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Supplementary Environmental Noise Level Impact Assessment of Upstream Components of Proposed Queensland Curtis Liquified Natural Gas Project

conducted for

Q G C Limited

Report No: R09147/D2333/Rev.1/20.01.10

Revision No.	Date	Comment
0	15.12.09	Original report.
1	14.01.10	Report amended to include updated noise limit criteria and revised computer modelling results - meteorological conditions changed to correction factor $C_0 = 0$.
1	20.01.10	**FINAL**

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INTRODUCTION

In July 2009 David Moore & Associates Pty Ltd prepared the environmental noise component of an EIS for the QCLNG Project, Upstream, titled *Environmental Noise Level Impact Assessment of Upstream and Pipeline Components of Proposed Queensland Curtis Liquified Natural Gas Project conducted for QGC Limited, Report No: R09016/D2217/Rev.1/20.07.09* . In this document a range of potential noise sources within the upstream part of the project were presented, including:

- Field compression stations (a total of 27 different locations proposed) utilizing screw compressors (eight compressors per station) powered by gas;
- Central processing plants (a total of 9 different locations proposed) utilizing reciprocating compressors (ten compressors per plant) powered by gas;
- drilling rigs;
- flare noise;
- hydra pack and oil lift noise.

Noise from one compression facility along the pipeline to Port Curtis was also included, with this facility comprising six screw compressors.

Subsequent to the preparation of this EIS some of the proposed methodology for gas compression has changed and this Supplementary EIS presents, for the same upstream area, the current approach for gas compression. It should be noted that there is no longer any proposal for a gas compression facility along the pipeline.

It is now proposed that gas compression will occur not only at field compression stations and central processing plants, but also at wellhead. Whilst it is proposed that there will be approximately 6,000 gas wells within the upstream area, at the time of preparing this report it was not known at how many of these wellheads there would be gas compression facilities operating concurrently. Accordingly wellhead gas compression could not be computer modelled for the complete upstream area, but has been computer modelled for a total of 16 gas wells on a 750 metre square grid with a residence in the centre of this grid pattern. This is likely to be representative of the worst case (highest likely potential noise impact) for gas compression facilities at wellheads.

In addition the number of potential receptors has been further refined by Mipela (GIS) Pty Ltd, and further work is still required in identifying surrounding structures as houses or otherwise.

This Supplementary EIS considers the following noise sources and their potential noise impact:

- Wellhead gas compression;
- Field compression stations (FCS) (a total of 53 different locations Proposed) utilizing screw compressors (eight compressors per station) powered by electricity and gas, with acoustic treatment to the engine and compressor only (100 mm panel enclosure) (no acoustic treatment for the fans);
- Central processing plants (CPP) (a total of 4 different locations proposed) utilizing reciprocating compressors (three compressors per plant) powered by electricity and gas, with acoustic treatment to the engine and compressor only (100 mm panel enclosure) (no acoustic treatment for the fans);
- water treatment plants;
- in-field water pumps;
- drilling rigs;
- flare noise;
- hydra pack and oil lift noise.

For the above compressor noise sources which are electric powered, the overall sound power level includes the noise of electrical transformers and associated fans.

All source noise levels presented in this Supplementary EIS are based on manufacturers data. In some instances this data is sound power levels expressed in octave frequency bands, or sound pressure levels at 1 metre from the source, expressed in octave frequency bands. This latter information (sound pressure levels), together with dimensions of the noise source provided by the manufacturer, have been converted to sound power levels expressed in octave frequency bands,

Total sound power levels for the electric and gas versions of the field compression stations (FCS) and central processing plants (CPP) were provided by Marshall Day Acoustics. Sound power level data for each of the noise sources associated with a water treatment plant were provided by Bridges Acoustics. Each of these individual source sound power levels was then totalled to determine the total sound power level for a water treatment plant.

The sound power levels were calculated in accordance with Australian Standard AS 1217.7-1985, *Acoustics – Determination of sound power levels of noise sources, Part 7, Survey Methods*.

Computer noise modelling was based on the Bruel & Kjaer Predictor software package, which models industrial noise sources in accordance with the algorithms detailed in ISO 9613.1 and 9613.2. International Standard ISO 9613.1 *Acoustics – Attenuation of sound during propagation outdoors – Part 1: Calculation of the absorption of sound by the atmosphere* and International Standard ISO 9613.2 *Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation*.

Figure 1 details the location of the upstream area considered in this Supplementary EIS.

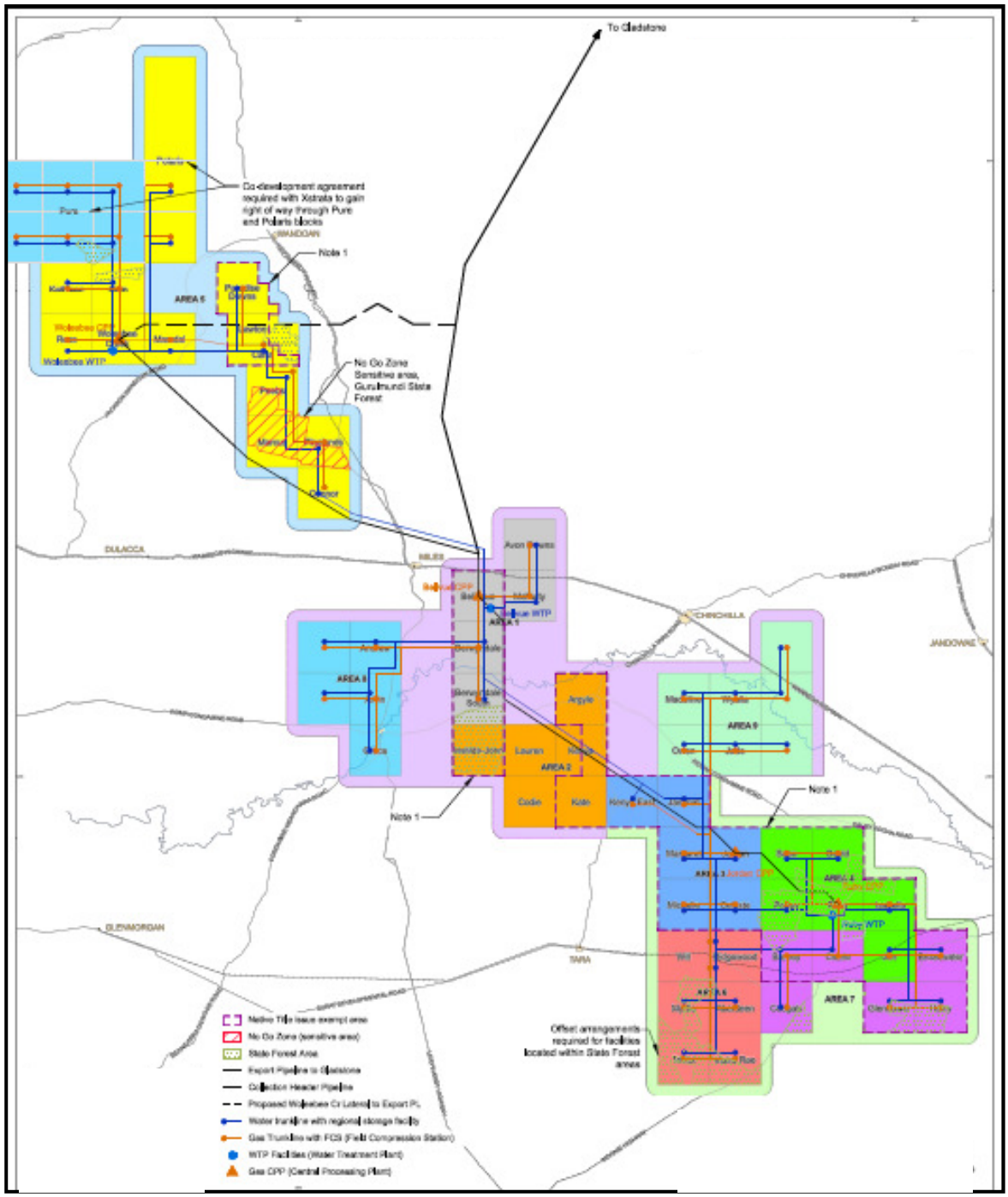

Figure 1
Location of Upstream Area

CRITERIA

Noise Limits

In accordance with advice from QGC Limited the relevant noise limit criteria is:

- daytime (0700 to 1800 hours): 35 dB(A)
- evening (1800 to 2200 hours): 30 dB(A)
- night-time (2200 to 0700 hours): 28 dB(A)

with the noise limit expressed as the $L_{Amax,adj,T}$, which is approximated by the $L_{A10,adj,T}$ – the A-weighted sound pressure level, adjusted for tonality and/or impulsiveness, and exceeded for 10% of the sample period T.

AMBIENT NOISE LEVELS

The consultant has conducted ambient noise assessments for QGC at the following locations:

- adjacent the Warrego Highway (set back from the highway approximately 260 metres) approximately 8 km east of Miles;
- Kenya field, adjacent a residence to the west of the Kenya field compression station, approximately 2700 metres distant; and
- Berwyndale South field, adjacent a residence approximately 3400 metres from the field compression station.

The results of these ambient noise assessments have been included in this report to provide an indication of the possible range of ambient noise levels. It should be noted that the consultant has also conducted other ambient noise assessments in rural Queensland, where the ambient noise levels were below those measured within the upstream area, with night-time background noise levels regularly below 20 dB(A).

