Technical Report 6 – Noise Assessment

YOUNG TO WELLINGTON GAS PIPELINE

EA CONSTRUCTION NOISE ASSESSMENT

ACOUSTICS AND AIR

REPORT NO. 00514
VERSION B

WILKINSON MURRAY

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PREPARED FOR

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1 INTRODUCTION

ERM Power Pty. Ltd. proposes to construct a 219 kilometre natural gas pipeline from the Young gas hub centre on the Moomba to Sydney gas pipeline to the, newly approved, yet to be constructed, gas turbine peaking power station at Wellington.

Wilkinson Murray have been engaged to conduct an assessment of noise and vibration impacts resulting from the construction of this pipeline, suitable for inclusion in the proposal's Environmental Assessment.

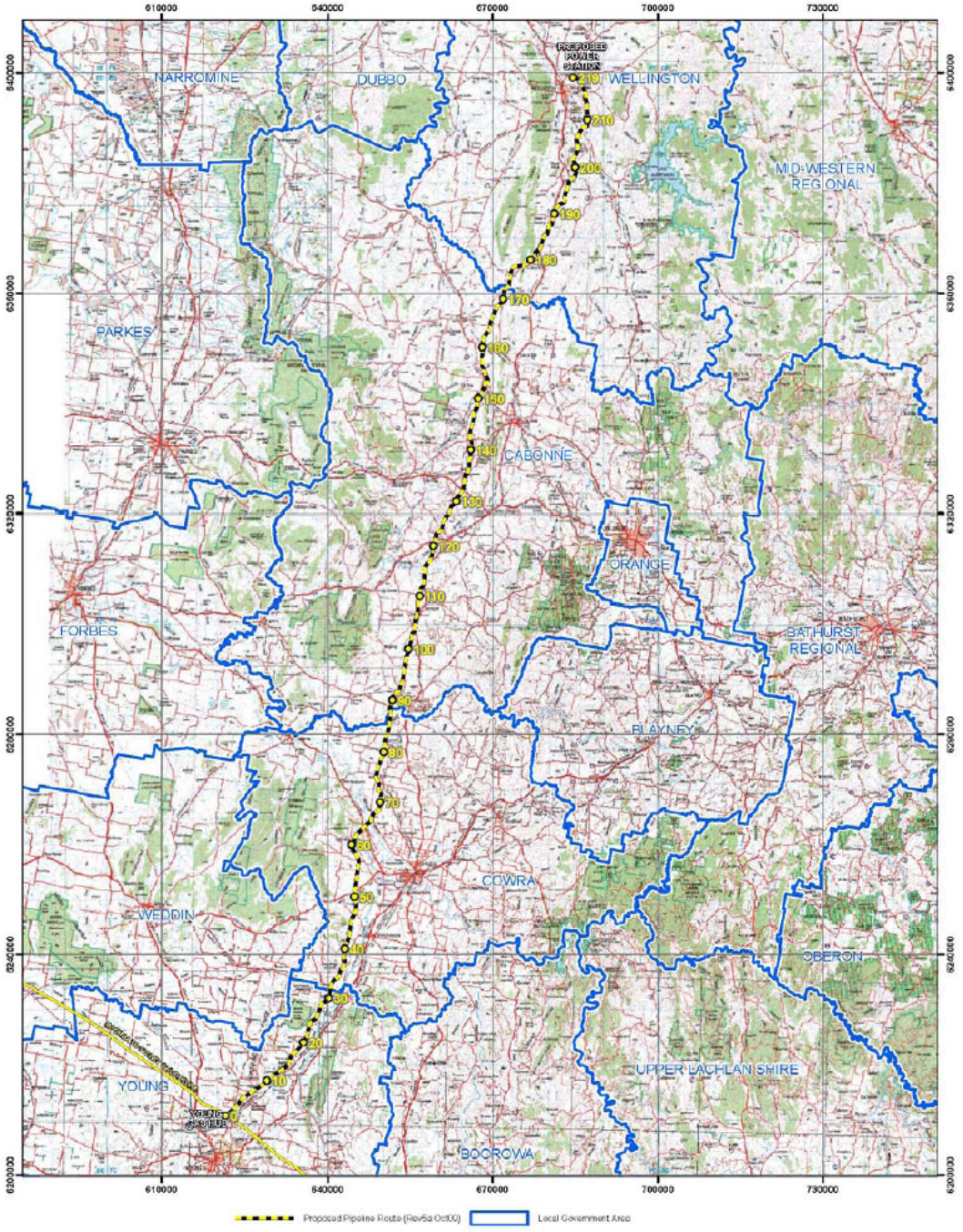
Wilkinson Murray understands that there are no pumping or compressor stations or other operational components that would result in a potential noise impact. Therefore our assessment is limited to impacts arising from the construction process.

2 ROUTE DESCRIPTION

The proposed route is shown in Figure 2-1.

The proposed route passes through predominantly rural areas. The route has been selected to maximise the distance to dwellings, whilst considering other important factors such as vegetation and waterways. Therefore the noise and vibration impacts are considered to have been minimized in this regard.

Figure 2-1 Proposal Route



3 SENSITIVE RECEIVERS

Table 3-1 presents the sensitive receivers surrounding the proposal. These have been provided by Landpartners Ltd. These receivers are shown in Appendix T of the project's EA.

