Australia Pacific LNG Project

Supplemental information to the EIS

Air Quality Impact Assessment

Gas Fields

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AUSTRALIA PACIFIC LNG GAS FIELDS SUPPLEMENTARY AIR QUALITY IMPACT ASSESSMENT

Prepared for

WorleyParsons

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Prepared by

Katestone Environmental Pty Ltd

ABN 92 097 270 276
Terrace 5, 249 Coronation Drive
PO Box 2217
Milton, Queensland, Australia 4064

www.katestone.com.au
environmental@katestone.com.au
Ph +61 7 3369 3699
Fax +61 7 3369 1966

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1. Introduction

Katestone Environmental was commission by WorleyParsons to undertake an air quality impact assessment in preparation of the gas-fields component of the Australia Pacific LNG Environmental Impact Statement (EIS). The Australia Pacific LNG Project (the Project) proposes to extract coal seam gas (CSG) from a network of wells and processing facilities in the Surat Basin, known as the Walloons gas fields, transport the CSG via pipeline to a processing facility in Gladstone and process the CSG ready for export as liquefied natural gas (LNG).

Since the completion of the EIS for the Project there have been a number of significant changes to the Project's pre-front end engineering design (pre-FEED) including the type, location and number of air emission sources.

This report details the outcomes of a supplementary air quality impact assessment (SAQIA) of the changes to the gas-fields component of the Project. The supplementary assessment has focused on the following key air pollutants that were found to be of importance in the EIS, namely:

- Oxides of nitrogen (NOx), as nitrogen dioxide (NO_2)
- Carbon monoxide (CO)
- Hydrocarbons (VOC) and in particular: acetaldehyde, acrolein, chloroethane, formaldehyde and phenanthrene

The assessment of potential impacts on air quality has been carried out using the atmospheric dispersion modelling methodology developed for the EIS. The location of each emission source has been provided by WorleyParsons for input into the dispersion model. The locations may change as the project develops further. Notwithstanding this, the outcome of the assessment is not expected to change substantially as a result of final siting details being determined.

2. SAQIA Methodology

2.1 Pre-FEED Design Changes

The major change to the gas-fields component of the Project is that electric motors will be used instead of gas-fired engines to drive equipment at the gas processing facilities, water transfer stations and water treatment facilities. The change from gas-fired engines to electric motors significantly reduces the emission rates of air pollutants from the Project and the number of air emission sources, as electric motors do not produce exhaust emissions.

To power all the electric motors across the Australia Pacific LNG gas field, electricity will be supplied from the grid. During the first two to five years of the Project's lifetime it is anticipated that the infrastructure to provide gridded power to the Project will not be fully developed. As a short-term solution it is proposed that eight temporary power stations, comprised of a single gas-fired power generation turbine (GE TM2500+), are located across the gas field at locations where gas infrastructure will be developed. This is likely to be quite conservative as there will not be eight temporary power stations operating at any one time. This is due to the progressive development of gas processing facilities coming on line and the progressive grid connection to these facilities as power line infrastructure is developed during the first five years.

The pre-FEED design for the EIS recommended an upgrade to the existing gas processing facility located at Talinga. The EIS considered an increase in the output of the plant from 90 TJ/day to 180 TJ/day and included provisions to retrofit NOx control technology to a number of existing gas engines. It is now the case that the existing facility at Talinga will remain at 90 TJ/day output and there will be no NOx control technology applied to the existing infrastructure.

A qualitative assessment of the impact of small gas-fired engines at the gas wells was conducted for the EIS based upon the proposed engine size at the wells compared to against the gas processing facilities gas engines. This showed that even though there were a large number of engines required at gas wells across the gas field, the overall impact would be minimal compared to the impact of the larger gas engines at each gas processing facility.

The decision to switch to electric motors at the gas processing facilities now means that the gas-fired engines at the gas wells are a relatively important source of air emissions and therefore a quantitative assessment has been conducted. Detailed information on the type of engines and the location of gas wells has been provided and will be assessed in this supplementary report as a case study in the *'Undullah Nose'* region of the gas-fields.

2.2 Assessment Methodology

This section describes the operational scenarios considered for the supplementary assessment of air quality for the entire Australia Pacific LNG gas-fields Project. A full description of the dispersion modelling assessment methodology can be found in section 7 of the EIS and relevant Appendices.

