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**Proposed Subdivision,
North Angels Beach, Ballina**

**ROAD TRAFFIC
NOISE IMPACT REPORT**

Prepared for

North Angels Beach Development (Ballina) Pty Ltd

27 July 2004

ttmref: 30214 report 27_07_04

1.0 INTRODUCTION

This report is in response to a request by S J Connelly Pty Limited, on behalf of North Angels Beach Development (Ballina) Pty Ltd, for a road traffic impact assessment post the Master Planning Stage of a proposed subdivision located adjacent to Angels Beach Drive Ballina.

On-site noise logging was conducted, and through modelling, predictions of future road noise impacts in the year 2010 were produced. Based upon these predicted levels, recommendations regarding acoustic treatments have been specified.

1.1 The Proposal

The proposal is for a subdivision of a block of vacant land fronting North Angels Beach Road, adjacent to the intersection with the Coast Road in Ballina East. The site is basically flat, with land rising on the north-eastern portion of the site. The following yield is anticipated:

- 33 conventional house lots (600 – 800m²);
- 27 beach house mews lots (300 – 570m²);
- 1 duplex (community title);
- 2 tree cluster housing precincts (community title).

There are no house designs proposed for this application, therefore, we have assessed using a 'typical' type of dwelling, although it should be noted that planning is under way for building layout to provide courtyard areas that are screened to the roadway for lots near the entry (refer to Sketch 3 & 4 in the appendix to this report). To minimise barriers, building layouts proximate to the entry will be applied to minimise noise exposure, with acoustic barriers located within the buffer strip for the remaining lots to the western and northern ends of the site. Principles applied to the design to ensure acceptable noise levels will be achieved through compliance with the New South Wales "Environmental criteria for criteria for road noise", and achieving indoor noise levels at the top floor levels of any two storey dwellings that do not achieve the required outdoor criteria in accordance with Australian Standard AS/NZ 2107:2000 "Acoustics – Recommended design sound levels and reverberation times for building interiors"

The site is buffered to North Angels Beach Drive by a 5m wide noise buffer/road verge (which increases at the western end of the site to approximately 15m), which is planned to be utilised for acoustic treatment works and landscaping.. A roundabout is proposed for the Coast Road/North Angels Beach Drive intersection.

For site detail, refer to the attached sketch.

2.0 EQUIPMENT

The following equipment was used to record existing road traffic noise impacting onto the site:

- Rion NC 73 Calibrator;
- ARL EL 315 Environmental Noise Logger.

3.0 MEASUREMENT PROCEDURE

A logger was located at a free-field position onsite, with the microphone approximately 1.3m above ground level, and a direct line of sight to Angels Beach Drive (approximately 14m away). For measurement location, refer to the attached Sketch No. 2.

The logger was set to record noise statistics in 15 minute blocks continually between 3:00pm (EST) Monday 03/02/03, to 7:30pm Tuesday 04/02/03. The statistical interval was chosen to provide detailed data, and to allow application of AS/NZS 2107:2000 '*Acoustics – Recommended Design Sound Level and Reverberation Times for Building Interiors*'.

Road traffic noise levels were conducted generally in accordance with Australian Standard AS2702 - 1984 '*Acoustics - Methods for the measurement of road traffic noise*'.

The operation of the sound level measuring equipment was field calibrated before and after the measurement session and was found to be within 0.1 dB of the reference signal. All instrumentation used in this assessment hold current calibration certificate from a certified NATA calibration laboratory.

Weather conditions during the survey were generally fine, overcast skies, with a local temperature range of 23 to 26° C.

4.0 NOISE CRITERIA

Noise limit criteria applicable to the site is pursuant to the “*Environmental criteria for road traffic noise*”, published by the New South Wales Environmental Protection Authority. Two parts of the Policy apply to the application as follows:

TYPE OF DEVELOPMENT	CRITERIA		WHERE CRITERIA ARE ALREADY EXCEEDED
	DAY (7am - 10pm) dB(A)	NIGHT (10pm – 7am) dB(A)	
2. New residential land use developments affected by freeway/arterial traffic noise	$L_{Aeq(15hr)}$ 55	$L_{Aeq(9hr)}$ 50	Where feasible and reasonable, existing noise levels should be reduced to meet the noise criteria via judicious design and construction of the development. /locations, internal layouts, building materials and construction should be chosen so as to minimise noise impacts.
7. Land use developments with potential to create additional traffic on existing freeways/arterials	$L_{Aeq(15hr)}$ 60	$L_{Aeq(9hr)}$ 55	Where feasible, existing noise levels should be mitigated to meet the noise criteria. Examples of applicable strategies include appropriate location of private access roads; regulating times of use; using clustering; using ‘quiet’ vehicles; and using barriers and acoustic treatments. In all cases, traffic arising from the development should not lead to an increase in existing noise levels of more than 2 dB.

Table 1 : Road traffic noise criteria applicable to the proposed development.
(After NSW EPA “*Environmental criteria for road traffic noise*”)

Section 2 of Table 1 applies to North Angels Beach Drive and the Coast Road noise impacting onto future dwellings, and Section 7 applies to potential noise from extra traffic on North Angels Beach Drive and the Coast Road generated by the development. Further to the above outdoor noise limit criteria, we recommend ensuring that road traffic noise levels assessed inside dwellings comply with AS/NZS 2107:2000 ‘*Acoustics – Recommended Design Sound Level and Reverberation Times for Building Interiors*’ if external noise criteria cannot be achieved (e.g. at top floor levels of two storey buildings that do not benefit from the acoustic barriers. These levels are presented in Table 2 below.

Type of Occupancy / Activity	Recommended Design Sound Level, L_{Aeq} , dB(A)	
	Satisfactory	Maximum
7. RESIDENTIAL BUILDINGS		
Houses and apartments near major roads –		
Living areas	35	45
Sleeping areas	30	40
Work areas	35	45
Apartment common areas (e.g. foyer, lift lobby)	45	55

Table 2: Internal noise limits for residential dwellings from Australian/New Zealand Standard AS/NZS 2107:2000 ‘*Acoustics - Recommended design sound levels and reverberation times for building interiors*’.

We recommend applying the Satisfactory levels from the above table, as the development is to be of a high quality, hence, buyers would have an expectation of a high level of amenity.

5.0 RESULTS & CALCULATIONS

5.1 Measured Levels – Ambient Noise

Table 3 below presents measured traffic noise levels measured over a concatenated 24 hour period at the logger measurement location on Monday 10/12, and Tuesday 11/12/01. The $L_{10,18hr}$ noise level was measured close to 56 dB(A). Graphical presentation of the measured road traffic noise levels is presented in the appendix to this report.