Table 3-1 Sensitive Receivers

Receiver Number	Easting	Northing	KP	Distance to Proposal (m)	Feature
1	621886.91	6210594.7	0.36	121.446	Dwelling
2	622145.28	6210841.2	0.57	164.534	Dwelling
3	622954.2	6212135.1	2.22	-279.172	Dwelling & Sheds
4	623455.57	6211784.9	2.24	332.009	Dwelling
5	623872.5	6213710.2	4.08	-581.074	Dwelling & Sheds
6	624458.98	6214186.7	4.66	-455.894	Dwelling & Sheds
7	625666.29	6214318.1	5.75	86.589	Dwelling
8	630414.73	6218499.5	12.05	-314.322	Dwelling
9	630486.99	6218434.7	12.07	-221.232	Dwelling
10	631685.54	6218255.8	13.04	613.472	Dwelling & Sheds
11	632525.95	6219096.8	14.14	494.729	Dwelling &Sheds
12	633050.7	6219434.3	14.76	575.302	Dwelling
13	633294.31	6219649	15.08	568.379	Dwelling
14	632535.44	6220791.8	15.76	-482.646	Dwelling
15	633985.34	6221445	16.98	429.446	Dwelling & Sheds
16	635758.65	6223429	19.89	510.552	Dwelling & Sheds
17	636081.59	6225776	22.12	-271.727	Dwelling & Sheds
18	637548.86	6227465.1	24.42	592.408	Dwelling & Sheds
19	639029.03	6230430	27.71	379.736	Dwelling
20	639144.43	6231793.3	28.82	-553.729	Dwelling
21	639834.03	6232275.9	30.15	-332.263	Dwelling
22	640263.79	6234338.1	32.16	-281.902	Dwelling
23	641824.48	6235311.4	34.02	446.813	Dwelling
24	642615.22	6236048.2	34.75	537.196	Dwelling
25	642317.12	6238137.4	36.85	-588.204	Dwelling
26	644267.62	6243131.3	42.31	489.955	Dwelling & Sheds
27	644521.65	6244515.5	43.68	483.929	Dwelling
28	644387.74	6247031.9	46.09	-246.569	Dwelling
29	644341.85	6251670.9	51.11	-535.237	Dwelling & Sheds
30	645454.12	6252274.2	51.89	461.604	Dwelling
31	645025.16	6253347.2	52.88	-133.128	Dwelling
32	645459.91	6255066.2	54.64	96.31	Dwelling
33	645822.77	6255488	55.1	406.096	Dwelling

Receiver Number	Easting	Northing	KP	Distance to Proposal (m)	Feature
34	645733.74	6256898.3	56.47	190.877	Dwelling
35	644470.24	6258303.6	58.32	-482.251	Dwelling
36	644672.23	6259451.7	59.21	270.303	Dwelling
37	644286.73	6260537.7	60.26	-379.11	Dwelling
38	644774.52	6259889.5	60.32	430.093	Dwelling
39	644544.43	6260607.4	60.78	-217.518	Dwelling
40	646502.61	6262544.5	63.56	391.499	New Dwelling & Sheds
41	646959.83	6263681.4	64.66	-164.918	Dwelling
42	647938.52	6263707.4	65.55	543.315	Dwelling & Sheds
43	647452.64	6264526.7	65.59	-408.08	Dwelling & Sheds
44	647279.82	6264796.6	65.6	-728.504	Dwelling
45	647872.17	6263916.2	65.61	332.61	Dwelling
46	648242.15	6264166.8	65.99	355.009	Dwelling
47	648816.79	6265314	67.65	530.001	Dwelling
48	648846.58	6265486	67.76	395.679	Dwelling
49	649398	6271837	74.34	487.147	Dwelling
50	648568.54	6271567.1	74.48	-374.492	Dwelling
51	649235.12	6272439.4	75.29	421.445	Dwelling & Sheds
52	649767.72	6276766.3	79.84	-392.355	Dwelling
53	650525.44	6276845.2	80.05	339.519	Dwelling
54	650184.95	6279766	82.89	-436.963	Dwelling
55	650979.57	6279930.6	83.23	320.189	Dwelling
56	650306.34	6280348.5	83.48	-535.977	Dwelling
57	650378.96	6280346.7	83.5	-465.304	Dwelling
58	651116.58	6281912.2	85.27	-73.732	Dwellings
59	651022.53	6281984.4	85.36	-159.763	Dwelling
60	650991.81	6282060.6	85.44	-182.395	Dwelling
61	651105.57	6282367.7	85.71	-105.712	Dwelling
62	651864.37	6283394.5	86.95	521.96	Dwelling
63	650899.95	6285183.3	88.49	-544.472	Dwelling
64	651787.18	6284768.2	88.56	432.933	Dwelling
65	651601.09	6284913.9	88.6	199.646	Dwelling
66	651341.83	6285915.8	89.5	-327.985	Dwelling
67	652119.28	6286400.3	90.11	354.96	Dwelling
68	653449.46	6287790.9	92.13	573.607	Dwelling & Sheds
69	652679.83	6288187.2	92.22	-287.268	Dwelling & Sheds
70	652491.04	6288386.3	92.34	-535.287	Dwelling
71	653669.89	6288809.3	93.16	410.693	Dwelling & Sheds
72	653870.38	6288809.7	93.23	597.464	Dwelling