Adjacent Warrego Highway

The ambient noise levels for this location, which was approximately 8 km east of the township of Miles and set back approximately 260 metres from the highway (general setback distance for residences in this area), were conducted over a 7 day period in June 2007, from Monday 11th to Monday 18th June, 2007. The average ambient background noise levels were:

- average L_{A90}
  - daytime: 40.8, 39.6, 34.4, 38.2, 34.8, 33.1, 34.9 Average = 36.5 dB(A)
  - evening: 25.6, 29.4, 28.3, 32.4, 33.1, 20.2, 24.8 Average = 27.6 dB(A)
  - night-time: 28.2, 26.6, 27.2, 29.0, 23.3, 19.0, 25.8 Average = 25.5 dB(A)
- average L_{A90} (tenth percentile)
  - daytime: 34.0, 32.1, 28.4, 32.5, 26.3, 27.3, 28.8 Average = 29.9 dB(A)
  - evening: 18.5, 21.0, 18.9, 18.9, 19.1, 18.1, 18.6 Average = 19.0 dB(A)
  - night-time: 17.4, 18.5, 17.9, 17.5, 17.7, 17.6, 18.6 Average = 17.9 dB(A)

Kenya Field

The ambient noise levels for this location, which was approximately 2700 metres west of the original Kenya field compression station (at such time that there was only one or two compressors operating some of the time), were conducted over a 7 day period in June 2007, from Monday 11th to Monday 18th June, 2007. The average ambient noise levels were:

- average L_{A90}
  - daytime: 36.5, 31.6, 28.0, 32.8, 34.0, 32.5, 30.6 Average = 32.2 dB(A)
  - evening: 20.5, 27.3, 24.0, 21.1, 22.4, 22.0, 21.2 Average = 22.6 dB(A)
  - night-time: 25.8, 32.0, 27.2, 24.6, 24.5, 24.6, 24.2 Average = 26.1 dB(A)
- average L_{A90} (10th percentile)
  - daytime: 28.0, 24.9, 21.9, 26.2, 22.9, 22.0, 23.1 Average = 24.1 dB(A)
  - evening: 17.8, 24.5, 21.7, 19.8, 20.1, 20.0, 18.7 Average = 20.4 dB(A)
  - night-time: 22.4, 27.8, 24.1, 21.9, 22.0, 21.1, 21.0 Average = 22.9 dB(A)

Berwyndale South Field

The ambient noise levels for this location, which was approximately 3400 metres north-west of the Berwyndale South field compression station (at such time that there was approximately 6 compressors operating all of the time), were conducted over a 7 day period in March 2007, from Tuesday 6th to Tuesday 13th March, 2007 were:

Average L_{A90}

- daytime: 41.1, 36.1, 37.4, 38.5, 41.0, 37.2, 42.8 Average = 39.1 dB(A)
- evening: 46.1, 41.9, 34.6, 39.2, 34.8, 36.1, 35.6 Average = 38.3 dB(A)
- night-time: 41.5, 36.3, 32.2, 35.3, 32.1, 38.0, 37.5 Average = 36.1 dB(A)

UPSTREAM NOISE SOURCES

Sound power levels were calculated in accordance with AS 1217.7-1985:

$$L_{WA} = (L_{pA} - K) + 10 \log_{10} (S \div S_O)$$

where L_{WA} = A-weighted sound power level;
L_{pA} = A-weighted sound pressure level averaged over the measurement surface;
S = area of the measurement surface, in m^2
S_O = 1 m^2
K = environmental correction to account for the influence of reflected sound, in dB.

Wellhead Compression

For the well head engine – assumed to be a Caterpillar G3304 gas/petroleum engine – the engine dimensions and sound pressure levels at 1 metre were provided directly by the manufacturer, and these were converted to sound power level in accordance with AS 1217.7-1985. Engine exhaust noise was assumed to be adequately controlled by muffling – only engine noise was included in the computer modelling at 1800 rpm.

The Caterpillar G3304 engine dimensions were 1.16 m long, 1.17 m high and 0.74 m wide. Creating a 'box' 1 m out from the sides and top of this engine resulted in a surface area of 34.3 m^2, with a resultant conversion of +15.4 dB in each octave frequency band from sound pressure to sound power level, resulting in the following sound power level for the engine:

Frequency (Hz)	31.5	63	125	250	500	1000	2000	4000	8000
Noise level SWL dB	-	93.7	95.7	96.2	97.7	100.7	101.2	97.7	91.7

The overall sound power level for the engine is 107.0 dB.

For the well head compressor – assumed to be a Howden XRV 204 – the manufacturer provided sound pressure level noise data at 1 metre and estimated dimensions for the compressor unit at 1800 rpm. The estimated dimensions for the compressor unit were used to estimate the surface area of a 1m 'box' over the compressor and, in accordance with AS 1217.7-1985, the sound power level was calculated.

The dimensions of the Howden XRV 204 compressor were estimated to be 2.5 m long, 1.5 m high and 1.2 m wide. With a 'box' 1 m out from the sides and top of this compressor the surface area was calculated to be 52.9 m^2, with a resultant conversion of +17.2 dB in each octave frequency band from sound pressure to sound power level, resulting in the following sound power level for the compressor:

Frequency (Hz)	31.5	63	125	250	500	1000	2000	4000	8000
Noise level SWL dB	-	88.2	91.2	97.2	99.2	96.2	93.2	90.2	85.2

The overall sound power level for the compressor is 103.7 dB.

The combined sound power level for the engine and compressor is 108.53 dB, with the following frequency spectrum:

Frequency (Hz)	31.5	63	125	250	500	1000	2000	4000	8000
Noise level SWL dB	-	94.8	97.0	99.7	101.5	102.0	101.8	98.4	92.6

Field Compression Station (FCS)

For the FCS the source sound power levels (SWL) were provided by Marshall Day Acoustics, with different SWL data for daytime, evening and night-time, based on the change in operational noise sources for each of these different time periods. SWL was also presented separately for the electric drive and gas engine drive. The sound power level noise data provided by Marshall Day Acoustics was for a 100 mm panel enclosure for the engine and compressor, but no acoustic treatment of any other noise sources (such as fans) associated with the FCS.

The SWL source noise levels are as per the following Table.

Drive	Time	FCS Noise Level SWL (dB) @ Frequency (Hz)								
		31.5	63	125	250	500	1000	2000	4000	8000
Electric	Day	118	117	117	113	108	106	100	94	88
Electric	Evening	114	112	112	108	102	100	94	89	93
Electric	Night	113	111	111	106	101	98	93	87	82
Gas	Day	118	117	117	113	108	107	102	97	94
Gas	Evening	114	112	112	108	103	103	99	95	94
Gas	Night	113	111	111	106	102	102	98	95	93

Central Processing Plant (CPP)

For the CPP the source sound power levels (SWL) were provided by Marshall Day Acoustics, with different SWL data for daytime, evening and night-time, based on the change in operational noise sources for each of these different time periods. SWL was also presented separately for the electric drive and gas turbine drive. The sound power level noise data provided by Marshall Day Acoustics was for a 100 mm panel enclosure for the engine and compressor, but no acoustic treatment of any other noise sources (such as fans) associated with the FCS.

The SWL source noise levels are as per the following Table.

Drive	Time	CPP Noise Level SWL (dB) @ Frequency (Hz)								
		31.5	63	125	250	500	1000	2000	4000	8000
Electric	Day	116	116	115	112	107	106	103	98	95
Electric	Evening	111	111	111	108	103	102	101	98	94
Electric	Night	110	109	110	107	102	101	101	97	94
Gas	Day	116	116	115	112	108	108	105	101	99
Gas	Evening	111	111	109	107	105	106	104	101	99
Gas	Night	110	110	108	105	104	105	104	101	99

Hydra Packs and Oil Lift

As these potential noise sources have not changed from the original EIS, they are not included in this Supplementary EIS.

Water Treatment Plant

Bridges Acoustics have provided individual source sound power levels for a 63 ML/day water treatment plant, based on an equipment list provided by CH2MHILL, the water treatment plant consultants to QGC Limited. The Table below details the individual sound power levels for the various noise sources, as well as the overall SWL applied in the computer modelling.

Noise Source	Water Treatment Plant Noise Level SWL (dB) @ Frequency (Hz)								
	31.5	63	125	250	500	1000	2000	4000	8000
Admin Bld A/C Unit	80	84	81	82	87	81	79	75	69
Blower	84	79	88	79	85	85	78	73	59
Centrifuge	93	92	93	88	86	83	77	71	58
Centrifuge Feed Pump	76	76	75	77	79	78	77	71	64
Flocculation Feed Pump	73	73	72	74	76	75	74	68	61
MF Feed Pump	77	77	76	78	80	79	78	72	65
MF Reverse Flush Pump	76	76	75	77	79	78	77	71	64
RO Booster Pump	78	78	77	79	81	80	79	73	66
RO Feed Pump	78	78	77	79	81	80	79	73	66
RO Service Water Pump	74	74	73	75	77	76	75	69	62
Sludge Transfer Pump	76	76	75	77	79	78	77	71	64
Control Room A/C	56	61	62	65	67	63	59	53	47
Treated Water Pumps	81	81	80	82	84	83	82	76	69
Brine Concentrator MVCt (2 of)	81	76	85	76	82	82	75	70	56
RO Reject Control Valve (2 of)	78	75	79	71	83	82	74	69	64
Truck Movement	72	72	74	72	67	56	57	54	46
Air Compressor	81	71	80	71	77	77	70	65	51
Screw Compressor (2 of)	59	60	63	61	61	62	65	63	61
TOTAL	**95.2**	**94.1**	**96.1**	**92.0**	**94.7**	**93.2**	**89.6**	**84.1**	**76.8**

The combined total SWL is 102.0 dB for the above water treatment plant.

Infield Pump

The most likely size of these pumps is 750 kW, however the manufacturer supplied information for both this size pump and a 1500 kW pump. Only the supplied noise data for the 1500 kW pump included unattenuated and attenuated noise levels. The location of these infield pumps was not known at the time of preparing this Supplementary EIS, but the manufacturer has provided sufficient noise data to calculate (and estimate) the sound power level of the 750 kW pump, attenuated. The sound power level determination was based on:

- overall noise level reduction of 26 dB(A) achieved with attenuation fitted to the 1500 kW pump;
- sound pressure levels for the unattenuated 750 kW pump, expressed in octave frequency bands;
- dimensions of the 750 kW pump being 3.734 m long, 2.159 m wide and 2.485 m high, giving a total surface area 1 m from the pump of 92.8 $m^{2;}$
- attenuation for the 750 kW pump assumed to be the same as for the 1500 kW pump with 26 dB reduction applied to each frequency band.

From the above the Table below details the SWL for the attenuated 750 kW pump.

Size	Attenuated Infield Pump Noise Level SWL (dB) @ Frequency (Hz)								
	31.5	63	125	250	500	1000	2000	4000	8000
750 kW	77.7	94.7	87.7	88.7	88.7	87.7	90.7	88.7	83.7

The overall SWL values are 98.9 dB and 95.2 dB(A) for the attenuated 750 kW pump.

