIX D NOISE CONTOURS FOR EXPANSION SCENARIO

Figure 2: Full Expansion – Peak Hour (No Rail).

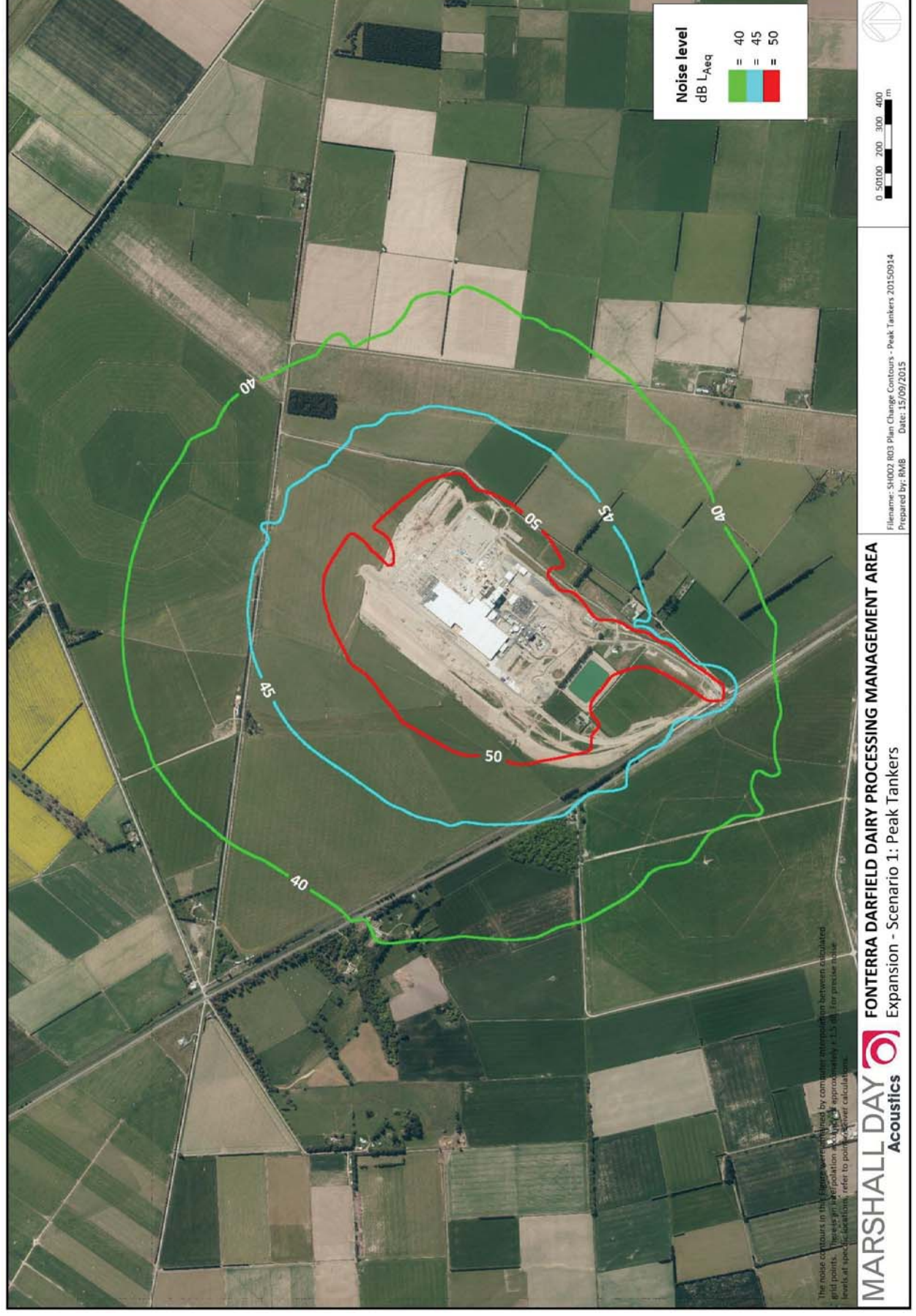