Receiver Number	Easting	Northing	KP	Distance to Proposal (m)	Feature
73	655661.42	6296703.6	101.31	532.88	Dwelling & Sheds
74	654852.81	6297368	101.8	-352.094	Dwelling & Sheds
75	655386.27	6298913.9	103.51	-324.79	Dwelling & Sheds
76	656283.23	6300074.9	104.77	413.91	Dwelling & Sheds
77	656366.6	6300789	105.68	366.185	Dwelling
78	656067.98	6302777.3	107.56	-305.133	Dwelling
79	656738.77	6303269.4	108.05	369.603	Dwelling
80	656231.44	6304986.9	109.82	-468.302	Dwelling
81	657211.02	6305890.2	110.82	408.217	Dwelling
82	656980.04	6308608.8	113.8	-545.283	Dwelling
83	657025.7	6308816.1	113.93	-518.739	Dwelling
84	659079.67	6314692.3	120.09	-550.068	Dwelling & Sheets
85	660646.96	6318656.1	125.17	-290.836	Dwelling & Sheds
86	660959.38	6319424.2	125.71	-502.077	Dwelling & Sheds
87	661713.41	6319511.1	126.51	202.868	Dwelling
88	662077.88	6319471.8	126.72	503.395	Dwelling & Sheds
89	664287.28	6324421.5	132.45	-315.805	Dwelling
90	664121.06	6324522.4	132.53	-495.587	Dwelling
91	664318.37	6326237.9	134.25	-565.131	Dwelling
92	665183.37	6329084	137.29	-460.731	Dwelling
93	666487.38	6331457.2	139.83	489.407	Dwelling & Sheds
94	666435.17	6333752.2	141.8	551.491	Dwelling
95	665560.61	6333650	142.22	-223.679	Dwelling & Sheds
96	666918.82	6336285.3	144.94	613.319	Dwelling
97	666034.28	6338367.2	146.72	-426.641	Dwelling & Sheds
98	666917.22	6338279	147.16	305.682	Dwelling & Sheds
99	667694.72	6340061.7	148.96	516.13	Dwelling & Sheds
100	667975.6	6343339.6	152.39	-545.416	Dwelling & Sheds
101	668529.09	6343721.1	152.81	-172.538	Dwelling & Sheds
102	670844.72	6356878.3	167.15	345.914	Dwelling
103	671461.46	6359675.9	170.33	-538.487	Dwelling & Sheds
104	673704.56	6363982.7	175.22	361.798	Dwelling
105	680320.7	6370924.3	185.76	362.025	Dwelling & Sheds
106	680512.38	6373059.9	188.32	-339.04	Dwelling & Sheds
107	680664.3	6373724.8	188.95	-353.22	Dwelling & Sheds
108	680628.19	6374034	189.24	-482.112	Dwelling & Sheds
109	680708.01	6374305.8	189.65	-465.64	Dwelling & Sheds
110	680963.98	6375168.1	190.37	-448.129	Dwelling & Sheds
111	683357.76	6377689.1	193.93	244.054	Dwelling & Sheds

Receiver Number	Easting	Northing	KP	Distance to Proposal (m)	Feature
112	685222.45	6383752.2	200.6	374.405	Dwelling & Sheds
113	684818.68	6384656.3	201.65	122.105	Dwelling & Sheds
114	684357.74	6384631.7	201.7	-337.208	Dwelling & Sheds
115	685461.26	6388095.1	205.44	187.293	Dwelling & Sheds
116	685897.66	6390317.4	207.6	-571.271	Dwelling
117	686940.06	6391183	209.38	-234.406	Dwelling & Sheds
118	686353.8	6393492.7	211.72	-587.146	Dwelling
119	686386.88	6393622.4	211.72	-587.146	Dwelling
120	686391.23	6393599.8	211.72	-587.146	Dwelling
121	686406.9	6393531	211.72	-587.146	Dwelling
122	686396.46	6393657.3	211.76	-576.383	Dwelling
123	686404.29	6393685.1	211.79	-576.714	Dwelling
124	686410.38	6393710.4	211.81	-577.979	Dwelling
125	686416.48	6393736.5	211.84	-579.49	Dwelling
126	686421.7	6393762.6	211.87	-581.836	Dwelling
127	686075.2	6396691.9	215.32	-537.313	Dwelling & Sheds
128	685182.46	6398330.4	217.19	-488.876	Dwelling & Sheds

4 ASSESSMENT METHODOLOGY

Construction will occur over a significant length. The works will be progressive and therefore the duration of impacts to any receiver, or group of receivers, will be limited.

With this considered, and also that sensitive receivers are sporadically located along the proposal's length, a traditional assessment is considered impractical.

Wilkinson Murray have proposed the following methodology, which has been accepted as appropriate by the Department of Planning:

- Background noise levels have been assumed to be the minimum under the NSW *Industrial Noise Policy*, i.e. 30dBA, for all receivers along the proposal. History has shown that for rural areas this assumption is reasonable and, if anything, introduces an element of conservatism to the assessment.
- Receiver noise levels have been predicted based on the provided distances using generic attenuation due to spherical spreading, ground absorption and air absorption. Again this assumption may be conservative as it neglects topographic features such as shielding and detailed ground absorption which would traditionally be incorporated into a noise model.

5 CONSTRUCTION METHODOLOGY

The construction works associated with the installation of the gas supply pipeline are detailed in Figure 5-1, based on information provided by Landpartners Ltd. Pipeline construction would proceed progressively along the route, with construction in any one location only 1-3 days. The overall duration of construction is expected to be four to five months.

Figure 5-1 Gas Pipeline Construction

	Construction Activity	Required Plant / Equipment
A	Ground clearance and soil separation	Grader, dozer, backhoe, tip trucks
B	Pipe haul and string	Semi-trailer trucks, mobile crane
C	Excavation	Dozer with ripper, excavator, trenching machine, tip trucks, backhoe, front end loader
D	Welding and x-ray joint wrapping	4WDs with trailers, generator
E	Pipe lay	Directional drilling rig and side booms
F	Backfill and topsoil spreading	Grader, dozer, backhoe, tip trucks
G	Seeding and restoration	Tractor and seeder

5.1 Construction Hours

Construction is proposed to occur generally between 6.00am to 6.00pm, seven days a week. Where required, work will be undertaken on a 24 hour basis.

6 NOISE & VIBRATION CRITERIA

6.1 Construction Noise Criteria

The NSW DECCW's *Interim Construction Noise Guidelines (ICNG)* recommends the following objectives:

Recommended standard hours of work

- Monday to Friday 7am to 6pm
- Saturday 8am to 1pm
- No work on Sundays or Public Holiday

Management Noise Goals

Noise goals are detailed in Table 6-1.

Table 6-1 Noise at Residences using Quantitative Assessment

Time of Day	Management Level $L_{Aeq,15min}$	How to Apply
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq,15\ min}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.