Drilling Rigs

In July 2007 David Moore & Associates Pty Ltd conducted source noise level measurements of drilling rigs for QGC Limited, for a total of four different drilling rigs, namely:

- Ensign #34 (Codie #2);
- Thor Energy Kato NK-450 crane rig;
- CCC Drill Rig RD20; and
- Wild Dessert #65.

Of the above drilling rigs Ensign #34 is a very large rig and Wild Dessert #65 is representative of a smaller drilling rig. As these two drilling rigs represent the largest and the smallest they have both been included in this Supplementary EIS. The sound power levels for these two drill rigs – primary noise sources and combined noise sources, are as per the Table below. It should be noted that for both of these drill rigs the presented noise levels are for the highest noise level from each of these rigs during actual normal drilling operations, that is, engines at maximum revs.

Noise Source	Drilling Rig Noise Level SWL (dB) @ Frequency (Hz)								
	31.5	63	125	250	500	1000	2000	4000	8000
Ensign #34									
Carrier	110.8	108.3	99.1	99.2	104.6	104.4	101.3	95.1	85.9
Mud Pumps	111.4	107.5	102.3	105.4	102.0	99.3	97.1	90.9	82.9
Generator	117.2	102.5	111.9	99.8	102.8	102.4	100.3	96.1	88.7
Combined	118.9	111.5	112.6	107.2	108.0	107.3	104.2	99.3	91.2
Wild Dessert #65									
Generator	108.9	122.4	98.9	96.4	95.9	94.0	91.8	83.7	75.2
Pump	101.5	114.6	102.9	94.3	97.8	100.8	97.0	91.2	82.7
Compressors	102.9	115.7	107.1	104.3	99.3	95.0	90.9	86.3	84.1
Crane	96.1	110.6	111.3	112.0	106.2	108.6	106.9	101.9	97.9
Combined	110.6	124.0	113.3	112.8	107.8	109.5	107.5	102.4	98.2

The overall sound power levels are 121.2 dB and 111.4 dB(A) for the Ensign #34 and 125.1 dB and 113.9 dB(A) for the Wild Dessert #65.

COMPUTER MODELLED NOISE LEVELS

Atmospheric and Ground Conditions

All computer noise modelling was conducted for flat ground (no ground contours), for ground absorption factor of -0.5 and the following atmospheric conditions:

- temperature: 20^0C;
- humidity: 60%;
- wind: light breeze from the compressor/s to the receiver, which is worst case scenario for wind speed and direction.

The above atmospheric conditions (atmospheric correction $C_0 = 0$), in particular wind speed and direction, provide noise levels at the receptors that represent the worst case scenario – that is, the highest likely noise levels at these receptors, as the wind direction that has been modelled is from the source to the receptor. If there was no wind then the actual noise levels would be less than those detailed in the following tables, and this reduction could be in the vicinity of 5 dB(A). For a wind in the opposite direction (from the receptor to the noise source) the noise levels detailed in the following tables could be up to 8 to 10 dB(A) less.

In assessing noise impact it is accepted practice to assess, within reason, worst case scenario, and this is the position of Department of Environment and Resource Management (DERM). For this reason the computer model presents the source noise levels at the receptors for the worst case – wind direction from source to receptor, for a light to moderate wind speed.

However, it should be noted that 'worst case scenario' is more an overall average than accounting for daily and seasonal variations. Daily and seasonal variations (other than wind speed and direction – modelled as blowing from noise source to receptor) are not generally accounted for, with an average temperature of 20^0C and humidity of 60% applied. Changing of these parameters to allow for daily and seasonal variations would not significantly change the resultant noise level at the closest residences.

Central Processing Plant

Computer noise modelling for three compressors (one central processing plant) was conducted for an average source height of 1 metre, for flat ground for a ground absorption factor of -0.5 and the following atmospheric conditions:

- temperature: 20^0C;
- humidity: 60%;
- wind: light breeze from the compressor/s to the receiver.

for the daytime, evening and night-time. Tables 1, 2 and 3 detail the results of the modelling for the three electric driven compressors for the daytime, evening and night-time respectively, with attenuation to the engine and compressor only (100 mm panel enclosure). Tables 4, 5 and 6 detail the results for the gas turbine driven compressors for the daytime, evening and night-time respectively, with attenuation to the engine and compressor only (100 mm panel enclosure).

The CPP noise sources are tonal (+3 dB(A)) and a correction is required for the accuracy of the computer modelling (+2 dB(A)), giving a total correction of +5 dB(A), which has been added to the results of the computer modelling.

Table 1
Noise Level of Central Processing Plant, Electric Driven, at Nominated Distances, for Daytime

Distance (m)	Noise Level dB(A)	Distance (m)	Noise Level dB(A)
100	64.3	1800	33.1
200	58.2	1900	32.4
300	54.3	2000	31.7
400	51.3	2100	31.1
500	48.9	2200	30.4
600	46.9	2300	29.8
700	45.1	2400	29.3
800	43.5	2500	28.7
900	42.0	2600	28.2
1000	40.7	2700	27.7
1100	39.5	2800	27.2
1200	38.4	2900	26.7
1300	37.4	3000	26.3
1400	36.4	3100	25.9
1500	35.5	3200	25.4
1600	34.7	3300	25.0
1700	33.9		

Table 2
Noise Level of Central Processing Plant, Electric Driven, at Nominated Distances, for Evening

Distance (m)	Noise Level dB(A)	Distance (m)	Noise Level dB(A)
100	61.2	1300	33.5
200	54.9	1400	32.5
300	50.9	1500	31.6
400	47.9	1600	30.7
500	45.4	1700	29.9
600	43.3	1800	29.1
700	41.5	1900	28.3
800	39.8	2000	27.6
900	38.3	2100	27.0
1000	37.0	2200	26.3
1100	35.7	2300	25.7
1200	34.6	2400	25.1

Table 3
Noise Level of Central Processing Plant, Electric Driven, at Nominated Distances, for Night-time

Distance (m)	Noise Level dB(A)	Distance (m)	Noise Level dB(A)
100	60.5	1200	33.7
200	54.3	1300	32.6
300	50.3	1400	31.6
400	47.2	1500	30.6
500	44.7	1600	29.7
600	43.6	1700	28.9
700	40.7	1800	28.1
800	39.0	1900	27.3
900	37.5	2000	26.6
1000	36.1	2100	25.9
1100	34.9	2200	25.2

Table 4
Noise Level of Central Processing Plant, Gas Turbine Driven, at Nominated Distances, for Daytime

Distance (m)	Noise Level dB(A)	Distance (m)	Noise Level dB(A)
100	66.0	1800	34.1
200	59.8	1900	33.3
300	55.8	2000	32.6
400	52.9	2100	31.9
500	50.4	2200	31.2
600	48.3	2300	30.6
700	46.5	2400	30.0
800	44.9	2500	29.4
900	43.4	2600	28.8
1000	42.1	2700	28.3
1100	40.8	2800	27.8
1200	39.7	2900	27.3
1300	38.6	3000	26.8
1400	37.6	3100	26.3
1500	36.6	3200	25.9
1600	35.7	3300	25.5
1700	34.9	3400	25.0

Table 5
Noise Level of Central Processing Plant, Gas Turbine Driven, at Nominated Distances, for Evening

Distance (m)	Noise Level dB(A)	Distance (m)	Noise Level dB(A)
100	64.1	1400	34.8
200	57.8	1500	33.8
300	53.8	1600	32.8
400	50.7	1700	31.9
500	48.2	1800	31.0
600	46.1	1900	30.1
700	44.2	2000	29.3
800	42.5	2100	28.6
900	41.0	2200	27.8
1000	39.6	2300	27.1
1100	38.3	2400	26.4
1200	37.0	2500	25.8
1300	35.9	2600	25.1

Table 6
Noise Level of Central Processing Plant, Gas Turbine Driven, at Nominated Distances, for Night-time

Distance (m)	Noise Level dB(A)	Distance (m)	Noise Level dB(A)
100	63.5	1300	35.0
200	57.2	1400	33.9
300	53.2	1500	32.8
400	50.1	1600	31.8
500	47.5	1700	30.9
600	45.4	1800	30.0
700	43.5	1900	29.1
800	41.7	2000	28.3
900	40.2	2100	27.5
1000	38.7	2200	26.8
1100	37.4	2300	26.0
1200	36.2	2400	25.3

For a night-time noise limit of 28 dB(A), the noise level of an electric driven CPP (adjusted for tonality and computer modelling degree of accuracy) complies with this noise limit at a separation distance of 1800 metres, whilst a daytime and evening noise limit of 35 and 30 dB(A) are complied with at separation distances of 1600 and 1700 metres respectively.

For the gas turbine driven CPP (adjusted for tonality and computer modelling degree of accuracy) a night-time noise limit of 28 dB(A) is complied with at a separation distance of 2000 metres, whilst a daytime and evening noise limit of 35 and 30 dB(A) are complied with at separation distances of 1700 and 1900 metres respectively.

Field Compression Station

Computer noise modelling for eight compressors (one field compression station) was conducted for an average source height of 1 metre, for flat ground for a ground absorption factor of -0.5 and the following atmospheric conditions:

- temperature: 20^0C;
- humidity: 60%;
- wind: light breeze from the compressor/s to the receiver.

for the daytime, evening and night-time. Tables 7, 8 and 9 detail the results of the modelling for the eight electric driven compressors for the daytime, evening and night-time respectively, with attenuation to the engine and compressor only (100 mm panel enclosure).

Tables 10, 11 and 12 detail the results for the gas turbine driven compressors for the daytime, evening and night-time respectively, with attenuation to the engine and compressor only (100 mm panel enclosure).

The FCS noise sources are tonal (+3 dB(A)) and a correction is required for the accuracy of the computer modelling (+2 dB(A)), giving a total correction of +5 dB(A), which has been added to the results of the computer modelling.