Road Traffic Noise Descriptor	Time Period	Measured Level dB(A)
$L_{A10,18hr}$	6:00am to 12:00pm	64
$L_{Aeq(15hr)}$	7:00am to 10:00pm	64
$L_{Aeq(9hr)}$	10:00pm to 7:00am	59

Table 3: Free-field measured road traffic noise levels at proposed site.

The acoustic environment at the start time of the survey was intermittent traffic on North Angels Beach Drive, and insect noise. It should be noted that the L10 level should not exceed the Leq level if road noise dominates the acoustic environment. We recommend applying the L10 level as the Leq daytime level (typically, the Leq daytime should be between 1 – 3 dB below the L10 18hr).

5.2 Modelled Noise Levels – Existing Situation

Road traffic noise predictions were conducted using “Tnoise”, a CoRTN based model produced by Main Roads Western Australia. The modelled $L_{A10,18hr}$ at the logger location was calculated at 64.1 dB, compared to the measured $L_{A10,18hr}$ of 64 dB. This is within the allowable 2 dB variation between measured vs. modelled level cited in the CoRTN methodology.

5.2.1 Existing and Future Traffic Flows

The existing and future traffic flows for North Angels Beach Drive were obtained from the Eppel Olsen “Ballina Road Network Study”. Predicted traffic flows are based upon projections for the year 2010 and are as follows:

Existing Traffic Flow: 11,000 vehicles per 24 hour

Predicted Traffic Flow: 11,000 vehicles per 24 hour

It should be noted that Eppel Olsen predict that by the Year 2033 traffic volumes on North Angels Beach Drive will drop to approximately 4,000 vpd.

5.3 Modelled Noise Levels – Year 2010 Lots 1 - 8

All modelled levels are predicted at 1.5m above floor level, and include a 2.5 dB correction for façade reflections, as the receptor is located 1m from the façade of the nearest point of a façade to the roadway. It is assumed that facades are 6m from the property boundary, and a 1m high acoustic barrier is located on the property boundary.

Based upon the predicted future traffic volumes, the Tnoise model predicts an ultimate road traffic noise impact of approximately 67 dB $L_{A10,18hr}$ at ground level, 14m from the road edge (e.g. a dwelling located in the area adjacent to the entry point, with the façade set 6m back from the property boundary, 8m to traffic lane from road edge).

This predicted $L_{A10,18hr}$ level represents future road traffic noise levels which can be applied to the measured L_{Aeq} levels to produce the following ultimate levels:

Daytime: 67 dB $L_{Aeq(15hr)}$;
Night time: 62 dB $L_{Aeq(9hr)}$;

The above Leq levels are above the NSW EPA criteria for road traffic noise, hence, further acoustic treatments are required in the form of building treatment and layout (principles are detailed in Sketch No. 4 in the appendix to this report).

5.4 Modelled Noise Levels – Year 2010 Lots 9 - 15

All modelled levels are predicted at 1.5m above floor level, and include a 2.5 dB correction for façade reflections, as the receptor is located 1m from the façade of the nearest point of a façade to the roadway. It is assumed that facades are 6m from the property boundary, and barriers are located 15m from the road edge.

Location	Barrier Height (m)	SPL dB(A) L10 18hr	Daytime SPL dB(A)	Night Time SPL dB(A)
GROUND FLOOR				
Detached house lots	3.8	55	55 Leq (15 hr)	50 Leq (9 hr)
FIRST FLOOR				
Detached house lots	3.8	62	62 Leq (15 hr)	57 Leq (9 hr)

Table 3: Predicted road traffic noise impact levels with acoustic barriers

5.5 Effect of Development on Surrounding Road Network

The traffic generated by the proposed development will be feeding onto North Angels Beach Drive, that carries approximately 11,000 vpd. For the proposed development to increase noise levels significantly (e.g. by more than 3 dB), traffic loads would need to be almost doubled as a result of the development. This doubling of traffic loads due to the proposed development will not occur.

6.0 RECOMMENDED ACOUSTIC TREATMENTS

Given the external noise levels are above the EPA criteria, the following noise control options are available as follows:

- Construction of acoustic barriers for Lots 9 to 18, and the Cluster Housing Precinct on the north-eastern boundary – this option will reduce noise impact levels to below EPA criteria at ground level, but noise levels at second storey will still exceed the criteria. Noise control at the building façade will be necessary (see dot point 4 below);
- Orientation and layout of dwellings for Lots 1 – 8 in accordance with the principles detailed in Sketch No. 3. This design will provide outdoor recreation areas that are screened to the road, and would be exposed to noise levels below the criteria. The building shells should also be designed to ensure compliance with acceptable indoor noise levels (see dot point 4 below);
- Provision of buffer land to attenuate noise over distance. These buffer distances (a distance of greater than 500m would be required) would be too great to be practical;
- Ensuring habitable spaces comply with internal noise levels specified in Australian Standard AS/NZ 2107 – 2000 '*Acoustics – Recommended Design Sound Level and Reverberation Times for Building Interiors*'.

Based upon predicted ultimate noise impact levels at nearest potentially affected dwellings, the following building shell acoustic treatments will achieve compliance with EPA criteria for dwellings fronting the road network.

As the development is only a subdivision at this stage, we are unable to provide detailed acoustic treatments, but recommend the following basic principles to be applied to buildings in the affected zone:

- Habitable spaces be located such that they are screened from the roadway by non-habitable spaces;
- Construction materials should be selected to reduce noise intruding inside the buildings;
- Provision for air conditioning or mechanical ventilation for the nearest row of dwellings to North Angels Beach Drive, to rooms that have openings facing, or at 90° to North Angels Beach Drive, as windows need to be closed to exclude noise;
- Minimisation of windows facing roadway.

Specific building treatments may be determined by using the calculation methods detailed in Australian Standard AS3671 1989 '*Road Traffic Noise Intrusion – Building Siting and Construction*' when house plans are drafted. We recommend designing to internal noise levels defined in Australian/New Zealand Standard AS/NZS 2107:2000 '*Acoustics - Recommended design sound levels and reverberation times for building interiors*'.

A typical house adjacent to the road would require the approximate building element sound reduction ratings (termed STC (Sound Transmission Class), or Rw (Weighted Sound Reduction Index) presented below. Please note that these are based upon a typical house, and that for building elements larger than typical sizes (i.e. floor to ceiling windows), a higher sound reduction may be required, and specialist advice should be sought.