Construction is proposed to occur generally between 6.00am to 6.00pm, seven days a week.

The time period between 6.00am to 7.00am is outside the standard construction hours and is also considered to be in the night time period, when the potential for sleep disturbance needs to be considered.

Work on Sundays and outside 8.00am to 1.00pm on Saturdays is also outside the standard construction hours.

Work outside standard construction hours that does not have a strong justification for the work being done at this time (such as being in the public interest or due to availability of infrastructure [roads or railways]) requires justification that the noise impacts are sufficiently low that receivers are unlikely to be affected. In the past Wilkinson Murray has suggested that a quantitative level of RBL – 5 dBA is sufficiently close to being inaudible that it is acceptable.

In this case the background noise levels have been assumed to be 30 dBA, however it is likely that lower background levels exist at some receivers at night. Therefore a noise level of 25 dBA might actually be greater than the actual background noise level. This is offset, in our opinion, by the absolute magnitude of the noise. An external noise level of 25 dBA equates to an internal noise level of 15 dBA, assuming a 10 dB attenuation through an open window. This internal level is similar or less than a typical internal background noise level due to household appliances (fridges etc.) and is likely to be very nearly inaudible in most receivers. Therefore an external noise level of 25 dBA is recommended as being appropriate for work to proceed outside standard construction hours, without the need to demonstrate reasons that works are required during these times.

Note that the above reasoning is most applicable to works in the middle of the night. Works on weekends during the daytime, which are still outside standard construction hours, are considered unlikely to generate complaints if a level of 35 dBA is achieved, especially considering the limited duration of works in any 1 area.

Table 6-2 shows relevant construction noise goals, based on the assumed RBL values.

Table 6-2 Construction Noise Goals

RBL – All Receivers (dBA)	Acceptable L_{Aeq} Noise Level			
	Standard Construction Hours RBL + 10 (dBA)	Outside Standard Construction Hours		
		With Justification RBL + 5 (dBA)	Without Justification, RBL – 5 (dBA)	
			Night	Daytime
30	40	35	25	35

There is a requirement at night to meet sleep disturbance criteria outlined in the ICNG for the intermittent/impulsive noise at night. The ICNG requires quantitative assessment of the potential for sleep disturbance if works will occur for more than two consecutive nights. The ICNG refers to the *Environmental Criteria for Road Traffic Noise* (ECRTN) for guidance on applicable sleep disturbance criteria. A commonly used criteria for assessment of sleep disturbance, which is specified in the DECCW's Noise Guide for Local Government (NGLG), is the $L_{A1,1min}$ should not exceed the background noise level by more than 15dBA. This applies to the level of construction noise external to any residence or other noise-sensitive receiver for the night period (10pm-7am).

Table 6-3 Sleep Disturbance Construction Noise Goals

RBL – All Receivers (dBA)	Acceptable $L_{A1,1min}$ Noise Level Night (dBA)
30	45

There is evidence in the appendices to the ECRTN to suggest that external noise levels of this magnitude are insufficient to cause awakening reactions. Therefore this criterion is considered conservative.

6.2 Construction Vibration Criteria

The following vibration impacts need to be considered:

- human exposure to vibration; and
- the potential for building damage from vibration.

6.2.1 Human Exposure to Vibration

The proposed construction activities are likely to produce vibration which is intermittent in nature with a low crest factor. Thus it is suitably assessed using the eVDV parameter, however for simplicity of assessment goal levels for continuous vibration have been conservatively applied.

Table 6-4 Preferred and Maximum Weighted RMS Values for Continuous Vibration Acceleration (m/s^2) in Residences – 1-80 Hz

	Preferred PPV (mm/s)		Maximum PPV (mm/s)	
Period	**z-axis**	**x- and y- axis**	**z-axis**	**x- and y- axis**
Day (7am – 10pm)	0.010	0.0071	0.020	0.014
Night (10pm – 7am)	0.007	0.005	0.014	0.010

For construction vibration it is reasonable to expect that some impacts from vibration will be tolerated.

6.2.2 Building Damage from Vibration

The most vibration intensive construction plant is typically rock breakers or vibratory rollers. It is anticipated that these will be necessary for limited portions of construction. This assessment considers them as a contingency only.

Typically the dominant frequency of vibration associated with these activities is in the 31.5 – 80 Hz third-octaves. DIN4150 states that a suitable goal level for this frequency is between 5-10 mm/s PPV for residential dwellings. Below these levels DIN4150 states that vibration is not considered to have potential to cause building damage,

Conservatively we have adopted a goal level of 5 mm/s.

6.2.3 Blasting Assessment Criteria

It is unlikely that blasting will be required for the project. In the event that blasting is required it should be designed by a competent professional to conform with the following criteria.

6.2.3.1 Annoyance & Discomfort Due to Blasting

For assessment of annoyance due to blasting, the DECCW (and most similar authorities in Australia) has adopted guidelines produced by the Australian and New Zealand Environment and Conservation Council (ANZECC). The fundamental criteria are that at any residence or other

sensitive location:

- The maximum overpressure due to blasting should not exceed 115dB for more than 5% of blasts in any year, and should not exceed 120dB for any blast; and
- The maximum peak particle ground velocity should not exceed 5mm/sec for more than 5% of blasts in any year, and should not exceed 10mm/sec for any blast.

6.2.3.2 Structural Damage Due to Blasting

At sufficiently high levels, blast overpressure may in itself cause structural damage to some building elements such as windows. However, this occurs at peak overpressure levels of about 133dB and above, well in excess of criteria for annoyance.