Table 7
Noise Level of Field Compression Station, Electric Driven, at Nominated Distances, for Daytime

Distance (m)	Noise Level dB(A)	Distance (m)	Noise Level dB(A)
100	64.0	1900	33.2
200	58.0	2000	32.6
300	54.2	2100	32.0
400	51.3	2200	31.4
500	49.0	2300	30.8
600	47.0	2400	30.3
700	45.3	2500	29.7
800	43.7	2600	29.2
900	42.4	2700	28.8
1000	41.1	2800	28.3
1100	40.0	2900	27.9
1200	38.9	3000	27.4
1300	37.9	3100	27.0
1400	37.0	3200	26.6
1500	36.2	3300	26.2
1600	35.4	3400	25.9

Table 7 Noise Level of Field Compression Station, Electric Driven, at Nominated Distances, for Daytime			
Distance (m)	Noise Level dB(A)	Distance (m)	Noise Level dB(A)
1700	34.6	3500	25.5
1800	33.9	3600	25.2

Table 8 Noise Level of Field Compression Station, Electric Driven, at Nominated Distances, for Evening			
Distance (m)	Noise Level dB(A)	Distance (m)	Noise Level dB(A)
100	58.3	1300	32.4
200	52.3	1400	31.5
300	48.5	1500	30.7
400	45.6	1600	29.9
500	43.3	1700	29.2
600	41.3	1800	28.5
700	39.6	1900	27.8
800	38.1	2000	27.2
900	36.8	2100	26.6
1000	35.5	2200	26.0
1100	34.4	2300	25.5
1200	33.4	2400	25.0

Table 10 Noise Level of Field Compression Station, Electric Driven, at Nominated Distances, for Night-time			
Distance (m)	Noise Level dB(A)	Distance (m)	Noise Level dB(A)
100	56.9	1200	31.9
200	50.8	1300	31.0
300	47.0	1400	30.1
400	44.2	1500	29.3
500	41.8	1600	28.5
600	39.8	1700	27.8
700	38.1	1800	27.1
800	36.6	1900	26.4
900	35.3	2000	25.8
1000	34.0	2100	25.2
1100	32.9		

Table 11
Noise Level of Field Compression Station, Gas Turbine Driven, at Nominated Distances, for Daytime

Distance (m)	Noise Level dB(A)	Distance (m)	Noise Level dB(A)
100	64.9	1900	33.5
200	58.8	2000	32.9
300	54.9	2100	32.2
400	52.0	2200	31.6
500	49.7	2300	31.0
600	47.6	2400	30.5
700	45.9	2500	29.9
800	44.3	2600	29.4
900	42.9	2700	28.9
1000	41.7	2800	28.4
1100	40.5	2900	28.0
1200	39.4	3000	27.6
1300	38.4	3100	27.1
1400	37.5	3200	26.7
1500	36.6	3300	26.3
1600	35.8	3400	26.0
1700	35.0	3500	25.6
1800	34.2	3600	25.2

Table 12
Noise Level of Field Compression Station, Gas Turbine Driven, at Nominated Distances, for Evening

Distance (m)	Noise Level dB(A)	Distance (m)	Noise Level dB(A)
100	60.9	1400	33.0
200	54.7	1500	32.1
300	50.8	1600	31.2
400	47.9	1700	30.4
500	45.5	1800	29.6
600	43.4	1900	28.9
700	41.6	2000	28.2
800	40.0	2100	27.6
900	38.6	2200	26.9
1000	37.3	2300	26.3
1100	36.1	2400	25.7
1200	35.0	2500	25.2
1300	34.0		

Table 13 Noise Level of Field Compression Plant, Gas Turbine Driven, at Nominated Distances, for Night-time			
Distance (m)	Noise Level dB(A)	Distance (m)	Noise Level dB(A)
100	59.9	1300	32.8
200	53.7	1400	31.9
300	49.8	1500	30.9
400	46.8	1600	30.1
500	44.4	1700	29.3
600	42.4	1800	28.5
700	40.6	1900	27.8
800	39.0	2000	27.1
900	37.5	2100	26.4
1000	36.2	2200	25.8
1100	35.0	2300	25.1
1200	33.9		

For a night-time noise limit of 28 dB(A), the noise level of an electric driven FCS complies with this noise limit at a separation distance of 1700 metres, whilst a daytime and evening noise limit of 35 and 30 dB(A) are complied with at separation distances of 1600 and 1600 metres respectively.

For the gas driven FCS a night-time noise limit of 28 dB(A) is complied with at a separation distance of 1900 metres, whilst a daytime and evening noise limit of 35 and 30 dB(A) are complied with at separation distances of 1700 and 1700 metres respectively.

Wellhead Compressor and Engine

Computer noise modelling for a wellhead engine (Cat G3304, 1800 rpm) and compressor (Howden XRV 204, 1800 rpm) was conducted for an average source height of 1 metre, for flat ground for a ground absorption factor of -0.5 and the following atmospheric conditions:

- temperature: 20^0C;
- humidity: 60%;
- wind: light breeze from the compressor/s to the receiver.

The wellhead compressor and engine noise sources are tonal (+3 dB(A)) and a correction is required for the accuracy of the computer modelling (+2 dB(A)), giving a total correction of +5 dB(A), which has been added to the results of the computer modelling. Table 14 detail the results of the modelling for the wellhead engine and compressor.

Table 14 Noise Level of Wellhead Engine and Compressor at Nominated Distances			
Distance (m)	Noise Level dB(A)	Distance (m)	Noise Level dB(A)
100	60.8	1100	34.3
200	54.5	1200	33.0
300	50.4	1300	31.8
400	47.3	1400	30.6
500	44.7	1500	29.5
600	42.5	1600	28.5
700	40.6	1700	27.4
800	38.8	1800	26.5
900	37.2	1900	25.5
1000	35.7	2000	24.6

For a night-time noise limit of 28 dB(A), the noise level of a wellhead engine and compressor complies with this noise limit at a separation distance of 1700 metres, whilst a daytime and evening noise limit of 35 and 30 dB(A) is complied with at separation distances of 1100 and 1500 metres respectively.

Water Treatment Plant

Computer noise modelling for a 63 ML/d water treatment plant was conducted for an average source height of 1 metre, for flat ground for a ground absorption factor of -0.5 and the following atmospheric conditions:

- temperature: 20^0C;
- humidity: 60%;
- wind: light breeze from the compressor/s to the receiver.

The water treatment plant noise sources are tonal (+3 dB(A)) and a correction is required for the accuracy of the computer modelling (+2 dB(A)), giving a total correction of +5 dB(A), which has been added to the results of the computer modelling. Table 15 detail the results of the modelling for the water treatment plant.

Table 15 Noise Level of Water Treatment Plant at Nominated Distances			
Distance (m)	Noise Level dB(A)	Distance (m)	Noise Level dB(A)
100	50.7	700	31.3
200	44.5	800	29.6
300	40.6	900	28.1
400	37.6	1000	26.7
500	35.2	1100	25.5
600	33.1	1200	24.2

For a night-time noise limit of 28 dB(A), the noise level of a water treatment plant complies with this noise limit at a separation distance of 900 metres, whilst a daytime and evening noise limit of 35 and 30 dB(A) is complied with at separation distances of 500 metres and 800 metres respectively.

Drilling Rigs

Computer noise modelling for two different drilling rigs was conducted for an average source height of 1 metre, for flat ground for a ground absorption factor of -0.5 and the following atmospheric conditions:

- temperature: 20^0C;
- humidity: 60%;
- wind: light breeze from the compressor/s to the receiver.

The drill rig noise sources are tonal (+3 dB(A)) and a correction is required for the accuracy of the computer modelling (+2 dB(A)), giving a total correction of +5 dB(A), which has been added to the results of the computer modelling. Table 20 detail the results of the modelling for the Ensign #34 (Codie #2) drilling rig and Table 21 details the results of the modelling for the Wild Dessert #65 drilling rig.

Table 20
Noise Level of Ensign #34 Drilling Rig (Codie #2), at Nominated Distances

Distance (m)	Noise Level dB(A)	Distance (m)	Noise Level dB(A)
100	65.0	1600	34.4
200	58.8	1700	33.5
300	54.9	1800	32.7
400	51.9	1900	31.9
500	49.4	2000	31.1
600	47.3	2100	30.3
700	45.5	2200	29.6
800	43.9	2300	28.9
900	42.4	2400	28.3
1000	41.0	2500	27.6
1100	39.7	2600	27.0
1200	38.5	2700	26.4
1300	37.4	2800	25.8
1400	36.4	2900	25.3
1500	35.4	3000	24.8

Table 21 Noise Level of Wild Dessert #65 Drilling Rig, at Nominated Distances			
Distance (m)	Noise Level dB(A)	Distance (m)	Noise Level dB(A)
100	67.7	2500	32.4
200	61.6	2600	31.9
300	57.7	2700	31.4
400	54.7	2800	31.0
500	52.3	2900	30.6
600	50.2	3000	30.2
700	48.5	3100	29.8
800	46.9	3200	29.4
900	45.4	3300	29.0
1000	44.1	3400	28.7
1100	42.9	3500	28.4
1200	41.8	3600	28.0
1300	40.8	3700	27.7
1400	39.8	3800	27.4
1500	38.9	3900	27.1
1600	38.1	4000	26.9
1700	37.3	4100	26.6
1800	36.6	4200	26.3
1900	35.9	4300	26.1
2000	35.2	4400	25.8
2100	34.6	4500	25.6
2200	34.0	4600	25.3
2300	33.4	4700	25.1
2400	32.9		

Infield Water Pump

Computer noise modelling for an attenuated 750 kW capacity infield water pump was conducted for an average source height of 1 metre, for flat ground for a ground absorption factor of -0.5 and the following atmospheric conditions:

- temperature: 20^0C;
- humidity: 60%;
- wind: light breeze from the compressor/s to the receiver.

The infield water pump noise source is tonal (+3 dB(A)) and a correction is required for the accuracy of the computer modelling (+2 dB(A)), giving a total correction of +5 dB(A), which has been added to the results of the computer modelling. Table 22 detail the results of the modelling for the attenuated 750 kW infield water pump.

Table 22 Noise Level of Attenuated 750 kW Infield Water Pump, at Nominated Distances			
Distance (m)	Noise Level dB(A)	Distance (m)	Noise Level dB(A)
100	49.0	600	30.1
200	42.5	700	28.1
300	38.3	800	26.3
400	35.1	900	24.6
500	32.4		

For the attenuated 750 kW infield water pump and a night-time noise limit of 28 dB(A), the noise level of this pump complies with this night-time noise limit at a separation distance of 700 metres, whilst daytime and evening noise limits of 35 and 30 dB(A) are complied with at separation distances of 400 and 600 metres respectively.