Two operational scenarios have been assessed that represent a worst-case air quality impact for the Project.

Scenario 1 assesses the potential impact of the Project on air quality across the study region. Scenario 2 assesses the potential local air quality impact for the central gas fields' area known as the *'Undullah Nose'*. The *'Undullah Nose'* was chosen because it is the location where the highest potential for cumulative impacts exists due to it having the greatest density of gas infrastructure both associated with the Australia Pacific LNG Project and activities of other producers.

1.1.1 Scenario 1 - Australia Pacific LNG gas field

The existing gas processing facility infrastructure at Talinga, operating at 90 TJ/day, has been assessed along with eight TM2500+ gas turbines to be located across the Australia Pacific LNG gas fields, which will provide electricity to the proposed gas processing facilities while grid power is unavailable. WorleyParsons provided Katestone Environmental with ten possible locations for the proposed gas turbines (Figure 1). There are two options for the locations of the gas turbines at Reedy Creek and Combabula. For this assessment the Reedy Creek Option C and Combabula Option D locations have been chosen as they represent the minimum separation between each other and the Pine Hills location to the west and therefore the maximum potential for cumulative impacts.

The existing Talinga gas processing facility comprises the following air emission sources:

- 12 x Waukesha L7042GSI gas-fired reciprocation screw compressors (rich burn)
- 5 x Caterpillar G3612 gas-fired reciprocating engines
- 3x Caterpillar G3406 gas-fired boilers

The assessment for Scenario 1 has been carried out for the existing Talinga operations and the proposed temporary gas turbines in isolation and cumulatively. For the cumulative assessment, background concentrations have been included for NO_2 and CO but not for the hydrocarbons. This approach is consistent with the EIS.

The assessment of background concentrations in the study area is the same as the EIS. NO_2 levels have been modelled for all existing sources and added to the Australia Pacific LNG air emission sources. A background CO level has been determined from the measurements from the DERM Toowoomba monitoring station.

The dispersion modelling results have been presented as a maximum concentration at any location across the model area, in isolation and cumulatively. Contour plots of NO_2 are presented for each source in isolation and cumulatively.

1.1.2 Scenario 2 - Gas wells case study

This scenario focuses on the area surrounding the existing Talinga gas processing facility known as the '*Undullah Nose'*. An indicative location of every gas well, spaced 750 metres apart, in the Talinga, Orana and Condabri tenements has been provided by WorleyParsons. The potential impact of the gas-fired engines to be installed at gas wells has been assessed in isolation and cumulatively to include both existing and proposed Australia Pacific LNG infrastructure and background sources (large power stations). A cumulative assessment that includes third party gas proponent infrastructure based upon the data submitted in the EIS has also been conducted.

To assess a worst-case impact each gas well has been assumed to require a gas compressor engine powered by a micro-turbine, giving a total of 1,730 micro-turbines across the *'Undullah Nose'* region. It has been assumed that 50% of the gas wells will require pumping at any particular point in time, and so every second gas well has been modelled with a gas-fired engine operating to drive the water pump (approximately 850 gas-engines). In reality, the development of a gas field tenement is transient over the lifetime of the Project and it is extremely unlikely that all the sources from the gas wells in the *'Undullah Nose'* region would be operating at the same time.

As will be shown in section 5 the major pollutant of concern is NO_2 from gas-fired engines at the existing Talinga gas processing facility and therefore this scenario has focused on NO_2 only.

The assessment of background concentrations in the study area is the same as the EIS. Nitrogen dioxide levels have been modelled for all existing sources and added to the Australia Pacific LNG air emission sources. The results have been presented as a maximum concentration at any location across the model area, in isolation and cumulatively. Contour plots of NO_2 are presented for all the gas wells in isolation and as a cumulative plot of all sources.

3. Emissions

The key pollutants identified in the EIS and assessed in this report include NO_X (as NO_2), CO and various hydrocarbon species. WorleyParsons provided information on the emissions and source characteristics for the proposed gas turbines and gas well engines. Emissions and source characteristics from the existing infrastructure and background sources have been taken from the EIS.