The table below presents predicted noise impact levels following construction of acoustic barriers along the property boundaries. Refer to Table 3 above for barrier height detail.

Typical Building Elements	Typical Minimum Acoustic Treatment WITH ACOUSTIC BARRIERS
TOP FLOOR – NEAREST ROW OF DWELLINGS TO NORTH ANGELS BEACH DRIVE Lots 9-18	
Facades Facing North Angels Beach Drive Main bedroom windows Main bedroom external walls Main bedroom roof	Rw 32: 6.38mm laminated glass in acoustic grade frames Rw 41: Masonry, or 9mm FC sheeting externally, 1 layer 13mm plasterboard internally, fibreglass min 10 kg/m ³ in wall void Rw 40: Tiled roof, with double-sided aluminium foil over rafters, and 75mm thick 85kg/m ³ mineral wool batts, or refer to the attached CSR Gyprock Design Guide in the appendix to this report. Provision for air conditioning or mechanical ventilation should be provided
Facades Facing North Angels Beach Drive 2 nd Bedroom windows 2 nd Bedroom Roof/Ceiling 2 nd Bedroom External Walls	Rw 31: 6.38mm laminated glass in acoustic grade frames Rw 40: Tiled roof, with double-sided aluminium foil over rafters, and 75mm thick 85kg/m ³ mineral wool batts, or refer to the attached CSR Gyprock Design Guide in the appendix to this report. Rw 45: Masonry construction Provision for air conditioning or mechanical ventilation should be provided
Facades 90° to North Angels Beach Drive Main bedroom windows Main bedroom external walls Main bedroom roof	Rw 29: 6.38mm laminated glass in acoustic grade frames Rw 38: Masonry, or 9mm FC sheeting externally, 1 layer 10mm plasterboard internally, fibreglass min 10 kg/m ³ in wall void Rw 37: Tiled roof, with double-sided aluminium foil over rafters, or refer to the attached CSR Gyprock Design Guide in the appendix to this report. Provision for air conditioning or mechanical ventilation should be provided
Facades 90° to North Angels Beach Drive 2 nd Bedroom windows 2 nd Bedroom Roof/Ceiling 2 nd Bedroom External Walls	Rw 28: 6.38mm laminated glass in acoustic grade frames Rw 38: Tiled roof, with double-sided aluminium foil over rafters, or refer to the attached CSR Gyprock Design Guide in the appendix to this report Rw 41: Masonry, or 9mm FC sheeting externally, 1 layer 13mm plasterboard internally, fibreglass min 10 kg/m ³ in wall void Provision for air conditioning or mechanical ventilation should be provided
TOP FLOOR – NEAREST ROW OF DWELLINGS TO NORTH ANGELS BEACH DRIVE Lots 1-7	
Facades Facing North Angels Beach Drive Main bedroom windows Main bedroom external walls Main bedroom roof	Rw 37: Double glazed windows – 6.38mm laminated glass with 12mm airgap (re: GJames Glass) Rw 46: Masonry construction Rw 45: Tiled roof, with double-sided aluminium foil over rafters, and 75mm thick 85kg/m ³ mineral wool batts, or refer to the attached CSR Gyprock Design Guide in the appendix to this report. Provision for air conditioning or mechanical ventilation should be provided

Table 4: Weighted sound reduction indices for typical highset housing.

7.0 DISCUSSION & CONCLUSIONS

Based upon our assessment of ultimate traffic flows in the year 2010, we conclude the following:

- With 3.8m high acoustic barriers located on the North Angels Beach Drive property frontage, noise levels from road traffic when assessed at ground level, will be below the Leq criteria defined in Section 4 above. To achieve acceptable external noise levels at second storey dwellings, barriers would need to be in excess of 4 metres high, hence our recommendations for building shell treatments to achieve acceptable road traffic noise levels (as defined in Australian Standard AS/NZ 2107 – 2000 '*Acoustics – Recommended Design Sound Level and Reverberation Times for Building Interiors*') when assessed inside habitable spaces;
- If buildings are laid out such that outdoor recreation spaces are screened to the roadway by the proposed dwellings, acceptable noise levels can be achieved. It is necessary to ensure that the building envelopes are acoustically treated to achieve acceptable road traffic noise levels (as defined in Australian Standard AS/NZ 2107 – 2000 '*Acoustics – Recommended Design Sound Level and Reverberation Times for Building Interiors*') when assessed inside habitable spaces;
- We note that the local internal road will carry relatively low traffic loads, with a low traffic speed. Given aesthetic and economic considerations, we believe that a barrier is not appropriate to control noise from the local road. We recommend applying restrictions for heavy vehicle access, and allow local traffic access only. With standard building construction, acceptable levels of noise can be achieved inside future dwellings;
- According to the Eppel Olsen traffic model, North Angels Beach Drive will gradually decrease in volumes.

The acoustic barrier arrangement is intended to minimise the visual impact of the barrier, and includes a combination earth mound and barrier fence. It should be noted that if the posted speed environment is reduced to 60km/hr, the barrier could be reduced to 3.2m in height.

Based upon ultimate traffic flows based upon the Eppel Olsen Ballina Road Network Study, the site will be exposed to road traffic noise levels above criteria defined in the NSW EPA "*Environmental criteria for road traffic noise*". We have provided some basic principles to consider at the design stage of future dwellings nearest the road edges. Overall, the recommended construction elements are not of a high noise reduction rating, excepting 2nd bedrooms facing North Angels Beach Drive. It would be best practice to avoid locating bedrooms facing the road in dwellings nearest the roadway, as this would remove the need for acoustic treatment to these spaces.

It is noted that the EPA Road Traffic Noise Criteria is not legislation, but rather is a guide to ensuring a reasonable level of acoustic amenity for occupants of dwellings adjacent to roadways. The document states that noise levels from roads should be reduced to meet the criteria where feasible and reasonable. It is noted that to gain total compliance with the criteria at top floors and ground floor level, barriers up to 4m high would be required.