Wellhead Engine and Compressor Cluster

For the well head engine – assumed to be a Caterpillar G3304 engine @1800 rpm – the engine dimensions and sound pressure levels at 1 metre were provided directly by the manufacturer, and these were converted to sound power level in accordance with AS 1217.7-1985. Engine exhaust noise was assumed to be adequately controlled by muffling – only engine noise was included in the computer modelling.

For the well head compressor – assumed to be a Howden XRV 204 @ 1800 rpm – the manufacturer provided sound pressure level noise data at 1 metre and estimated dimensions for the compressor unit. The estimated dimensions for the compressor unit were used to estimate the surface area of a 1m 'box' over the compressor and, in accordance with AS 1217.7-1985, the sound power level was calculated.

Computer noise modelling was based on the Bruel & Kjaer Predictor software package, which models industrial noise sources in accordance with the algorithms detailed in ISO 9613.1 and 9613.2. International Standard ISO 9613.1 *Acoustics – Attenuation of sound during propagation outdoors – Part 1: Calculation of the absorption of sound by the atmosphere* and International Standard ISO 9613.2 *Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation*.

The wellhead compressor and engine noise sources are tonal (+3 dB(A)) and a correction is required for the accuracy of the computer modelling (+2 dB(A)), giving a total correction of +5 dB(A), which has been added to the results of the computer modelling.

Computer noise modelling of wellhead engine and compressor for 16 wellheads (on a 750 metre grid) was conducted for flat ground (no ground contours), for an average source height of 1 metre, for a ground absorption factor of -0.5 and the following atmospheric conditions:

- temperature: 20^0C;
- humidity: 60%;
- wind: light breeze from the compressor/s to the receiver.

For a residence centrally located within a grid of 16 wellhead compressors and engines, with the noise level of these wellhead compressors and engines attenuated 20 dB(A), the noise level at this residence would be 26.6 dB(A).

It should be noted that the nominated 20 dB(A) attenuation is a completely arbitrary number and is not based on any scientific or engineering assessment of the noise of a wellhead engine and compressor and includes no consideration of precisely how this magnitude of attenuation could be achieved.

Complete Upstream Area – CPP and FCS and Water Treatment Plants Only

Computer noise modelling for fifty-three field compression stations (FCS), four central processing plants (CPP) and three water treatment plants has been completed for the daytime, evening and night-time periods. For the FCS and CPP facilities the source noise data included attenuation to the engine and compressor only (100 mm panel enclosure), with no noise attenuation to the fans.

This computer modelling was conducted for flat ground (no ground contours), for an average source height of 1 metre, for a ground absorption factor of -0.5 and the following atmospheric conditions:

- temperature: 20^0C;
- humidity: 60%;
- wind: light breeze from the compressor/s to the receiver.

The CPP, FCS and water treatment plant noise sources are tonal (+3 dB(A)) and a correction is required for the accuracy of the computer modelling (+2 dB(A)), giving a total correction of +5 dB(A), which has been added to the results of the computer modelling.

Table 23 details the results of the modelling for the daytime, Table 24 for the evening and Table 25 for the night-time periods. This computer modelling does not include any other noise sources (does not include any noise from wellhead compressors or engines).

Table 23
Computer Modelled CPP, FCS and Water Treatment Plants to Closest Residences, Daytime

Residence	Noise Level dB(A)	Residence	Noise Level dB(A)	Residence	Noise Level dB(A)	Residence	Noise Level dB(A)
7662	69.8	226	31.9	7617	28.1	7104	26.6
565	68.7	8435	31.8	8122	28.1	8563	26.6
7835	59.0	7668	31.8	9014	28.1	6655	26.6
4855	58.1	7512	31.8	6619	28.1	6937	26.6
8046	56.9	8501	31.7	7046	28.1	7708	26.6
7836	55.6	7833	31.7	7854	28.1	597	26.6
7837	53.3	8571	31.7	1462	28.1	7897	26.5
7600	51.5	3836	31.6	7453	28.1	8656	26.5
7823	51.4	7090	31.6	7860	28.1	8983	26.5
1170	50.7	7671	31.6	8691	28.1	7133	26.5
105	49.4	7480	31.5	208	28.1	7186	26.5
7456	48.7	656	31.5	6803	28.1	7471	26.5
744	48.6	7510	31.5	8532	28.0	263	26.5
4618	47.6	7479	31.4	8335	28.0	7642	26.5
7551	47.4	8414	31.4	8375	28.0	120	26.5
3911	47.0	8514	31.4	7616	28.0	8630	26.5
8478	46.4	3956	31.4	7653	28.0	608	26.5
563	45.9	9024	31.4	8332	28.0	4082	26.5
7664	45.7	221	31.3	4445	28.0	7181	26.5
504	45.7	9025	31.3	8268	28.0	8013	26.5
7818	44.9	647	31.3	7590	27.9	614	26.5
4479	44.0	110	31.3	474	27.9	652	26.5
172	43.2	4820	31.2	55	27.9	8984	26.5
638	42.5	7072	31.2	277	27.9	7525	26.5
729	42.5	7561	31.2	7123	27.9	4404	26.5
552	42.3	7073	31.2	7701	27.9	621	26.5
4481	42.2	7677	31.1	599	27.9	8519	26.5
385	42.2	6922	31.1	7927	27.9	8560	26.5
987	41.8	7804	31.1	7077	27.9	7061	26.4
699	41.6	7786	31.0	8041	27.9	7465	26.4
3958	41.6	4266	31.0	1693	27.9	8402	26.4
4317	41.5	8437	31.0	4359	27.8	4106	26.4
7813	41.3	4842	31.0	7615	27.8	602	26.4
641	10.8	643	30.9	7977	27.7	7898	26.4
7599	40.7	4562	30.8	334	27.7	8238	26.4
7815	40.2	7788	30.8	4364	27.7	7556	26.4

Table 23
Computer Modelled CPP, FCS and Water Treatment Plants to Closest Residences, Daytime

Residence	Noise Level dB(A)	Residence	Noise Level dB(A)	Residence	Noise Level dB(A)	Residence	Noise Level dB(A)
560	40.2	8415	30.8	7110	27.7	8456	26.4
8553	39.9	8504	30.7	4020	27.7	7045	26.4
3989	39.7	6858	30.7	628	27.7	8329	26.4
7936	39.5	7529	30.7	8390	27.7	8182	26.4
3983	39.5	7596	30.7	186	27.7	80	26.4
648	39.4	7089	30.7	605	27.6	8351	26.4
7459	39.1	210	30.6	7477	27.6	3141	26.4
7817	39.1	8538	30.6	7490	27.6	8176	26.4
7605	38.9	8494	30.6	7380	27.6	626	26.3
4844	38.9	1495	30.6	8254	27.6	8179	26.3
7610	38.7	8095	30.6	333	27.6	8468	26.3
236	38.7	7800	30.5	7932	27.6	4434	26.3
371	38.6	8537	30.5	8010	27.6	678	26.3
7656	38.6	7801	30.5	6883	27.6	8521	26.3
8047	38.5	8262	30.5	7102	27.6	7107	26.3
8579	38.5	8534	30.4	281	27.6	8523	26.3
362	38.3	7582	30.4	325	27.6	7044	26.3
245	38.2	583	30.4	49	27.6	7428	26.3
3939	38.2	7907	30.3	8117	27.6	7485	26.3
553	38.1	8432	30.3	4858	27.6	307	26.3
7602	38.0	7842	30.2	7460	27.5	7719	26.3
6371	38.0	199	30.2	7716	27.5	7062	26.3
7917	37.9	8511	30.2	4068	27.5	640	26.3
3980	37.9	7578	30.2	531	27.5	7711	26.3
7660	37.8	636	30.1	7381	27.5	8018	26.3
3917	37.7	7469	30.1	8245	27.5	319	26.2
3305	37.6	7545	30.1	7488	27.5	6852	26.2
7606	37.6	4857	30.0	4408	27.5	8581	26.2
7592	37.6	7468	30.0	7185	27.5	7128	26.2
8666	37.4	6675	30.0	246	27.5	622	26.2
8062	37.4	7119	30.0	8413	27.5	7650	26.2
45	37.4	7908	30.0	7374	27.4	7862	26.2
168	37.2	8007	29.9	7379	27.4	46	26.2
7067	37.2	551	29.9	7085	27.4	8171	26.2
7678	37.0	7120	29.9	8566	27.4	3356	26.2
6887	37.0	8416	29.9	686	27.4	7448	26.2
4836	37.0	8005	29.9	7864	27.4	7861	26.2

Table 23
Computer Modelled CPP, FCS and Water Treatment Plants to Closest Residences, Daytime

Residence	Noise Level dB(A)	Residence	Noise Level dB(A)	Residence	Noise Level dB(A)	Residence	Noise Level dB(A)
555	36.8	4850	29.8	7375	27.4	7539	26.1
6930	36.7	8549	29.8	6548	27.4	8343	26.1
8966	36.6	7116	29.7	7084	27.4	269	26.1
7796	36.3	7870	29.6	7382	27.4	7949	26.1
8484	36.3	7683	29.6	9007	27.4	528	26.1
7574	36.2	7527	29.6	617	27.4	7967	26.1
7572	36.2	8591	29.6	8526	27.4	7693	26.1
8554	36.2	8407	29.5	9110	27.4	2955	26.1
755	36.1	1640	29.5	8250	27.4	7105	26.1
434	35.9	7893	29.5	150	27.3	596	26.1
8271	35.7	7563	29.5	7372	27.3	7950	26.1
3902	35.7	673	29.5	195	27.3	610	26.0
7866	35.6	8602	29.5	7373	27.3	7941	26.0
692	35.5	7074	29.5	7376	27.3	8340	26.0
7790	35.4	212	29.4	5255	27.3	7141	26.0
532	35.4	4880	29.4	7378	27.3	181	26.0
7682	35.4	7496	29.4	7705	27.3	4860	26.0
8490	35.4	7909	29.4	8540	27.3	339	26.0
7390	35.3	48	29.4	7412	27.3	758	26.0
7792	35.3	274	29.3	7974	27.3	7970	26.0
8286	35.3	7869	29.3	7371	27.3	94	26.0
7852	35.2	6711	29.3	6629	27.3	4043	26.0
7885	35.2	7598	29.3	6811	27.2	7143	26.0
7794	35.2	695	29.3	7482	27.2	682	26.0
7068	35.0	7849	29.2	7986	27.2	7770	26.0
7554	35.0	7087	29.2	8642	27.2	8037	26.0
8425	34.9	7848	29.2	7377	27.2	321	26.0
7791	34.8	8377	29.2	7370	27.2	6882	26.0
7608	34.8	7362	29.2	7478	27.2	7146	25.9
8284	34.8	8399	29.2	272	27.2	7142	25.9
8505	34.8	8574	29.0	7981	27.2	327	25.9
8631	34.7	558	29.0	7461	27.2	8032	25.9
8556	34.4	8539	29.0	7124	27.1	8323	25.9
6859	34.4	8209	29.0	338	27.1	8393	25.9
7911	34.3	8443	28.9	6912	27.1	328	25.9
7857	34.3	4840	28.9	7363	27.1	4874	25.9
7889	34.2	4875	28.9	7369	27.1	7636	25.9