Chemical speciation of the hydrocarbons that could be found in the exhaust emissions from the gas-fired turbines was not available in the information provided by WorleyParsons. The conventional approach to speciate hydrocarbon emissions is to use the USEPA AP-42 document *Stationary Gas Turbines (Chapter 3.1).*

3.1 TM2500 Gas Turbines

The eight temporary power stations will each use a single TM2500+ gas turbine to generate electricity. The source characteristics have been supplied by WorleyParsons and are detailed in Table 1. Emission rates of NO_X, CO and hydrocarbons are detailed in Table 2.

Table 1 Source characteristics of the TM2500+ gas turbine under normal operating conditions at 100% capacity

Parameter	Units	Value
Number of stacks per turbine unit	--	1
Total number of turbine units	--	8
Stack height (above ground level)	m	6
Stack diameter	m	2.5
Exhaust gas temperature	K	770
Exhaust gas velocity	m/s	35.4
Exhaust gas flow rate (actual stack conditions)	m^3/s	161.6
Normalised exhaust gas flow rate (0^oC, 1 Atm)	Nm^3/s	57.3

Table 2 Exhaust concentrations and emission rates of NOx, CO and hydrocarbons from a TM2500+ gas turbine under normal operating conditions at 100% capacity

Pollutant	Concentration (mg/Nm^3)	Emission rate (g/s)
Oxides of nitrogen	52.46	3.01
Carbon monoxide	47.27	2.71
Acetaldehyde	2.1E-02	0.001
Acrolein	3.3E-03	0.0002
Formaldehyde	3.7E-01	0.02

Table note:

Exhaust gas concentrations (mg/Nm^3) and emission rates (g/s) are based on total emissions per unit at 100% operating load.

Exhaust oxygen content not provided.

Concentrations provided at stack conditions.

3.2 Gas Wells

The emission source characteristics of the small gas-fired engine used to drive the wellhead water pumps and the micro-turbines used to extract CSG as well production declines are presented in Table 3, while the stack concentration and mass emission rate of NOx is presented in Table 4.

Table 3 Source characteristics of the gas well engines under normal operating conditions at 100% capacity

Parameter	Units	Water Pump Engine	Gas Compressor
Number of stacks per unit	--	1	1
Total number of assessed units	--	870	1,750
Stack height (above ground level)	m	2.6	2.1
Stack diameter	m	0.08	0.13
Exhaust gas temperature	^{o}C	649	275
Exhaust gas velocity	m/s	41	37.9
Exhaust gas flow rate (actual stack conditions)	m^3/s	0.21	0.48
Normalised exhaust gas flow rate ($0^{o}C$, 1 Atm)	Nm^3/s	0.06	0.24

Table 4 Exhaust concentrations and emission rates of NOx from the gas well engines under normal operating conditions at 100% capacity

Pollutant	Water Pump Engine		Gas Compressor	
	Concentration (mg/Nm^3)	Emission rate (g/s)	Concentration (mg/Nm^3)	Emission rate (g/s)
Oxides of nitrogen	3,312	0.20	23.2	0.01

Table note:

Exhaust gas concentrations (mg/Nm^3) and emission rates (g/s) are based on total emissions per unit at 100% operating load.

Exhaust oxygen content not provided.

Concentrations provided at stack conditions.

3.3 Existing Talinga Gas Processing Facility

The emissions and source characteristics of the existing Talinga gas processing facility operating at 90 TJ/day is detailed in Section 4.13 of the EIS and reproduced here in Table 5 and Table 6.

Table 5 Emission source characteristics of the gas-fired engines used at the Talinga GPF at maximum load (90 TJ/day)

Parameter	Units	Waukesha L7042GSI	CAT G3612	CAT G3406
Number of stacks per engine	-	1	2	1
Number of units	-	12	5	3
Stack height	m	7.2	11.1	5.0
Stack diameter	m	0.355	0.457	0.127
Stack cross-sectional area	m^2	0.10	0.16	0.01
Exhaust gas velocity	m/s	33.2	34.3	29.2
Temperature	^oC	607	459	593
Actual volume flow rate[1]	Am^3/hr	11,830	40,452	1,332
Actual volume flow rate[2]	Am^3/s	3.29	5.62	0.37
Normalised volume flow rate[2]	Nm^3/s	1.02	2.10	0.12
Plume buoyancy flux[3]	m^4/s^3	6.93	10.72	0.77

Table note:

[1] Volume flow per engine unit

[2] Volume flow per stack. Flow from the CATG3616 and CAT G3612 engines is assumed to be equally split between two 50% exhaust stacks.