For assessment of damage due to ground vibration, *Australian Standard AS2187.2-1993 Explosives – Storage, Transport and Use* contains an appendix specifying recommended levels for peak particle vibration velocity to protect typical buildings from damage. These are:

- "Structures that may be particularly susceptible to ground vibration" – 5mm/sec
- "Houses and low-rise residential buildings; commercial buildings not included below" – 10mm/sec
- "Commercial and industrial buildings or structures of reinforced concrete or steel construction" – 25mm/sec

7 NOISE SOURCE LEVELS

Table 7-1 Typical Construction Plant Sound Power Levels (SWL)

Plant	L_{Aeq} SWL (dBA)	$L_{A1,1min}$ SWL
Concrete Adgi/Vibro	108	111
Excavators	100-110	115
Rock Breaker	118	123
Backhoe	105	113
Generators	90	92
Front End Loader	111	113
Grader	107	112
Directional Drilling Rig	107	110
Vibratory Roller	101	105
Cranes	105-111	115
Truck	105	112
Tip Truck	105	112
Dozer	115	120

Note that the above sound power levels depend greatly on the type and size of equipment used and also the manner in which it is operated. We have assumed realistic size plant equipment will be used in a careful, considerate manner so as to minimize noise impacts whilst working in the vicinity of surrounding receivers.

Based on the sound power levels in Table 7-1 the following sound power levels have been assumed for each stage of construction.

In any scenario, all pieces of equipment are not necessarily operating at their loudest simultaneously. Hence, for each scenario, a correction is applied to the total SWL from all equipment, to represent the maximum likely SWL emitted at any one time.

Note that the ICNG requires a correction for annoying sound characteristics such as impulsiveness or tonality. The application of such a penalty for these characteristics needs to be assessed at the residence, i.e. the character of the sound that the resident is exposed to. Due to the significant distance between the source and receiver, and the consequently attenuated sound level at the receiver, no corrections are considered appropriate for the likely construction scenarios.

Table 7-2 Construction Sound Power Levels

	Construction Activity	Required Plant / Equipment	SWL (dBA)	
			L_{Aeq}	$L_{A1,1min}$
A	Ground clearance and soil separation	Grader, dozer, backhoe, tip trucks	115	120
B	Pipe haul and string	Semi-trailer trucks, mobile crane	111	115
C	Excavation	Dozer with ripper, excavator, trenching machine, tip trucks, backhoe, front end loader	115	120
D	Welding and x-ray joint wrapping	4WDs with trailers, generator	95	99
E	Pipe lay	Directional drilling rig and side booms	107	110
F	Backfill and topsoil spreading	Grader, dozer, backhoe, tip trucks	115	120
G	Seeding and restoration	Tractor and seeder	95	99

It should be noted that the use of the dozer contributes heavily to the overall noise emissions in many of the above scenarios. Emissions from other plant items in these scenarios, with the exclusion of the dozer, are likely to be approximately 5dB less than those presented.

8 NOISE LEVEL PREDICTIONS

Receiver noise levels were predicted accounting for attenuation due to distance, ground absorption and air absorption.

Appendix B presents the predicted noise levels for all identified receivers.

Exceedances of the noise level criteria are expected when the works are in the vicinity of sensitive receivers.

In order to manage noise impacts it is recommended that construction works be limited to standard construction hours when they are within a nominated distance of sensitive receivers.

Generally the use of the dozer dominates noise levels. Other noise generating equipment is approximately 5dB below the noise level of the dozer. Quieter activities, such as seeding and welding are a further 10-15dB below. Therefore buffer distances have been calculated for 3 construction scenarios.

- Dozer works – any works requiring the use of the dozer.
- High noise emitting works not requiring the dozer – e.g. drilling, pipe haul and string, other stages when the dozer is not required.
- Low noise emitting works – typically involving 4WDs and generators, e.g. welding, seeding.

Table 8-1 Recommended Buffer Distance for Night Works With Justification

Scenario	Criteria (dBA)		Assumed SWL (dBA)		Buffer Distance (m)
	$L_{A1,1min}$	L_{Aeq}	$L_{A1,1min}$	L_{Aeq}	
Dozer	45	35	120	115	800
High Noise			115	110	600
Low Noise			100	95	250

Table 8-2 Recommended Buffer Distance for Night Works Without Justification

Scenario	Criteria (dBA)		Assumed SWL (dBA)		Buffer Distance (m)
	$L_{A1,1min}$	L_{Aeq}	$L_{A1,1min}$	L_{Aeq}	
Dozer	45	25	120	115	1400
High Noise			115	110	1100
Low Noise			100	95	500

Table 8-3 Recommended Buffer Distance for Weekend Day/Evening Works

Scenario	Criteria (dBA)	Assumed SWL (dBA)	Buffer Distance (m)
	L_{Aeq}	L_{Aeq}	
Dozer	35	115	800
High Noise		110	600
Low Noise		95	250

For some works, such as directional drilling, it may be necessary to conduct work 24 hours for engineering reasons. If these works are required to occur within the above buffer distances it is recommended that receivers within these radii be contacted prior to the works and informed of the expected duration and that some minor impacts may be experienced during the works.

It is recommended that activities with annoying characteristics, such as rock breaking, should not be permitted to occur outside standard construction hours. The noise from these activities could potentially impact receivers several kilometres away and for this reason it is strongly advised that they not occur outside standard hours.

Tonal or beeping reversing alarms are a regular source of complaint. These should not be permitted for use on plant that will operate at night. Squawking type reverse alarms are available and should be implemented. This will also reduce impacts during the day time, thus it is strongly recommended that plant items that will regularly be used on site be fitted with non-tonal reversing alarms.

9 CONSTRUCTION VIBRATION IMPACTS

The majority of equipment expected to be used in the construction does not emit significant vibration. Vibratory rollers and rock hammers are expected to be used sparingly on the project and furthermore their use at night will be avoided, except where they are deemed necessary for critical works. The nearest identified receiver is 74m from the proposal. At this distance both rock breaker and vibratory roller vibration levels will be well below building damage criteria.

With regard to human comfort from vibration, the vibration level from these plant at 74m might be slightly perceptible. During the day these impacts are likely to be comfortably tolerated by residences. During night time these levels may become unacceptable to the nearest receivers however the use of these equipment at night is very unlikely.