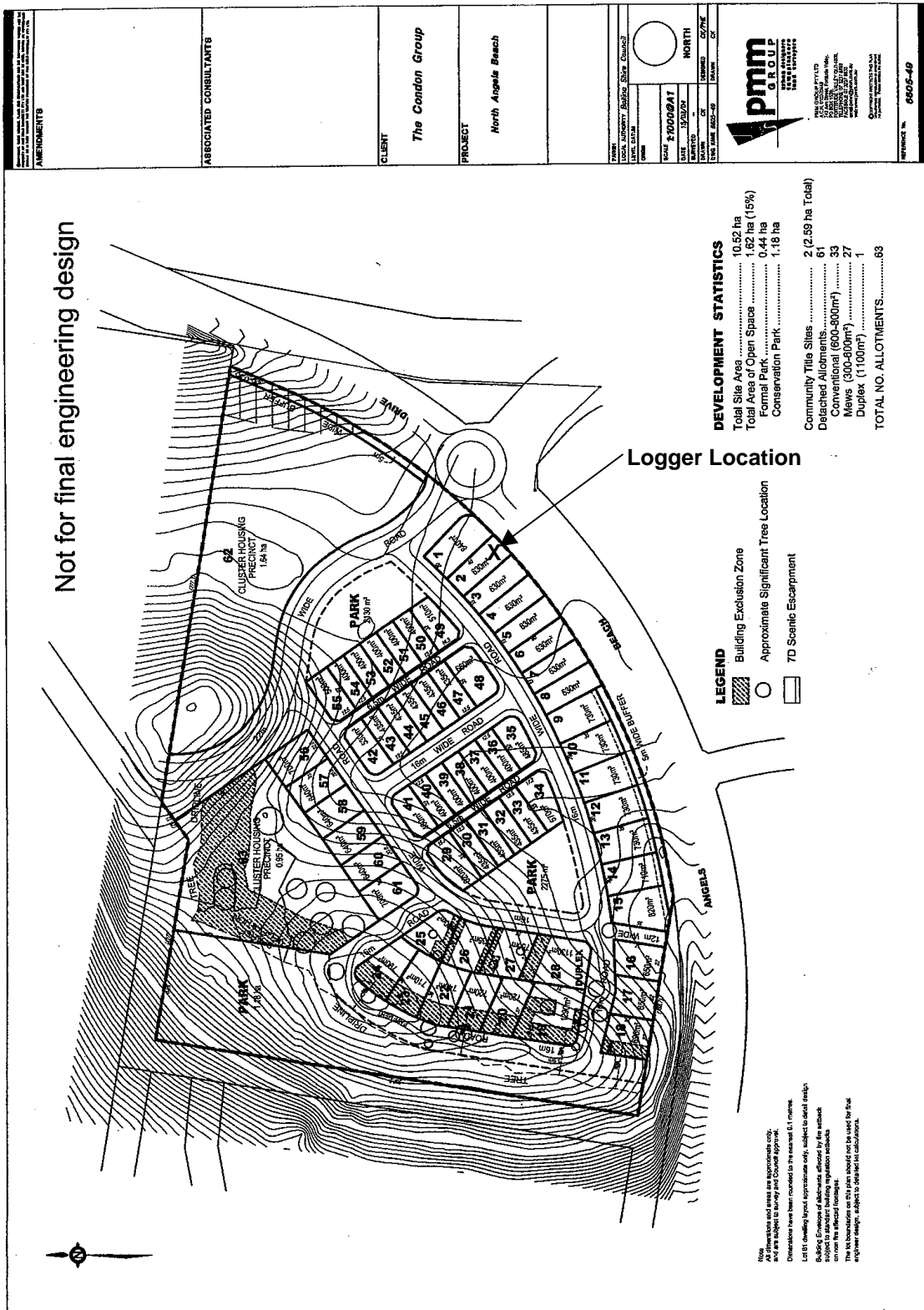
Our recommendations provide a solution balancing control of future road traffic noise impacts with other amenity issues associated with construction of roadside barriers.

Report Compiled by:

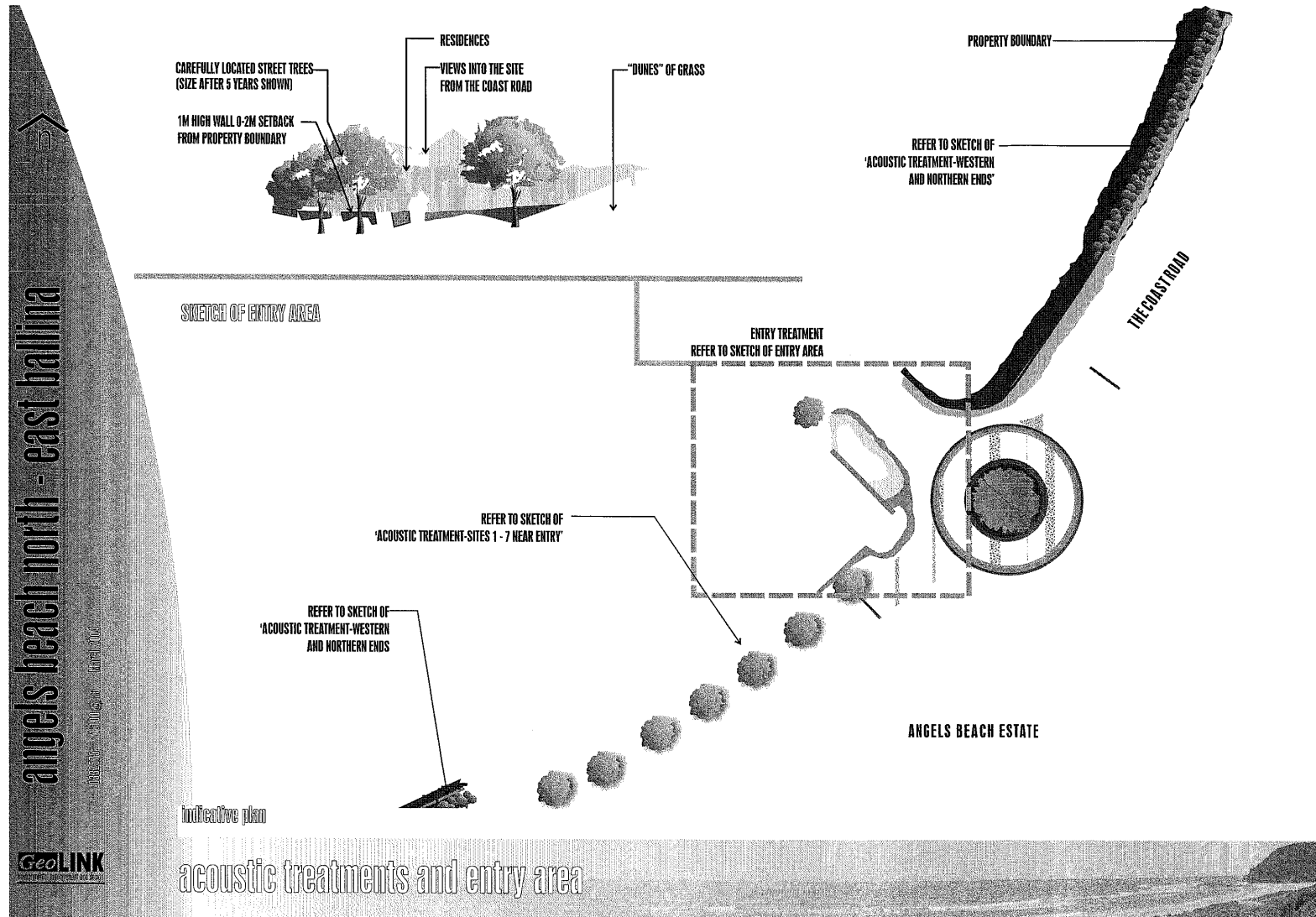


JAY CARTER BSc
Manager

Sketch No. 2: Indicative Site Layout

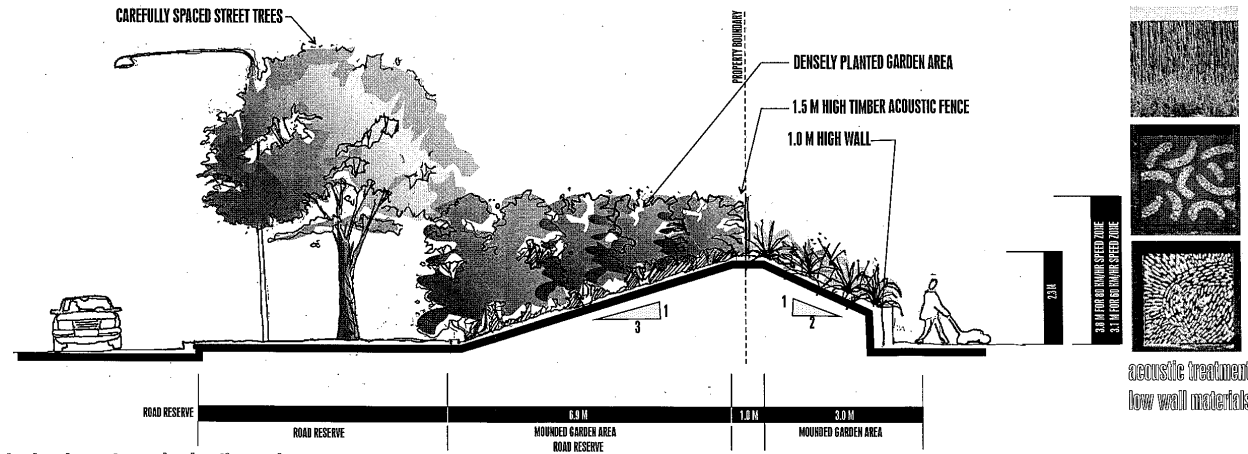


Sketch No. 3: Acoustic Treatment Principles

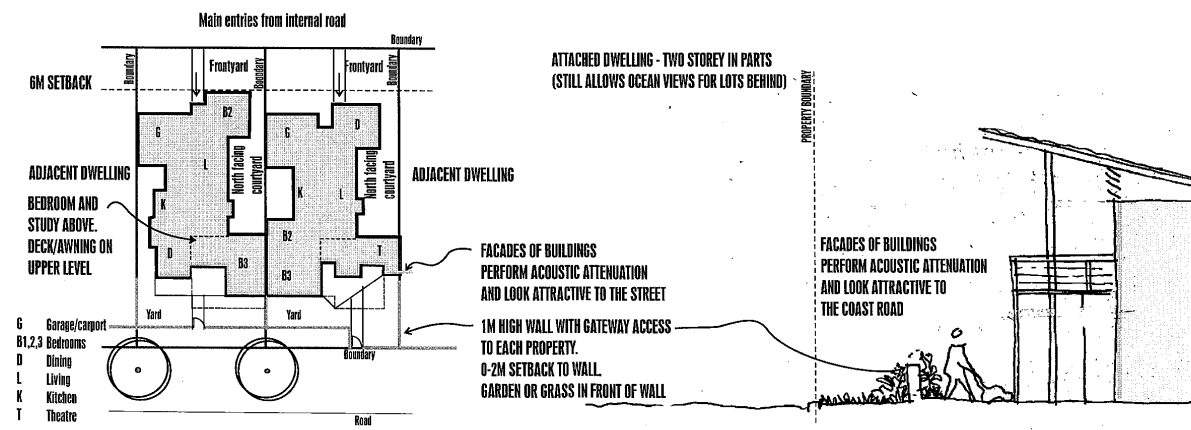


Sketch No. 4: Acoustic Treatment Principles

angels beach north - east ballina
 www.angelshomes.com.au
GeoLINK
 landscape architecture



acoustic treatment - western end and northern ends



typical acoustic treatment - sites 1-7 near entry

plan 3.17 - acoustic treatments



North Angels Beach East Ballina - Existing Situation

Segment	Abbrev	L10	Seg Group	Group Total
1 North Angels Beach		64.1		

Total is the L10(18hour) = 64.1 dB(A)

INPUT DATA Seg 1

Total Flow (veh/18h) 11000
 Heavy Vehicles (%) 4
 SPEED:
 Average (km/h) 80
 Origin (Zone or Est) E
 Road RL (m) 0
 Road Gradient (%) 1
 ROAD SURFACE:
 Surface Type (B,C,P) b
 Texture Depth (mm) 1
 Dist Road-Rec (m) 14
 Absorbing Ground (%) 100
 Av Prop Ht (m) .5
 Angle View (deg) 140
 SPECIAL ADJUSTMENT?
 Value (±dBA)
 Comment
 BARRIERS ?
 1:Dist Road-Barr (m)
 Barrier RL (m)
 Description
 2:Dist Road-Barr (m)
 Barrier RL (m)
 Description
 3:Dist Road-Barr (m)
 Barrier RL (m)
 Description
 REFLECTORS ONLY ?
 Refl Angle View (deg)
 COMBINED REFL/BARR?
 Reflector RL (m)
 Reflector Tilt (deg)
 DistanceBetween (m)
 Either on Embankment?