[3] Plume buoyancy flux calculated based on annual average minimum daily temperature (night time) at Miles of 12.2 ^oC.

Maximum operating load for all engines is assumed to be 100% capacity.

Table 6 Exhaust gas concentrations and emission rates of criteria pollutants for the existing Talinga GPF at maximum load (90 TJ/day)

Pollutant	Load	Units	Waukesha L7042GSI	CAT G3612	CAT G3406
Oxides of nitrogen	Max	mg/Nm	6,455	1,643	14,760
		g/s	6.58	3.44	1.72
Carbon monoxide	Max	mg/Nm	5,230	5,964	952
		g/s	5.33	12.50	0.11
Reference oxygen content	%	%	5.0	N/A	2.0

Table note:

Exhaust gas concentrations (mg/Nm^3) and emission rates (g/s) are based on total emissions per engine unit.

Reference oxygen conditions at 0^oC, 1 Atm.

4. Air Quality Criteria

4.1 Queensland Environmental Protection Policies

The *Environmental Protection Act 1994* (EP Act) provides for the management of the air environment in Queensland. The legislation applies to government, industry and individuals and provides a mechanism for the delegation of responsibility to other government departments and local government and provides all government departments with a mechanism to incorporate environmental factors into decision-making.

The object of the EP Act is summarised as follows:

> *The object of the Environmental Protection Act 1994 is to protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends. (EPP (Air) Explanatory notes, General outline)*

The EP Act gives the Environment Minister the power to create Environmental Protection Policies that aim to protect the environmental values identified for Queensland. In accordance with the EP Act, the Environmental Protection (Air) Policy (EPP (Air)) is to be reviewed every ten years, with the initial EPP(Air) having been gazetted in 1997. Consequently, the EPP (Air) was scheduled for revision in 2008 and the revised EPP (Air) 2008 commenced on 1 January 2009.

The objective of the EPP (Air) 2008 is summarised as follows:

> *The objective of the Environmental Protection (Air) Policy 2008 is to identify the environmental values of the air environment to be enhanced or protected and to achieve the object of the Environmental Protection Act 1994, i.e., ecologically sustainable development.*

The application and purpose of the EPP (Air) 2008 is summarised as follows:

> *The purpose of the EPP (Air) is to achieve the object of the Act in relation to the air environment (EPP (Air) Part 2, Section 5).*
>
> *The purpose of this policy is achieved by -*
>
> a) *Identifying environmental values to be enhanced or protected; and*
> b) *Stating indicators and air quality objectives for enhancing or protecting the environmental values; and*
> c) *providing a framework for making consistent, equitable and informed decisions about the air environment (EPP (Air) Part 2, Section 6).*
>
> *The environmental values to be enhanced or protected under the EPP (Air) are –*
>
> a) *the qualities of the air environment that are conducive to protecting the health and biodiversity of ecosystems; and*
> b) *the qualities of the air environment that are conducive to human health and wellbeing; and*

c) the qualities of the air environment that are conducive to protecting the aesthetics of the environment, including the appearance of buildings structures and other property; and
d) the qualities of the air environment that are conducive to protecting agricultural use of the environment.

The administering authority must consider the requirements of the EPP (Air) when it decides an application for an environmental authority, amendment of a licence or approval of a draft Environmental Management Plan. Schedule 1 of the EPP (Air) specifies air quality objectives for various averaging periods.

4.2 National Environment Protection Measure

The National Environment Protection Council defines national ambient air quality standards and goals in consultation, and with agreement from, all state governments. These were first published in 1998 in the National Environment Protection (Ambient Air Quality) Measure (NEPM (Air)). Compliance with the NEPM (Air) standards is assessed via ambient air quality monitoring undertaken at locations prescribed by the NEPM (Air) and that are representative of large urban populations. The goal of the NEPM (Air) is for the ambient air quality standards to be achieved at these monitoring stations within ten years of commencement; that is in 2008. The EPP (Air) 2008 has adopted the NEPM (Air) goals as air quality objectives.