With the implementation of the above measures to manage airborne noise it is considered that minimal vibration impacts will result from the construction.

Blasting may be used by the constructors. Prediction of blasting overpressure and groundborne vibration requires precise knowledge of the type of explosive, the amount to be used and the manner in which it will be used. These details are not available at this stage and therefore blasting predictions have not been made. Any blasting should be designed by a competent professional to adhere to the criteria specified in this report.

10 CONCLUSION

Wilkinson Murray have assessed the noise and vibration impacts predicted to result from the construction of the Young to Wellington Gas Pipeline.

Assessment has been done in accordance with relevant DECCW guidelines.

It is recommended that works be limited to standard construction hours whilst they receivers are within the "buffer" distances detailed in this report. With this management it is considered that noise and vibration impacts from the construction will be minimized.

It is recommended that non-tonal reversing alarms be fitted to all plant and that this be a requirement for any plant that will be used outside standard construction hours.

Work outside standard construction hours is required for the project so as to shorten the duration of exposure for residents to construction noise and to make effective use of expert construction personnel who will work remotely on a set roster (e.g. three weeks on and one week off). It is recommended that work during the preferred construction hours and outside the standard construction hours, i.e. 6-7am weekdays, 6-8am and 1-6pm Saturdays and 6am-6pm Sundays, can be permitted to occur within the stated "buffer" distances pursuant to the following conditions:

- Remove all tonal reversing alarms;
- Avoid the use of noisy plant in the early morning period between 6-7am;
- Not permit rock breaking at night;
- Conduct an audit of the noise emissions from the selected plant items once the detailed methodology is finalized and revise the assessment of buffer distances accordingly;
- Negotiate agreements with landowners within the buffers to conduct noisy works outside the standard construction hours with the trade off being that the duration of exposure will be decreased; and
- Implementation of a detailed, real-time complaints handling system with the commitment to investigated noise levels and stop work if required when complaints are received.

It should be noted that the majority of the proposal area is rural in nature. It is quite possible that for the majority of surrounding receivers, the early morning period between 6-7am, which is typically considered to be in the night time period, is not used for sleeping due to their daily routine. As such there may be no additional impacts associated with this time period, as compared with the standard construction hours. This will be identified through the negotiation of working hours within the vicinity of each receiver.

It should also be noted that this assessment is conservative in nature. The client has indicated that a detailed audit of plant to be used for the works will be conducted once this plant has been selected. If the levels are shown to significantly differ from those predicted a revision of the "buffer" distances may be appropriate. Any such revision is expected to decrease the "buffer" distance, i.e. permitting works outside standard construction hours to occur in closer proximity to receivers.

Note

All materials specified by Wilkinson Murray (Sydney) Pty Limited have been selected solely on the basis of acoustic performance. Any other properties of these materials, such as fire rating, chemical properties etc. should be checked with the suppliers or other specialised bodies for fitness for a given purpose. The information contained in this document produced by Wilkinson Murray is solely for the use of the client identified on front page of this report. Our client becomes the owner of this document upon full payment of our **Tax Invoice** for its provision. This document must not be used for any purposes other than those of the document's owner. Wilkinson Murray undertakes no duty to or accepts any responsibility to any third party who may rely upon this document.

Quality Assurance

We are committed to and have implemented AS/NZS ISO 9001:2008 "Quality Management Systems – Requirements". This management system has been externally certified and Licence No. QEC 13457 has been issued.

AAAC

This firm is a member firm of the Association of Australian Acoustical Consultants and the work here reported has been carried out in accordance with the terms of that membership.

Version	Status	Date	Prepared by	Checked by
A	Draft	14 May 2010	Adam Bioletti	Neil Gross
B	Final	20 May 2010	Adam Bioletti	

APPENDIX A

GLOSSARY OF TERMS

GLOSSARY

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are demonstrated in the graph overleaf, are here defined.

Maximum Noise Level (L_{Amax}) – The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

L_{A1} – The L_{A1} level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.

L_{A10} – The L_{A10} level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.

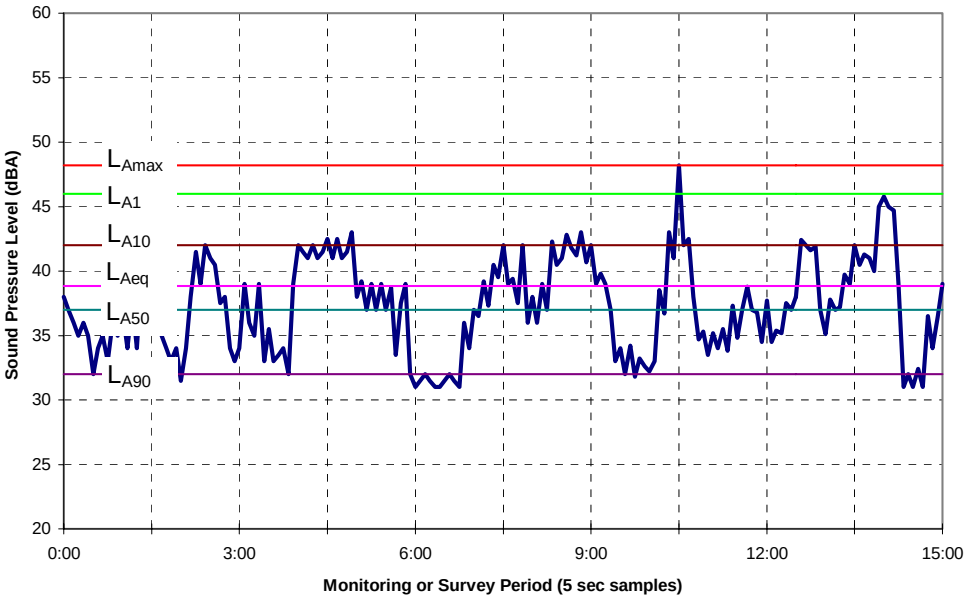
L_{Aeq} – The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.