Ground RL at Receiver: 0.0
 Height of Receiver above ground: 1.3
 Road Surface Corrections supplied by: CRTN
 Building Facade at Receiver: No
 User's overall adjustment to CRTN: 0.0

CORRECTIONS Seg 1

Total Flow 18h	(Ch3)	69.5
Low Flow 18h	(Ch12)	0.0
Heavy Vehicles	(Ch4)	1.5
{SpChange,km/h}	(Ch5)	0.0
Road Gradient	(Ch6)	0.3
Road Surface	(CRTN)	-1.0
Dist Road-Rec	(Ch7)	-1.1
{h,metres}	(Ch7)	0.8
Av Prop Ht	(Ch8)	-4.0
Angle View	(Ch10)	-1.1
Special	(User)	0.0
BARRIERS		
Barrier Absent	(Ch8)	
1:Pot Barr Corr	(Ch9)	
{PathDiff,metres}	(P21)	
Description		
2:Pot Barr Corr	(Ch9)	
{PathDiff,metres}	(P21)	
Description		
3:Pot Barr Corr	(Ch9)	
{PathDiff,metres}	(P21)	
Description		
Barr Multiple Effect:		
Barr Numbers		
Pot Barr Corr	(P35)	
REFLECTORS		
Refl Angle of View	(P26)	
COMBINED REFL/BARR		
Correction	(P36)	
{Y}	(P36)	
{W}	(P36)	
{Alpha}	(P36)	
{Delta1}	(P36)	
{Delta2}	(Ch13)	
{Delta3}	(Ch13)	
{Delta4}	(Ch14)	
{Delta5}	(Ch15)	

Receiver position not at a building facade
User's overall adjust to CRTN: 0

North Angels Beach - Future Situation - Lots on western and northern end of site

Segment	Abbrev	L10	Seg Group	Group Total
1 North Angels Beach		55.4		

Total is the L10(18hour) = 55.4 dB(A)

INPUT DATA Seg 1

Total Flow (veh/18h) 11000
 Heavy Vehicles (%) 4
 SPEED:
 Average (km/h) 60
 Origin (Zone or Est) Z
 Road RL (m) 0
 Road Gradient (%) 1
 ROAD SURFACE:
 Surface Type (B,C,P) b
 Texture Depth (mm) 1
 Dist Road-Rec (m) 20.5
 Absorbing Ground (%) 0
 Av Prop Ht (m) .98
 Angle View (deg) 150
 SPECIAL ADJUSTMENT?
 Value (±dBA)
 Comment
 BARRIERS ?
 1:Dist Road-Barr (m) 15.5
 Barrier RL (m) 3.2
 Description
 2:Dist Road-Barr (m)
 Barrier RL (m)
 Description
 3:Dist Road-Barr (m)
 Barrier RL (m)
 Description
 REFLECTORS ONLY ?
 Refl Angle View (deg)
 COMBINED REFL/BARR?
 Reflector RL (m)
 Reflector Tilt (deg)
 DistanceBetween (m)
 Either on Embankment?

Ground RL at Receiver: 0.0
 Height of Receiver above ground: 1.8
 Road Surface Corrections supplied by: CRTN
 Building Facade at Receiver: Yes
 User's overall adjustment to CRTN: 0.0

CORRECTIONS Seg 1

Total Flow 18h	(Ch3)	69.5
Low Flow 18h	(Ch12)	0.0
Heavy Vehicles	(Ch4)	-0.5
{SpChange,km/h}	(Ch5)	-0.8
Road Gradient	(Ch6)	0.3
Road Surface	(CRTN)	-1.0
Dist Road-Rec	(Ch7)	-2.5
{h,metres}	(Ch7)	1.3
Av Prop Ht	(Ch8)	0.0
Angle View	(Ch10)	-0.8
Special	(User)	0.0
BARRIERS		
Barrier Absent	(Ch8)	0.0
1:Pot Barr Corr	(Ch9)	-12.1
{PathDiff,metres}	(P21)	0.348
Description		
2:Pot Barr Corr	(Ch9)	
{PathDiff,metres}	(P21)	
Description		
3:Pot Barr Corr	(Ch9)	
{PathDiff,metres}	(P21)	
Description		
Barr Multiple Effect:		
Barr Numbers		
Pot Barr Corr	(P35)	
REFLECTORS		
Refl Angle of View	(P26)	
COMBINED REFL/BARR		
Correction	(P36)	
{Y}	(P36)	
{W}	(P36)	
{Alpha}	(P36)	
{Delta1}	(P36)	
{Delta2}	(Ch13)	
{Delta3}	(Ch13)	
{Delta4}	(Ch14)	
{Delta5}	(Ch15)	