4.3 Relevant Ambient Air Quality Goals for the Project

The predicted ground-level concentrations of air pollutants have been compared with the relevant state, national and international ambient air quality objectives and standards to determine acceptability, namely:

- Queensland Environmental Protection (Air) Policy 2008
- National Environment Protection Measure (Ambient Air Quality) 1998
- NSW Department of Environment and Climate Change (NSW DECC) *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (2005)*
- Texas Commission on Environmental Quality Toxicological section list of Effects Screening Levels.

Table 7 presents a summary of the relevant ambient air quality goals for criteria pollutants adopted for this assessment.

Table 7 Relevant ambient air quality objectives for criteria air pollutants (EPP (Air) 2008)

Indicator	Environmental value	Averaging period	Air quality objective [1] (µg/m³)	Number of days of exceedence allowed
Nitrogen dioxide	Health and wellbeing	1-hour	250	1
		1-year	62	0
	Health and biodiversity of ecosystems	1-year	33	0
Carbon monoxide	Health and wellbeing	8-hour	11,000	1

Note
[1] Air quality objective at $0^{o}C$

In addition to the criteria air pollutants detailed above small quantities of hydrocarbons may be emitted from the Project's sources. The hydrocarbons that were found in the EIS to be relatively significant are presented in Table 8 along with their relevant air quality objective.

Table 8 Ambient air quality objectives and standards for the top five hydrocarbons

Indicator	Environmental value	Averaging period	Air quality objective or standard (µg/m³)	Source of standard or goal
Acetaldehyde	Odour	1-hour	42	NSW DECCW
Acrolein	Health (Extremely toxic - USEPA)	1-hour	0.42	NSW DECCW
Ethyl chloride (chloroethane)	Health and wellbeing	1-hour	0.048	NSW DECCW
Formaldehyde	Health and wellbeing	24-hour	54	EPP Air
Phenanthrene	Health	1-hour	0.5	TCEQ

Comparison of air quality objectives from each jurisdiction to the predicted maximum is based on a specific percentile of the distribution of predicted ground-level concentrations. The percentile used for each is presented in Table 9.

Table 9 Summary of percentile values used for comparison to air quality objectives

Standard or goal	Pollutant	Percentile
Environment Protection (Air) Policy	Criteria	100
NSW Department of Environment, Climate Change and Water	Non-criteria	99.9
Texas Commission on Environmental Quality	Non-Criteria	100

5. Scenario 1 – Australia Pacific LNG entire gas field results

This section describes the results of the air quality assessment for NO_2, CO and selected hydrocarbons for the entire Australia Pacific LNG gas field revised pre-FEED design.

5.1 Nitrogen dioxide and carbon monoxide

The predicted ground-level concentrations of NO_2 and CO for each individual source type in isolation and as a cumulative assessment are presented in Table 10. Contour plots predicted 1-hour maximum and annual average ground-level concentrations of NO_2 from gas turbines in isolation and all Scenario 1 sources are presented in Figure 3 to Figure 6, respectively.

Table 10 Predicted maximum 1 hour and annual average ground-level concentrations of NO_2 and 8-hour average CO for the revised Australia Pacific LNG gas field operations

	Nitrogen dioxide (NO_2)		Carbon monoxide (CO)
Averaging period	*1-hour*	*Annual*	*8-hour*
EPP (Air) objective	*250*	*62*	*11,000*
Maximum ground-level concentration in isolation (µg/m³)			
8 power stations (TM2500+)	7.7	0.02	3.07
Existing Talinga GPF	278	2.3	416
Background Source contribution[1]	68.1	0.5	54.7
Maximum cumulative ground-level concentration (µg/m³)			
All sources	278	2.5	470.7

Table note:

[1] Background sources (power stations) for NO_2 have been modelled. Background sources for CO have been taken from monitoring data at Toowoomba

The results show the following:

- Predicted maximum 1-hour average ground-level concentrations of NO_2 due to all Scenario 1 sources exceeds the EPP (Air) objective of 250 µg/m^3 in close proximity to the Talinga gas processing facility. Away from the Talinga facility, compliance with the object is achieved by a significant margin.

- The main contribution to the predicted exceedances is the existing Talinga gas processing facility. The proposed TM2500+ gas turbines contribute a relatively small amount.