L_{A50} – The L_{A50} level is the noise level which is exceeded for 50% of the sample period. During the sample period, the noise level is below the L_{A50} level for 50% of the time.

L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

ABL – The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night time) for each day. It is determined by calculating the 10^{th} percentile (lowest 10^{th} percent) background level (L_{A90}) for each period.

RBL – The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period **–** daytime, evening and night time.


60
55
50
45
40
35
30
25
20
Sound Pressure Level (dBA)
LAmax
LA1
LA10
LAeq
LA50
LA90
0:00
3:00
6:00
9:00
12:00
15:00
Monitoring or Survey Period (5 sec samples)

APPENDIX B

NOISE LEVEL PREDICTIONS

Table B-1 Noise Level Predictions - L_{Aeq}

Rec. #	Construction Scenario						
	A	B	C	D	E	F	G
1	62	58	62	42	54	62	42
2	58	54	58	38	50	58	38
3	52	48	52	32	44	52	32
4	50	46	50	30	42	50	30
5	42	38	42	22	34	42	22
6	46	42	46	26	38	46	26
7	65	61	65	45	57	65	45
8	51	47	51	31	43	51	31
9	55	51	55	35	47	55	35
10	41	37	41	21	33	41	21
11	44	40	44	24	36	44	24
12	42	38	42	22	34	42	22
13	42	38	42	22	34	42	22
14	45	41	45	25	37	45	25
15	46	42	46	26	38	46	26
16	44	40	44	24	36	44	24
17	53	49	53	33	45	53	33
18	41	37	41	21	33	41	21
19	48	44	48	28	40	48	28
20	43	39	43	23	35	43	23
21	50	46	50	30	42	50	30
22	52	48	52	32	44	52	32
23	46	42	46	26	38	46	26
24	43	39	43	23	35	43	23
25	42	38	42	22	34	42	22
26	44	40	44	24	36	44	24
27	45	41	45	25	37	45	25
28	54	50	54	34	46	54	34
29	43	39	43	23	35	43	23
30	45	41	45	25	37	45	25
31	61	57	61	41	53	61	41
32	64	60	64	44	56	64	44
33	47	43	47	27	39	47	27
34	57	53	57	37	49	57	37
35	45	41	45	25	37	45	25
36	53	49	53	33	45	53	33
37	48	44	48	28	40	48	28
38	46	42	46	26	38	46	26
39	55	51	55	35	47	55	35
40	48	44	48	28	40	48	28
41	58	54	58	38	50	58	38
42	43	39	43	23	35	43	23
43	47	43	47	27	39	47	27

Rec. #	Construction Scenario						
	A	B	C	D	E	F	G
44	38	34	38	18	30	38	18
45	50	46	50	30	42	50	30
46	49	45	49	29	41	49	29
47	43	39	43	23	35	43	23
48	48	44	48	28	40	48	28
49	45	41	45	25	37	45	25
50	48	44	48	28	40	48	28
51	47	43	47	27	39	47	27
52	48	44	48	28	40	48	28
53	50	46	50	30	42	50	30
54	46	42	46	26	38	46	26
55	50	46	50	30	42	50	30
56	43	39	43	23	35	43	23
57	45	41	45	25	37	45	25
58	66	62	66	46	58	66	46
59	59	55	59	39	51	59	39
60	57	53	57	37	49	57	37
61	63	59	63	43	55	63	43
62	44	40	44	24	36	44	24
63	43	39	43	23	35	43	23
64	46	42	46	26	38	46	26
65	56	52	56	36	48	56	36
66	50	46	50	30	42	50	30
67	49	45	49	29	41	49	29
68	42	38	42	22	34	42	22
69	52	48	52	32	44	52	32
70	43	39	43	23	35	43	23
71	47	43	47	27	39	47	27
72	41	37	41	21	33	41	21
73	43	39	43	23	35	43	23
74	49	45	49	29	41	49	29
75	50	46	50	30	42	50	30
76	47	43	47	27	39	47	27
77	49	45	49	29	41	49	29
78	51	47	51	31	43	51	31
79	49	45	49	29	41	49	29
80	45	41	45	25	37	45	25
81	47	43	47	27	39	47	27
82	43	39	43	23	35	43	23
83	44	40	44	24	36	44	24
84	43	39	43	23	35	43	23
85	52	48	52	32	44	52	32
86	44	40	44	24	36	44	24
87	56	52	56	36	48	56	36
88	44	40	44	24	36	44	24

Rec. #	Construction Scenario						
	A	B	C	D	E	F	G
89	51	47	51	31	43	51	31
90	44	40	44	24	36	44	24
91	42	38	42	22	34	42	22
92	45	41	45	25	37	45	25
93	45	41	45	25	37	45	25
94	43	39	43	23	35	43	23
95	55	51	55	35	47	55	35
96	41	37	41	21	33	41	21
97	47	43	47	27	39	47	27
98	51	47	51	31	43	51	31
99	44	40	44	24	36	44	24
100	43	39	43	23	35	43	23
101	58	54	58	38	50	58	38
102	49	45	49	29	41	49	29
103	43	39	43	23	35	43	23
104	49	45	49	29	41	49	29
105	49	45	49	29	41	49	29
106	50	46	50	30	42	50	30
107	49	45	49	29	41	49	29
108	45	41	45	25	37	45	25
109	45	41	45	25	37	45	25
110	46	42	46	26	38	46	26
111	54	50	54	34	46	54	34
112	48	44	48	28	40	48	28
113	61	57	61	41	53	61	41
114	50	46	50	30	42	50	30
115	57	53	57	37	49	57	37
116	42	38	42	22	34	42	22
117	54	50	54	34	46	54	34
118	42	38	42	22	34	42	22
119	42	38	42	22	34	42	22
120	42	38	42	22	34	42	22
121	42	38	42	22	34	42	22
122	42	38	42	22	34	42	22
123	42	38	42	22	34	42	22
124	42	38	42	22	34	42	22
125	42	38	42	22	34	42	22
126	42	38	42	22	34	42	22
127	43	39	43	23	35	43	23
128	45	41	45	25	37	45	25