Table 23
Computer Modelled CPP, FCS and Water Treatment Plants to Closest Residences, Daytime

Residence	Noise Level dB(A)	Residence	Noise Level dB(A)	Residence	Noise Level dB(A)	Residence	Noise Level dB(A)
7097	34.2	7114	28.9	3033	27.1	92	25.8
8205	34.2	7115	28.9	6860	27.1	7988	25.8
7872	34.1	4547	28.9	284	27.1	632	25.8
8420	34.1	4545	28.9	7368	27.1	7566	25.8
47	34.0	577	28.9	282	27.1	7723	25.8
7069	34.0	7922	28.9	7367	27.1	41	25.8
7871	34.0	6895	28.8	4448	27.1	613	25.8
7873	34.0	7674	28.8	6862	27.1	4079	25.8
3969	34.0	8385	28.8	6818	27.0	7051	25.8
3963	34.0	8568	28.8	7078	27.0	7966	25.8
634	34.0	7100	28.7	331	27.0	32	25.8
314	33.9	979	28.7	7140	27.0	8397	25.8
7878	33.9	1432	28.7	4444	27.0	8368	25.8
6969	33.9	7691	28.7	7366	27.0	8382	25.8
7810	33.9	7340	28.7	7597	27.0	6900	25.8
8430	33.9	8119	28.7	29	27.0	8074	25.7
8497	33.8	8386	28.7	7532	27.0	7613	25.7
7826	33.7	7491	28.7	7648	27.0	4210	25.7
665	33.7	7547	28.7	4873	27.0	4838	25.7
7841	33.7	7978	28.7	7365	27.0	619	25.7
653	33.6	8440	28.7	7697	27.0	4584	25.7
3951	33.6	360	28.6	280	27.0	4374	25.7
3930	33.4	366	28.6	7924	27.0	7951	25.7
8426	33.4	4776	28.6	324	26.9	8124	25.7
8066	33.4	6910	28.6	7473	26.9	8000	25.7
356	33.3	7121	28.5	7364	26.9	8021	25.7
7806	33.3	8445	28.5	7464	26.9	618	25.6
4295	33.3	8576	28.5	8235	26.9	8244	25.6
4346	33.3	3818	28.5	7641	26.9	7619	25.6
8067	33.2	8305	28.5	8964	26.9	612	25.6
5254	33.2	97	28.5	7929	26.9	8001	25.6
6940	33.1	6908	28.5	8565	26.9	8019	25.6
8214	33.1	8583	28.5	7083	26.9	4872	25.6
4839	33.1	7926	28.4	8264	26.9	503	25.6
100	33.0	6884	28.4	594	26.9	60	25.6
7670	32.9	8548	28.4	6554	26.8	6964	25.6
679	32.8	6909	28.4	659	26.8	7424	25.6

Table 23
Computer Modelled CPP, FCS and Water Treatment Plants to Closest Residences, Daytime

Residence	Noise Level dB(A)	Residence	Noise Level dB(A)	Residence	Noise Level dB(A)	Residence	Noise Level dB(A)
9011	32.8	8670	28.4	4555	26.8	8242	25.6
651	32.8	7086	28.4	4813	26.8	8317	25.6
7094	32.8	4835	28.4	669	26.8	8367	25.6
4841	32.8	8111	28.3	7082	26.8	8072	25.6
581	32.8	649	28.3	6610	26.8	8987	25.6
8434	32.6	6808	28.3	7079	26.8	6392	25.6
6925	32.6	7925	28.3	8459	26.8	8199	25.6
6804	32.6	8248	28.3	5296	26.8	7631	25.6
9009	32.6	9005	28.3	26	26.7	7213	25.6
6924	32.5	8044	28.3	4560	26.7	7989	25.5
234	32.5	4368	28.3	7136	26.7	4868	25.5
8099	32.4	1659	28.3	8307	26.7	7503	25.5
9022	32.4	1733	28.2	4037	26.7	7960	25.5
538	32.4	658	28.2	3051	26.7	499	25.5
8470	32.3	8455	28.2	7138	26.7	7995	25.5
8655	32.3	216	28.2	7139	26.7	623	25.5
7798	32.3	271	28.2	56	26.7	6609	25.5
7558	32.2	1675	28.2	7715	26.7	6880	25.5
7070	32.1	332	28.2	4096	26.6	7906	25.5
7805	32.1	6809	28.2	6936	26.6	4859	25.5
7538	32.1	6810	28.2	8012	26.6	7774	25.5
7828	32.1	7481	28.2	4718	26.6	8322	25.5
4032	32.1	8249	28.2	3052	26.6	7058	25.5
6923	32.1	219	28.2	601	26.6	6881	25.5
7536	32.0	7048	28.2	8136	26.6	8587	25.5
8106	32.0	7183	28.2	8330	26.6	8309	25.5
3905	31.9	1476	28.2	518	26.6		
4194	31.9	544	28.1	8237	26.6		

From Table 23 the following should be noted:

- total number of receptors modelled = 1563;
- receptors which exceed 35 dB(A) = 87.

The daytime noise limit is 35 dB(A) and for just the CPP, FCS and water treatment plants this is exceeded at 87 receptors (5.6% of receptors).

Table 24
Computer Modelled CPP, FCS and Water Treatment Plants to Closest Residences, Evening

Residence	Noise Level dB(A)	Residence	Noise Level dB(A)	Residence	Noise Level dB(A)	Residence	Noise Level dB(A)
7662	64.1	8047	33.0	7857	28.9	7805	26.9
565	63.0	8666	33.0	7097	28.9	7558	26.9
4855	53.7	362	32.9	8205	28.9	7828	26.9
7835	53.3	3939	32.7	7872	28.8	7070	26.9
8046	51.2	553	32.6	8420	28.7	7538	26.8
7836	50.0	7602	32.6	7871	28.7	6923	26.8
7837	47.6	3980	32.4	47	28.7	4032	26.8
7600	45.9	7660	32.3	7873	28.7	7536	26.8
7823	45.8	3917	32.2	7069	28.6	8106	26.8
1170	45.0	3305	32.2	314	28.6	9024	26.7
105	43.7	7606	32.2	7878	28.6	9025	26.6
7456	43.0	7592	32.1	3969	28.6	4184	26.6
744	42.9	8966	32.1	634	28.6	3905	26.6
4618	42.0	8062	31.9	7810	28.6	221	26.6
7551	41.8	45	31.9	3963	28.6	8435	26.6
3911	41.4	168	31.8	8430	28.5	7668	26.5
8478	40.8	7067	31.7	8497	28.5	7512	26.5
563	40.3	7678	31.6	7826	28.5	7833	26.5
7664	40.1	6887	31.5	7841	28.4	7820	26.5
504	40.0	4836	31.5	665	28.3	8501	26.5
7818	39.3	555	31.3	653	28.3	8571	26.5
4479	38.3	6930	31.3	3951	28.3	7090	26.3
172	37.6	434	31.1	9011	28.2	3836	26.3
638	37.0	7796	31.0	8426	28.1	7671	26.3
729	36.9	8484	30.9	3930	28.1	7480	26.3
552	36.7	7866	30.9	8066	28.1	8510	26.3
385	36.6	7574	30.8	4841	28.1	4842	26.2
4481	36.6	8554	30.8	7806	28.0	8414	26.2
987	36.3	7572	30.8	356	28.0	8514	26.2
699	36.1	755	30.7	8067	28.0	656	26.2
3958	36.0	7885	30.5	4346	27.9	7479	26.2
4317	35.9	8271	30.3	4295	27.9	3956	26.1
4481	35.1	3902	30.3	9009	27.9	110	26.1
987	34.8	692	30.1	6804	27.9	647	26.0
699	34.6	8631	30.1	5254	27.9	7072	26.0
3958	34.5	7790	30.1	8214	27.8	7561	26.0
4317	34.4	532	30.0	6940	27.8	7677	25.9

Table 24
Computer Modelled CPP, FCS and Water Treatment Plants to Closest Residences, Evening

Residence	Noise Level dB(A)	Residence	Noise Level dB(A)	Residence	Noise Level dB(A)	Residence	Noise Level dB(A)
7813	34.3	7682	30.0	4839	27.8	7073	25.9
6969	33.8	8490	30.0	234	27.7	7804	25.9
641	33.7	7792	30.0	9022	27.7	210	25.9
7599	33.6	7390	29.9	100	27.7	6922	25.8
7815	33.2	7794	29.9	8655	27.6	7786	25.8
560	33.2	7852	29.9	7670	27.6	8437	25.8
4844	33.0	8286	29.9	679	27.5	4266	25.8
6969	33.8	7068	29.6	581	27.5	643	25.7
8579	33.8	7554	29.6	651	27.5	7788	25.6
7459	33.6	7911	29.6	7094	27.5	4562	25.6
7817	33.6	7791	29.6	8434	27.4	8415	25.6
6371	33.5	8425	29.6	6925	27.3	8504	25.5
245	33.5	7889	29.5	6924	27.2	7907	25.5
7605	33.4	7608	29.5	8099	27.2	7596	25.5
7610	33.3	8284	29.4	226	27.1	8538	25.5
7917	33.2	8505	29.4	7798	27.1	7529	25.5
371	33.1	8556	29.1	538	27.1	8494	25.5
7656	33.1	6859	29.0	8470	27.1	7089	25.5

From Table 24 the following should be noted:

- total number of receptors modelled = 1563;
- receptors which exceed 28 dB(A) = 86.

The evening noise limit is 30 dB(A) and for just the CPP, FCS and water treatment plants this is exceeded at 86 receptors (5.5% of receptors).