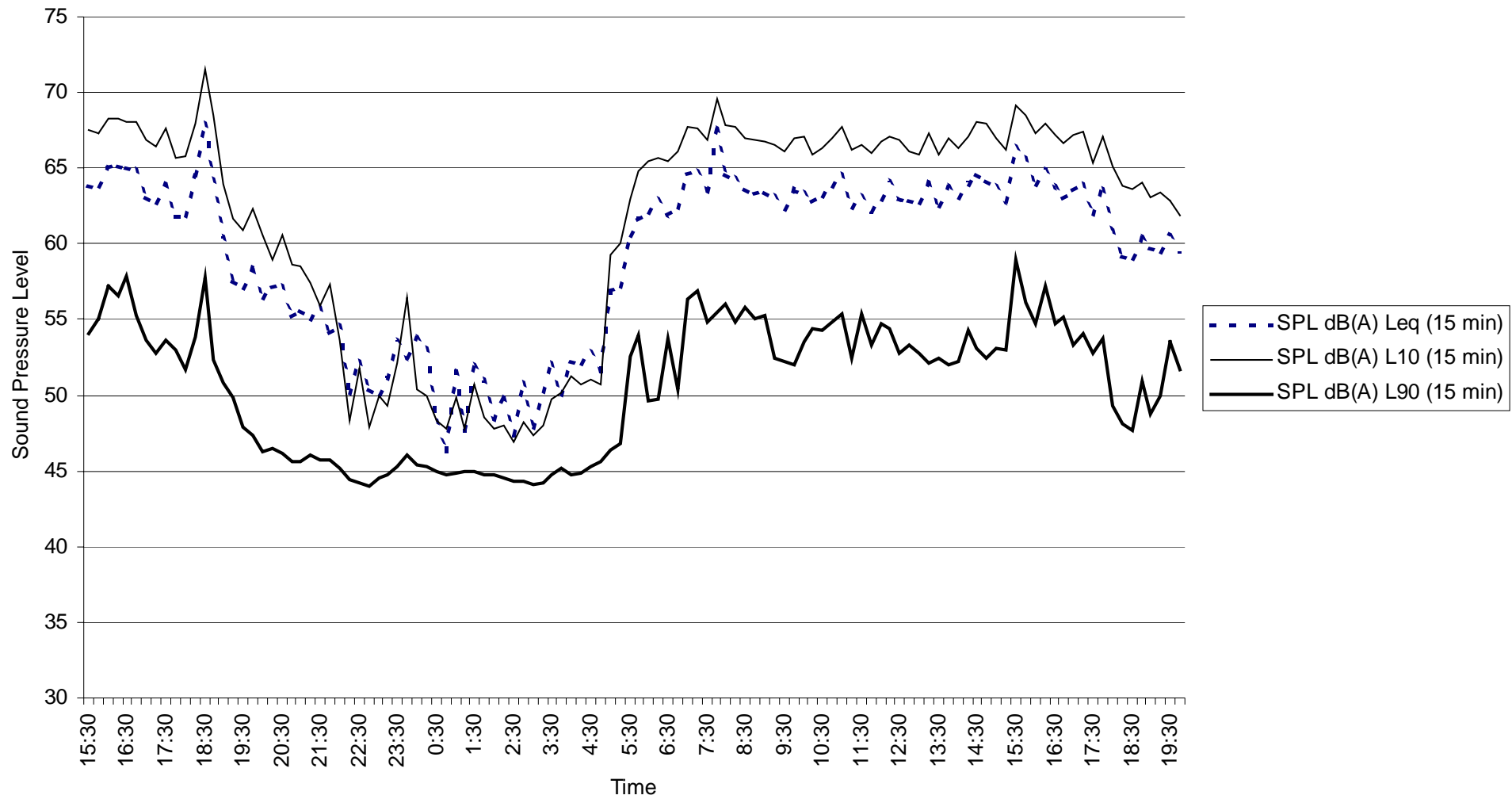
Building facade at receiver: +2.5
User's overall adjust to CRTN: 0

Rw Calculations to AS3671

BASED UPON TYPICAL FLOOR PLAN

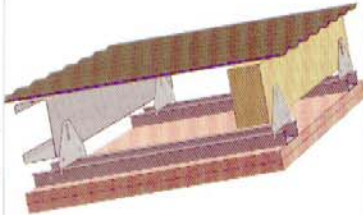
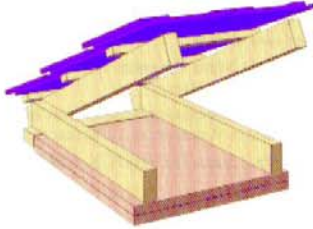
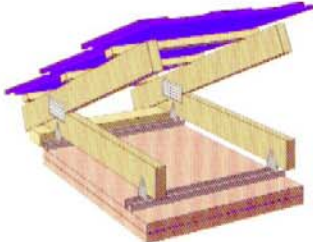
Space	Building Component	Impact dB(A)	Criteria dB(A)	TNR dB(A)	Element Area (m2)	Floor Area (m2)	Height (m)	RT60 (s)	C	TNA	Rw
Lot 9-18 + Northern Cluster Detached houses Top Floor - Facing Roadway											
Main bedroom	Window	57.0	30	27.0	3.80	20.00	2.20	0.50	3	25.91	32
Main bedroom	Walls	57.0	30	27.0	20.00	12.00	2.20	0.50	3	35.34	41
Main bedroom	Roof	57.0	30	27.0	14.00	12.00	2.20	0.50	3	33.79	40
2nd bedroom	Window	57.0	30	27.0	2.60	16.00	2.20	0.50	3	25.23	31
2nd bedroom	Walls	57.0	30	27.0	52.00	12.00	2.20	0.50	3	39.49	45
2nd bedroom	Roof	57.0	30	27.0	17.00	12.00	2.20	0.50	3	34.63	41
Lot 9-18 + Northern Cluster Detached house Top Floor - 90 Ddegrees to Roadway											
Main bedroom	Window	54.0	30	24.0	3.80	20.00	2.20	0.50	3	22.91	29
Main bedroom	Walls	54.0	30	24.0	20.00	12.00	2.20	0.50	3	32.34	38
Main bedroom	Roof	54.0	30	24.0	14.00	12.00	2.20	0.50	3	30.79	37
2nd bedroom	Window	54.0	30	24.0	2.60	16.00	2.20	0.50	3	22.23	28
2nd bedroom	Walls	54.0	30	24.0	52.00	12.00	2.20	0.50	3	36.49	42
2nd bedroom	Roof	54.0	30	24.0	17.00	12.00	2.20	0.50	3	31.63	38
Lot 1-8 Top Floor - Facing Roadway											
Main bedroom	Window	62.0	30	32.0	3.80	20.00	2.20	0.50	3	30.91	37
Main bedroom	Walls	62.0	30	32.0	20.00	12.00	2.20	0.50	3	40.34	46
Main bedroom	Roof	62.0	30	32.0	14.00	12.00	2.20	0.50	3	38.79	45
2nd bedroom	Window	62.0	30	32.0	2.60	16.00	2.20	0.50	3	30.23	36
2nd bedroom	Walls	62.0	30	32.0	52.00	12.00	2.20	0.50	3	44.49	50
2nd bedroom	Roof	62.0	30	32.0	17.00	12.00	2.20	0.50	3	39.63	46

North Angels Beach 03/02/03 - 04/02/03



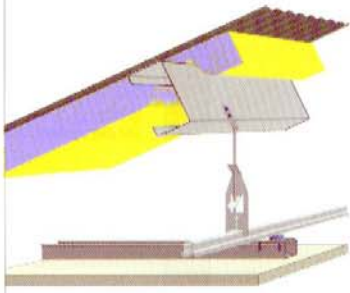
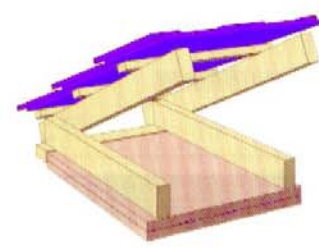
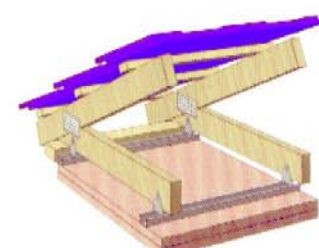
Roof/Ceiling Systems.