- Predicted maximum 1-hour average ground-level concentrations of NO_2 as a result of eight TM2500+ gas turbines is 7.7 µg/m^3 or 3% of the EPP (Air) objective of 250 µg/m^3

- Predicted maximum 1-hour average ground-level concentrations of NO_2 as a result of the existing Talinga gas processing facility operating at 90 TJ/day is 278 µg/m^3 or 111% of the EPP (Air) objective of 250 µg/m^3

- Predicted maximum 1-hour average ground-level concentration of NO_2 at all sensitive receptors due to all Scenario 1 sources is below the EPP (Air) objective of 250 µg/m^3

- Predicted annual average ground-level concentrations of NO_2 due to all Scenario 1 sources, including a background concentration, are well below the EPP (Air) air quality objective at all locations within the modelled domain

- Predicted ground-level concentrations of CO are well below the EPP (Air) air quality objective for the 8-hour averaging period due to all Scenario 1 sources, including a background concentration of 54.7 µg/m^3, at all locations within the modelled domain.

5.2 Hydrocarbons

The predicted ground-level concentrations of hydrocarbons for the various individual elements in isolation and as a cumulative assessment are presented in Table 11.

Table 11 Predicted ground-level concentrations of hydrocarbons of interest for the revised Australia Pacific LNG gas field operations

	Acetaldehyde	Acrolein	Formaldehyde	Chloroethane	Phenanthrene
Averaging period	*1-hour*	*1-hour*	*24-hour*	*1-hour*	*1-hour*
Air quality objective	*42*	*0.42*	*54*	*0.048*	*0.5*
Ground-level concentration in isolation (μg/m³)					
8 power stations (TM2500+)	0.01	0.0002	0.008	-	-
Existing Talinga GPF	1.9	0.03	2.4	0.0004	0.006
Cumulative ground-level concentration (μg/m³)					
All sources	1.9	0.03	2.4	0.0004	0.006

The results show the following:

- Predicted ground-level concentrations of key hydrocarbons are well below the air quality objectives for acetaldehyde, acrolein, formaldehyde, chloroethane and phenanthrene, due to all Scenario 1 sources, assessed in isolation and cumulatively, at all locations within the modelled domain

5.3 Comparison with EIS results

There are two main differences between the EIS and SAQIA gas-field results. The switch to electric motors has significantly reduced the potential impact of the Project on air quality across the entire Australia Pacific LNG gas field. The existing Talinga gas processing facility operating without retrofitted NOx controls results in marginal exceedances of the 1-hour NO_2 EPP (Air) quality objective in close proximity to the Talinga gas processing facility. The application of NOx control technologies, such as non-selective catalytic reduction (NSCR), which was contemplated in the EIS would reduce the potential impact on air quality of the existing facilities at Talinga to below the EPP(Air) objective.

6. Scenario 2 – *'Undullah Nose'* case study results

This section describes the results of the air quality assessment for NO_2 for the case study in the '*Undullah Nose'* region.

6.1 Nitrogen dioxide

The predicted ground-level concentrations of NO_2 for the various individual elements of the Project in isolation and as cumulative assessment are presented in Table 12 . Contour plots of predicted maximum 1-hour and annual average ground-level concentrations of NO_2 from gas wells in isolation, existing Talinga in isolation and all Scenario 2 sources are presented in Figure 7 to Figure 12, respectively.

Table 12 Predicted maximum 1 hour and annual average ground-level concentrations of NO_2 for the Australia Pacific LNG gas wells case study operations

Pollutant	Nitrogen dioxide (NO_2)	
Averaging period	***1-hour[1]***	***Annual***
EPP (Air) Objective	***250***	***62***
Maximum ground-level concentration in isolation (µg/m^3)		
Gas Wells	81.9	9.15
Temporary power stations (8 x TM2500+)	7.7	0.02
Existing Talinga GPF	278	2.3
Background Source contribution[2]	68.1	0.5
Maximum cumulative ground-level concentration (µg/m^3)		
All sources	286	10.2

Table notes:

[1]Predicted maximum ground-level concentration

[2]Existing background sources of NO_X have been modelled. The facilities of proposed third party gas producers have not been included here, but are assessed in Section 7.

The results show the following:

- Predicted maximum 1-hour average ground-level concentrations of NO_2 as a result of all Scenario 2 sources exceeds the EPP (Air) objective of 250 µg/m^3 in close proximity to the Talinga gas processing facility.

- Predicted maximum 1-hour average ground-level concentrations of NO_2 as a result of all Scenario 2 sources is 286 µg/m^3 or 114% of the EPP (Air) objective of 250 µg/m^3. The main contribution to the predicted exceedance is from the existing Talinga gas processing facility.