Table 25
Computer Modelled CPP, FCS and Water Treatment Plants to Closest Residences, Night-time

Residence	Noise Level dB(A)	Residence	Noise Level dB(A)	Residence	Noise Level dB(A)	Residence	Noise Level dB(A)
7662	62.7	7936	32.5	8631	29.0	665	26.9
565	61.6	3983	32.4	8271	28.9	653	26.9
4855	52.8	648	32.4	692	28.7	3951	26.8
7835	51.9	6371	32.4	7790	28.7	4841	26.8
8046	49.8	245	32.3	532	28.6	9009	26.8
7836	48.5	7459	32.1	7682	28.6	6804	26.8
7837	46.1	7817	32.1	7792	28.6	8426	26.7
7600	44.4	7917	32.0	8490	28.6	8066	26.7

Table 25
Computer Modelled CPP, FCS and Water Treatment Plants to Closest Residences, Night-time

Residence	Noise Level dB(A)	Residence	Noise Level dB(A)	Residence	Noise Level dB(A)	Residence	Noise Level dB(A)
7823	44.3	7605	32.0	7794	28.5	3930	26.7
1170	43.5	8666	31.8	7390	28.5	7806	26.7
105	42.2	7610	31.8	7852	28.4	356	26.6
7456	41.5	371	31.7	8286	28.4	9022	26.6
744	41.4	7656	31.6	7911	28.4	8067	26.6
4618	40.5	8047	31.5	7889	28.3	4295	26.5
7551	40.3	362	31.4	7068	28.2	4346	26.5
3911	39.9	3939	31.2	7791	28.2	234	26.5
8478	39.3	553	31.2	7554	28.2	5254	26.5
563	38.8	7602	31.1	8425	28.1	8655	26.5
7664	38.6	8966	30.9	7608	28.0	8214	26.4
504	38.5	3980	30.9	8284	28.0	6940	26.4
7818	37.8	7660	30.9	8505	28.0	4839	26.4
4479	36.8	3917	30.8	8556	27.7	100	26.3
172	36.1	7606	30.7	6859	27.6	7670	26.2
638	35.5	3305	30.7	7857	27.5	679	26.1
729	35.4	7592	30.7	7097	27.4	581	26.1
7813	35.8	8062	30.5	8205	27.4	7094	26.1
641	35.2	45	30.4	7872	27.4	651	26.1
7599	35.1	168	30.3	8420	27.3	8434	26.0
7815	34.7	7067	30.3	7871	27.3	6925	25.9
560	34.7	7678	30.1	7873	27.3	226	25.9
8553	34.4	6887	30.1	47	27.2	6924	25.8
4844	34.2	4836	30.1	7069	27.2	8099	25.8
3989	34.2	434	29.9	7878	27.2	7798	25.8
7936	34.0	555	29.9	314	27.2	538	25.7
236	34.0	6930	29.8	7810	27.2	8470	25.7
3983	33.9	7866	29.6	3969	27.2	7805	25.6
648	33.9	7796	29.5	634	27.2	7828	25.6
552	35.2	8484	29.4	3963	27.2	7558	25.5
385	35.1	7574	29.4	8430	27.1	9024	25.5
8553	32.9	8554	29.4	8497	27.1	7070	25.5
236	32.8	7572	29.3	7826	27.1	7538	25.5
3989	32.7	7885	29.2	9011	27.0	9025	25.5
8579	32.6	755	29.2	7841	27.0	6923	25.4

From Table 25 the following should be noted:

- total number of receptors modelled = 1563;
- receptors which exceed 28 dB(A) = 97.

The night-time noise limit is 28 dB(A) and for just the CPP, FCS and water treatment plants this is exceeded at 97 receptors (6.2% of receptors).

Figure 2 is a graphical presentation of the computer modelling with respect to Table 23 – CPP, FCS and water treatment plants during the daytime, whilst Figure 3 is for the evening period (Table 24 refers) and Figure 4 is for the night-time period (Table 25 refers).

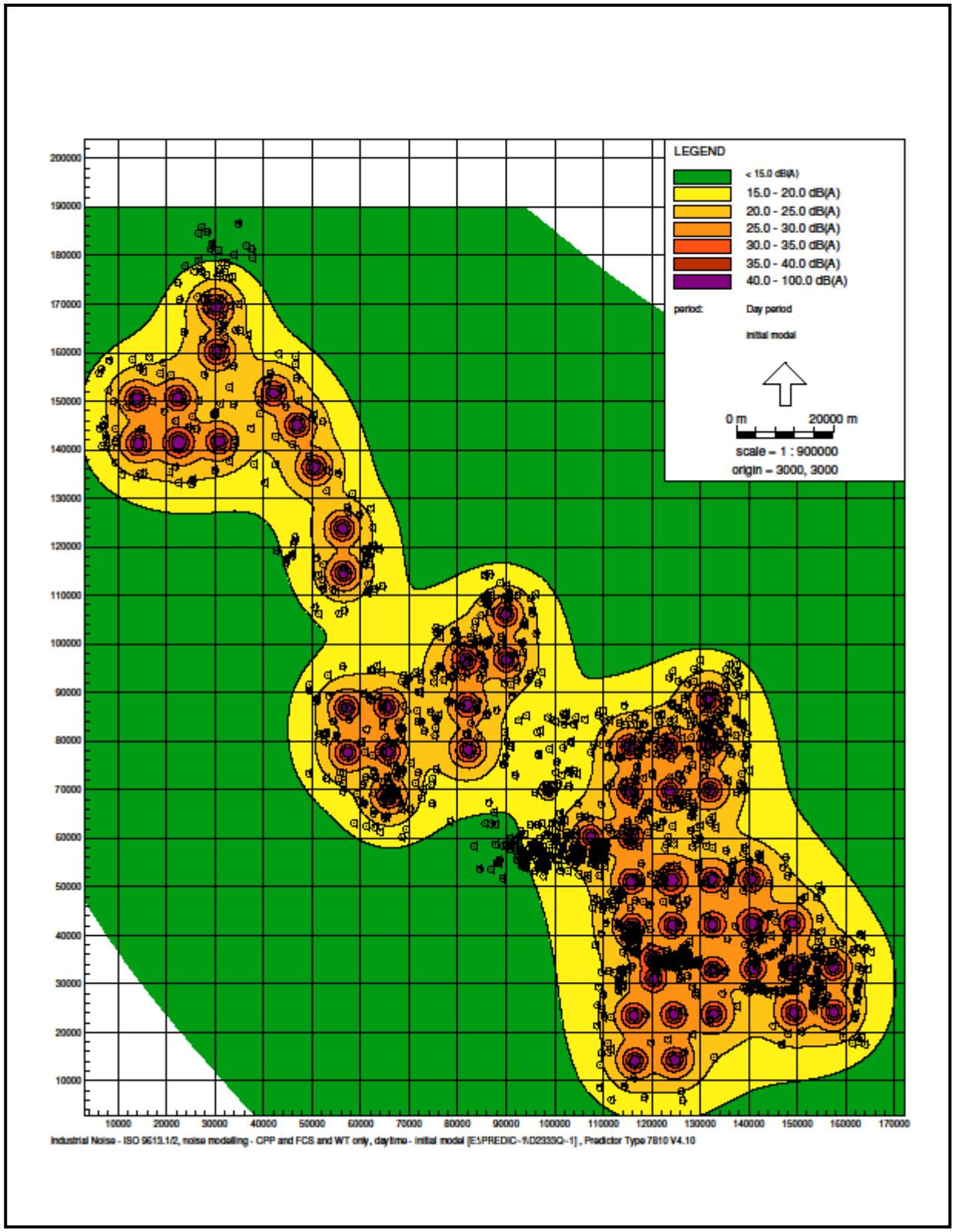

Figure 2
Computer Noise Modelling of CPP, FCS and Water Treatment Plants, Daytime

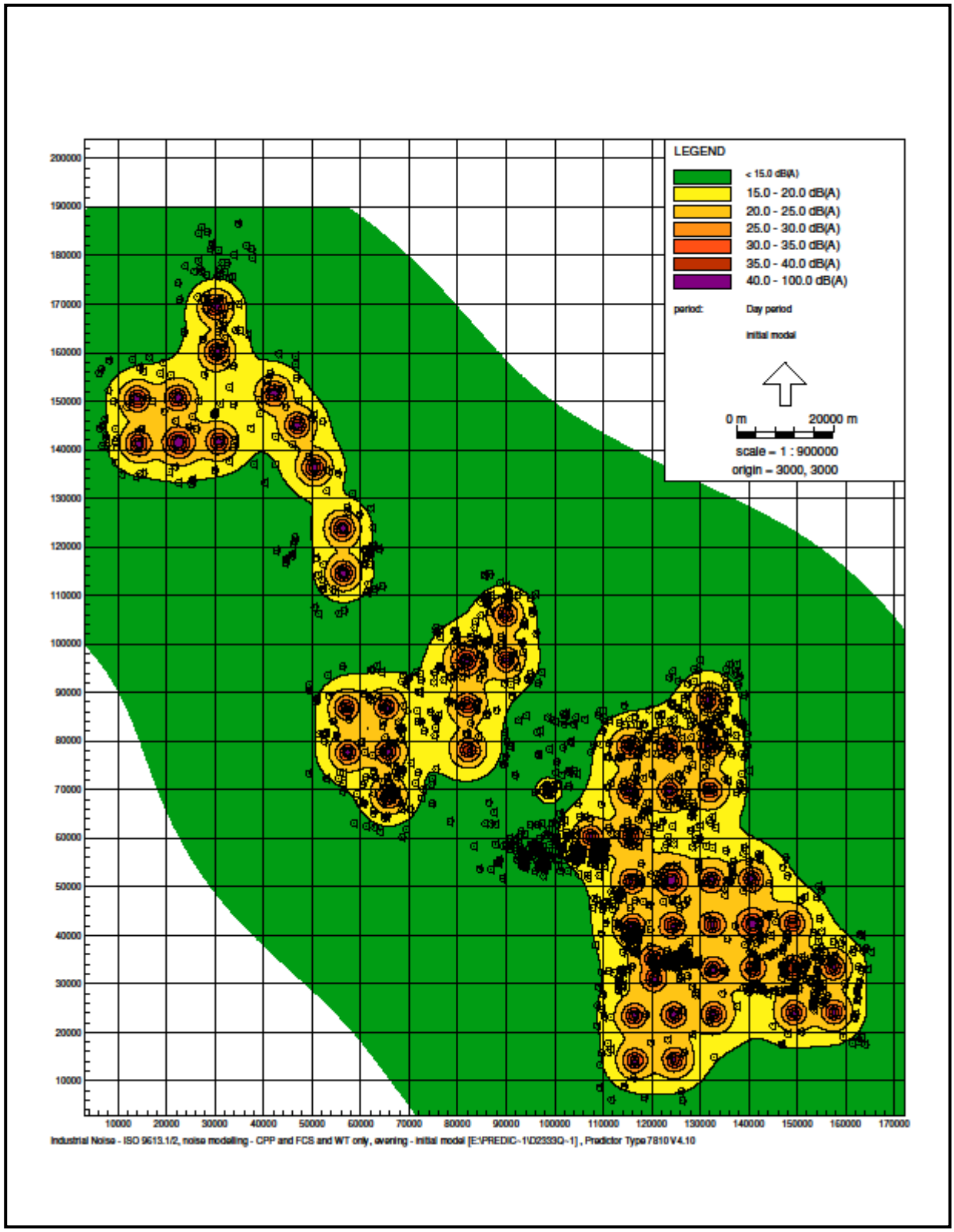

Figure 3
Computer Noise Modelling of CPP, FCS and Water Treatment Plants, Evening