Table B-2 Noise Level Predictions – Sleep Disturbance $L_{A1,1min}$

Rec. #	Construction Scenario						
	A	B	C	D	E	F	G
1	67	62	67	46	57	67	46
2	63	58	63	42	53	63	42
3	57	52	57	36	47	57	36
4	55	50	55	34	45	55	34
5	47	42	47	26	37	47	26
6	51	46	51	30	41	51	30
7	70	65	70	49	60	70	49
8	56	51	56	35	46	56	35
9	60	55	60	39	50	60	39
10	46	41	46	25	36	46	25
11	49	44	49	28	39	49	28
12	47	42	47	26	37	47	26
13	47	42	47	26	37	47	26
14	50	45	50	29	40	50	29
15	51	46	51	30	41	51	30
16	49	44	49	28	39	49	28
17	58	53	58	37	48	58	37
18	46	41	46	25	36	46	25
19	53	48	53	32	43	53	32
20	48	43	48	27	38	48	27
21	55	50	55	34	45	55	34
22	57	52	57	36	47	57	36
23	51	46	51	30	41	51	30
24	48	43	48	27	38	48	27
25	47	42	47	26	37	47	26
26	49	44	49	28	39	49	28
27	50	45	50	29	40	50	29
28	59	54	59	38	49	59	38
29	48	43	48	27	38	48	27
30	50	45	50	29	40	50	29
31	66	61	66	45	56	66	45
32	69	64	69	48	59	69	48
33	52	47	52	31	42	52	31
34	62	57	62	41	52	62	41
35	50	45	50	29	40	50	29
36	58	53	58	37	48	58	37
37	53	48	53	32	43	53	32
38	51	46	51	30	41	51	30
39	60	55	60	39	50	60	39
40	53	48	53	32	43	53	32
41	63	58	63	42	53	63	42
42	48	43	48	27	38	48	27
43	52	47	52	31	42	52	31

Rec. #	Construction Scenario						
	A	B	C	D	E	F	G
44	43	38	43	22	33	43	22
45	55	50	55	34	45	55	34
46	54	49	54	33	44	54	33
47	48	43	48	27	38	48	27
48	53	48	53	32	43	53	32
49	50	45	50	29	40	50	29
50	53	48	53	32	43	53	32
51	52	47	52	31	42	52	31
52	53	48	53	32	43	53	32
53	55	50	55	34	45	55	34
54	51	46	51	30	41	51	30
55	55	50	55	34	45	55	34
56	48	43	48	27	38	48	27
57	50	45	50	29	40	50	29
58	71	66	71	50	61	71	50
59	64	59	64	43	54	64	43
60	62	57	62	41	52	62	41
61	68	63	68	47	58	68	47
62	49	44	49	28	39	49	28
63	48	43	48	27	38	48	27
64	51	46	51	30	41	51	30
65	61	56	61	40	51	61	40
66	55	50	55	34	45	55	34
67	54	49	54	33	44	54	33
68	47	42	47	26	37	47	26
69	57	52	57	36	47	57	36
70	48	43	48	27	38	48	27
71	52	47	52	31	42	52	31
72	46	41	46	25	36	46	25
73	48	43	48	27	38	48	27
74	54	49	54	33	44	54	33
75	55	50	55	34	45	55	34
76	52	47	52	31	42	52	31
77	54	49	54	33	44	54	33
78	56	51	56	35	46	56	35
79	54	49	54	33	44	54	33
80	50	45	50	29	40	50	29
81	52	47	52	31	42	52	31
82	48	43	48	27	38	48	27
83	49	44	49	28	39	49	28
84	48	43	48	27	38	48	27
85	57	52	57	36	47	57	36
86	49	44	49	28	39	49	28
87	61	56	61	40	51	61	40
88	49	44	49	28	39	49	28

Rec. #	Construction Scenario						
	A	B	C	D	E	F	G
89	56	51	56	35	46	56	35
90	49	44	49	28	39	49	28
91	47	42	47	26	37	47	26
92	50	45	50	29	40	50	29
93	50	45	50	29	40	50	29
94	48	43	48	27	38	48	27
95	60	55	60	39	50	60	39
96	46	41	46	25	36	46	25
97	52	47	52	31	42	52	31
98	56	51	56	35	46	56	35
99	49	44	49	28	39	49	28
100	48	43	48	27	38	48	27
101	63	58	63	42	53	63	42
102	54	49	54	33	44	54	33
103	48	43	48	27	38	48	27
104	54	49	54	33	44	54	33
105	54	49	54	33	44	54	33
106	55	50	55	34	45	55	34
107	54	49	54	33	44	54	33
108	50	45	50	29	40	50	29
109	50	45	50	29	40	50	29
110	51	46	51	30	41	51	30
111	59	54	59	38	49	59	38
112	53	48	53	32	43	53	32
113	66	61	66	45	56	66	45
114	55	50	55	34	45	55	34
115	62	57	62	41	52	62	41
116	47	42	47	26	37	47	26
117	59	54	59	38	49	59	38
118	47	42	47	26	37	47	26
119	47	42	47	26	37	47	26
120	47	42	47	26	37	47	26
121	47	42	47	26	37	47	26
122	47	42	47	26	37	47	26
123	47	42	47	26	37	47	26
124	47	42	47	26	37	47	26
125	47	42	47	26	37	47	26
126	47	42	47	26	37	47	26
127	48	43	48	27	38	48	27
128	50	45	50	29	40	50	29