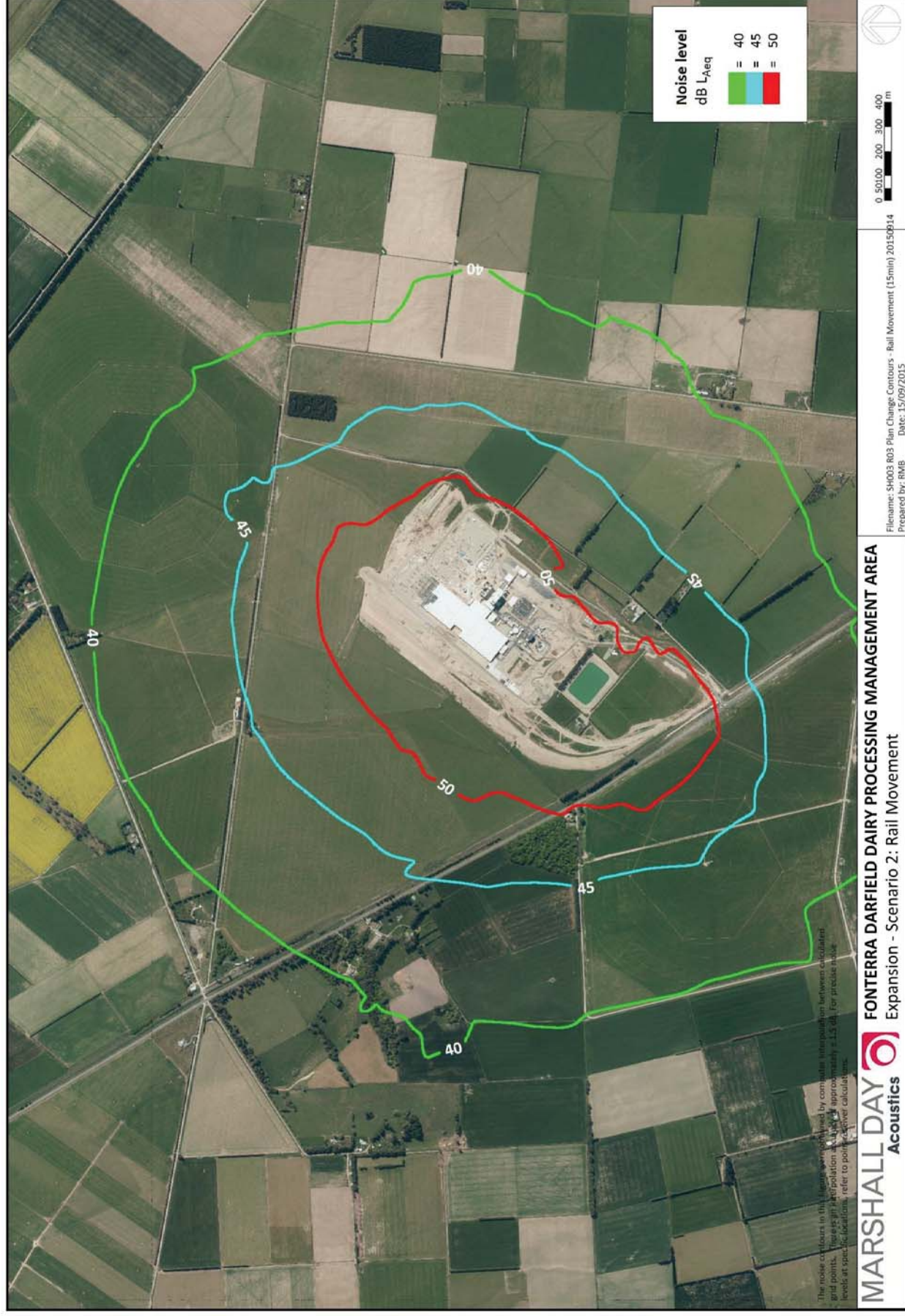


Figure 3: Full Expansion – Rail Movement



FONTERRA DARFIELD PROCESSING MANAGEMENT AREA - ODP