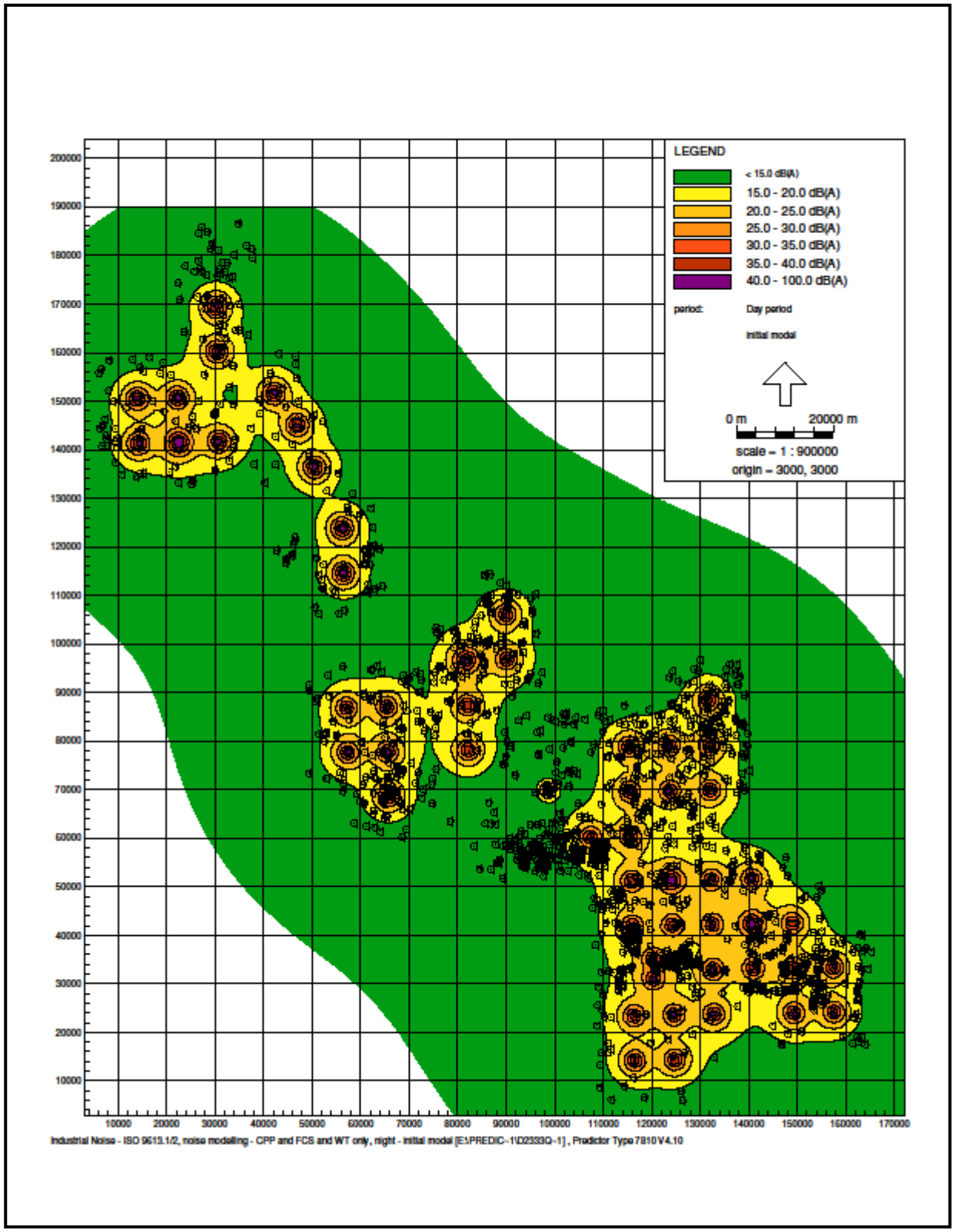

Figure 4
Computer Noise Modelling of CPP, FCS and Water Treatment Plants, Night-time

NOISE IMPACT

Central Processing Plant

There will be a total of four central processing plants, with one of these plants being gas turbine driven and the other three being electric driven. For the CPP facilities the source noise data included attenuation to the engine and compressor only (100 mm panel enclosure), with no noise attenuation to the fans, as well as a tonal correction of +3 dB(A) and a correction factor of +2 dB(A) for the accuracy of the computer model (total adjustment of +5 dB(A)).

From Tables 1, 2 and 3, for a night-time noise limit of 28 dB(A), the noise level of an electric driven CPP complies with this noise limit at a separation distance of 1800 metres, whilst a daytime noise limit of 35 dB(A) and an evening noise limit of 30 dB(A) are complied with at separation distances of 1600 and 1700 metres respectively.

From Tables 4, 5 and 6, for the gas turbine driven CPP a night-time noise limit of 28 dB(A) is complied with at a separation distance of 2000 metres, whilst a daytime noise limit of 35 dB(A) and an evening noise limit of 30 dB(A) are complied with at separation distances of 1700 and 1900 metres respectively.

Field Compression Station

There will be a total of fifty-three field compression stations, with twelve of these plants being gas turbine driven and the other forty-one being electric driven. For the FCS facilities the source noise data included attenuation to the engine and compressor only (100 mm panel enclosure), with no noise attenuation to the fans, as well as a tonal correction of +3 dB(A) and a correction factor of +2 dB(A) for the accuracy of the computer model (total adjustment of +5 dB(A)).

From Tables 7, 8 and 9, for a night-time noise limit of 28 dB(A), the noise level of an electric driven FCS complies with this noise limit at a separation distance of 1700 metres, whilst a daytime noise limit of 35 dB(A) and an evening noise limit of 30 dB(A) are complied with at separation distances of 1600 and 1600 metres respectively.

From Tables 4, 5 and 6, for the gas turbine driven FCS a night-time noise limit of 28 dB(A) is complied with at a separation distance of 1900 metres, whilst a daytime noise limit of 35 dB(A) and an evening noise limit of 30 dB(A) are complied with at separation distances of 1700 and 1700 metres respectively.

Wellhead Engine and Compressor

Computer noise modelling for a wellhead engine (Cat G3304, 1800 rpm) and compressor (Howden XRV 204, 1800 rpm) was conducted.

For this noise source a tonal correction of +3 dB(A) and a correction factor of +2 dB(A) for the accuracy of the computer model (total adjustment of +5 dB(A)) has been applied.

For a night-time noise limit of 28 dB(A), the noise level of a wellhead engine and compressor complies with this noise limit at a separation distance of 1700 metres, whilst a daytime noise limit of 35 dB(A) and an evening noise limit of 30 dB(A) are complied with at separation distances of 1100 metres and 1500 metres respectively.

Water Treatment Plant

Computer noise modelling for a 63 ML/d water treatment plant was conducted. For this noise source a tonal correction of +3 dB(A) and a correction factor of +2 dB(A) for the accuracy of the computer model (total adjustment of +5 dB(A)) has been applied.

For a night-time noise limit of 28 dB(A), the noise level of a water treatment plant complies with this noise limit at a separation distance of 900 metres, whilst a daytime noise limit of 35 dB(A) and an evening noise limit of 30 dB(A) are complied with at separation distances of 500 metres and 800 metres respectively.

Drilling Rigs

Computer noise modelling for two different drilling rigs, namely an Ensign #34 (Codie #2) drilling rig and the Wild Dessert #65 drilling rig, was conducted. For these noise sources a tonal correction of +3 dB(A) and a correction factor of +2 dB(A) for the accuracy of the computer model (total adjustment of +5 dB(A)) has been applied.

For the Ensign #34 (Codie #2) drilling rig and the Wild Dessert #65 drilling rig, noise levels at nominated distances are detailed in Tables 20 and 21 respectively.

Infield Water Pumps

Computer noise modelling was conducted for an attenuated 750 kW infield water pump.

For the attenuated 750 kW infield water pump and a night-time noise limit of 28 dB(A), the noise level of this pump complies with the night-time noise limit at a separation distance of 700 metres, whilst for a daytime noise limit of 35 dB(A) and an evening noise limit of 30 dB(A) are complied with at separation distances of 400 metres and 600 metres respectively.

CPP, FCS and Water Treatment Plant

Computer noise modelling was conducted for the complete upstream area and included the four central processing plants, fifty-three field compression stations and a water treatment plant. All source noise data was adjusted by +3 dB(A) for tonality and +2 dB(A) for accuracy of the computer model. The source noise data for the compressor facilities included attenuation for the engines and compressors only (100 mm panel enclosure), with no noise control applied to any of the fans.

For the daytime noise limit of 35 dB(A) the noise of the CPP, FCS and water treatment plants exceeds the noise limit at 87 receptors (5.6% of receptors).

For the evening noise limit of 30 dB(A) the noise of the CPP, FCS and water treatment plants exceeds the noise limit at 86 receptors (5.5% of receptors).

For the night-time noise limit of 28 dB(A) the noise of the CPP, FCS and water treatment plants exceeds the noise limit at 97 receptors (6.2% of receptors).