RISF = Resistance to Incipient Spread of Fire.

<p>FRL 90/90/90 and RISF for 60 minutes</p> <p>Report/Opinion CSIRO FCO 1373</p>	<h2>CSR 865</h2>		<p>R_w 43 – 49</p>						
	<ul style="list-style-type: none"> • A low slope metal roof. • Timber or Steel Purlins at 1200mm maximum centres. • RONDO Furring Channel at 600mm maximum centres, fixed to purlin with fixing clips (N°226). • 2 layers x 16mm GYPROCK FYRCHEK plasterboard fixed to furring channel. 								
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr style="background-color: #FFFF00;"> <th style="text-align: left;">INSULATION INFILL</th> <th style="text-align: center;">R_w</th> <th style="text-align: center;">IIC</th> </tr> </thead> <tbody> <tr> <td>(a) Nil</td> <td style="text-align: center;">43</td> <td style="text-align: center;">–</td> </tr> <tr> <td>(b) Bradford R2.0 Glasswool Batts</td> <td style="text-align: center;">49</td> <td style="text-align: center;">–</td> </tr> </tbody> </table>			INSULATION INFILL	R _w	IIC	(a) Nil	43	–
INSULATION INFILL	R _w	IIC							
(a) Nil	43	–							
(b) Bradford R2.0 Glasswool Batts	49	–							
<p>FRL 90/90/90 and RISF for 60 minutes</p> <p>Report/Opinion CSIRO FCO 1373</p>	<h2>CSR 871</h2>		<p>R_w 38 – 44</p>						
	<ul style="list-style-type: none"> • A pitched tiled roof with sarking. or • A sheetmetal roof with minimum 50mm Bradford Anticon insulation over battens. • Timber Ceiling Joists or Trusses at 600mm maximum centres. • 2 layers x 16mm GYPROCK FYRCHEK plasterboard fixed directly to joists/bottom chord. 								
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr style="background-color: #FFFF00;"> <th style="text-align: left;">INSULATION INFILL</th> <th style="text-align: center;">R_w</th> <th style="text-align: center;">IIC</th> </tr> </thead> <tbody> <tr> <td>(a) Nil</td> <td style="text-align: center;">38</td> <td style="text-align: center;">–</td> </tr> <tr> <td>(b) Bradford R2.0 Glasswool Batts</td> <td style="text-align: center;">44</td> <td style="text-align: center;">–</td> </tr> </tbody> </table>			INSULATION INFILL	R _w	IIC	(a) Nil	38	–
INSULATION INFILL	R _w	IIC							
(a) Nil	38	–							
(b) Bradford R2.0 Glasswool Batts	44	–							
<p>FRL 90/90/90 and RISF for 60 minutes</p> <p>Report/Opinion CSIRO FCO 1373</p>	<h2>CSR 876</h2>		<p>R_w 43 – 49</p>						
	<ul style="list-style-type: none"> • A pitched tiled roof with sarking. or • A sheetmetal roof with minimum 50mm Bradford Anticon insulation over battens. • Timber Trusses at 1200mm maximum centres. • RONDO Furring Channel at 600mm maximum centres, fixed to truss bottom cord with fixing clips (N°226). • 2 layers x 16mm GYPROCK FYRCHEK plasterboard fixed to furring channel. 								
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr style="background-color: #FFFF00;"> <th style="text-align: left;">INSULATION INFILL</th> <th style="text-align: center;">R_w</th> <th style="text-align: center;">IIC</th> </tr> </thead> <tbody> <tr> <td>(a) Nil</td> <td style="text-align: center;">43</td> <td style="text-align: center;">–</td> </tr> <tr> <td>(b) Bradford R2.0 Glasswool Batts</td> <td style="text-align: center;">49</td> <td style="text-align: center;">–</td> </tr> </tbody> </table>			INSULATION INFILL	R _w	IIC	(a) Nil	43	–
INSULATION INFILL	R _w	IIC							
(a) Nil	43	–							
(b) Bradford R2.0 Glasswool Batts	49	–							

Roof/Ceiling Systems.

RISF = Resistance to Incipient Spread of Fire.

CSR 860			R_w 42 – 50
FRL - / - / -	<ul style="list-style-type: none"> • Metal deck roof • Bradford R1.5 Glasswool Batts over steel purlins hard under roof. • RONDO Concealed Grid Suspended Ceiling System with Top Cross Rail Hangers and Top Cross Rails installed at 1200 x 1200mm maximum centres. • RONDO Furring Channel at 600mm maximum centres, clipped to Top Cross Rail at each cross-over point with a CSR Resilient Mount. • 1 layer x 13mm GYPROCK Plasterboard CD fixed to furring channels. 		
INSULATION INFILL		R _w	IIC
(a) Nil		42	-
(b) Bradford R2.0 Glasswool Batts on ceiling		50	-
CSR 870			R_w 38 – 44
FRL 60/60/60 and RISF for 60 minutes Report/Opinion CSIRO FCO 1373	<ul style="list-style-type: none"> • A pitched tiled roof with sarking. or • A sheetmetal roof with minimum 50mm Bradford Anticon insulation over battens. • Timber Ceiling Joists or Trusses at 600mm maximum centres. • 1 layer x 13mm GYPROCK FYRCHEK + • 1 layer x 16mm GYPROCK FYRCHEK plasterboard fixed directly to joists/bottom chord. <p style="margin-top: 10px;"><i>NOTE: 13mm Gyprock Fyrchek plasterboard must be applied first.</i></p>		
INSULATION INFILL		R _w	IIC
(a) Nil		38	-
(b) Bradford R2.0 Glasswool Batts		44	-
CSR 875			R_w 43 – 49
FRL 60/60/60 and RISF for 60 minutes Report/Opinion CSIRO FCO 1373	<ul style="list-style-type: none"> • A pitched tiled roof with sarking. or • A sheetmetal roof with minimum 50mm Bradford Anticon insulation over battens. • Timber Trusses at 1200mm maximum centres. • RONDO Furring Channel at 600mm maximum centres, fixed to truss bottom cord with fixing clips (N°226). • 1 layer x 13mm GYPROCK FYRCHEK + • 1 layer x 16mm GYPROCK FYRCHEK plasterboard fixed to furring channels. <p style="margin-top: 10px;"><i>NOTE: 13mm Gyprock Fyrchek plasterboard must be applied first.</i></p>		
INSULATION INFILL		R _w	IIC
(a) Nil		43	-
(b) Bradford R2.0 Glasswool Batts		49	-