- Predicted maximum 1-hour average ground-level concentrations of NO_2 as a result of the existing Talinga gas processing facility operating at 90 TJ/day, assessed in isolation, is 278 µg/m^3 or 111% of the EPP (Air) objective of 250 µg/m^3

- Predicted maximum 1-hour average ground-level concentrations of NO_2 due to gas wells, temporary power stations and background sources is 82 µg/m^3 or 33% of the EPP (Air) air quality objective of 250 µg/m^3.

- Predicted maximum 1-hour average ground-level concentration of NO_2 at all sensitive receptors due to all Scenario 2 sources is below the EPP (Air) objective of 250 µg/m^3

- Predicted annual average ground-level concentrations of NO_2 due to all Scenario 2 sources are well below the EPP (Air) air quality objective at all locations within the modelled domain

7. Cumulative Impacts with Third Party Gas Producers

For the EIS, Katestone Environmental carried out a cumulative assessment of Australia Pacific LNG and third party gas proponent infrastructure in the *'Undullah Nose'* region. Conservative estimates of locations and total emissions from third party infrastructure were provided by Australia Pacific LNG.

Australia Pacific LNG has now provided information that states the third party gas proponent infrastructure will use electric motors at the gas processing facilities and a small gas-fired engine at each gas well. As detailed in EIS prepared by third party proponents, the maximum 1-hour ground-level concentration of NO_2 associated with third party gas wells in the *'Undullah Nose'* region is approximately 45 $\mu g/m^3$. This peak concentration is predicted to occur within the third parties' gas tenement to the south and southwest of the Australia Pacific LNG Talinga tenement.

Cumulative ground-level concentrations of NO_2 due to both the proposed third party infrastructure in the *'Undullah Nose'* region, the existing activities and the Australia Pacific LNG Project are unlikely to cause exceedances of the objectives at any of the existing sensitive receptors. However, compliance at the two receptors closest to Talinga gas processing facility would be marginal. The application of NOx control technologies, such as non-selective catalytic reduction (NSCR), which was contemplated in the EIS would reduce the potential impact on air quality of the existing facilities at Talinga to well below the EPP (Air) objective.

8. Conclusion

Katestone Environmental has undertaken a supplementary air quality impact assessment for the revised pre-FEED designs to the Australia Pacific LNG Gas-Fields Project located in the Surat Basin, south central Queensland.

The supplementary air quality assessment focussed on the key pollutants identified in the EIS, namely:

- NO_2
- CO
- Acetaldehyde
- Acrolein
- Formaldehyde
- Chloroethane
- Phenanthrene.

The following conclusion can be drawn:

<u>Scenario 1</u>

- Predicted maximum 1-hour average ground-level concentrations of NO_2 due to all Scenario 1 sources exceeds the EPP (Air) objective of 250 µg/m^3 in close proximity to the Talinga gas processing facility. Away from the Talinga facility, compliance with the object is achieved by a significant margin.

- The main contribution to the predicted exceedances is the existing Talinga gas processing facility. The proposed TM2500+ gas turbines contribute a relatively small amount. Australia Pacific LNG is currently undergoing stack monitoring at Talinga to understand the actual emissions. Results from this monitoring will be available upon request.

- Predicted maximum 1-hour average ground-level concentration of NO_2 at all sensitive receptors due to all Scenario 1 sources is below the EPP (Air) objective of 250 µg/m^3.

- Predicted annual average ground-level concentrations of NO_2 due to all Scenario 1 sources, including a background concentration, are well below the EPP (Air) air quality objective at all locations within the modelled domain.

- Predicted ground-level concentrations of CO are well below the EPP (Air) air quality objective for the 8-hour averaging period due to all Scenario 1 sources, including a background concentration of 54.7 µg/m^3, at all locations within the modelled domain.

- Predicted ground-level concentrations of key hydrocarbons are well below the air quality objectives for acetaldehyde, acrolein, formaldehyde, chloroethane and phenanthrene, due to all Scenario 1 sources, at all locations within the modelled domain.

Scenario 2

- Predicted maximum 1-hour average ground-level concentrations of NO_2 as a result of all Scenario 2 sources exceeds the EPP (Air) objective of 250 µg/m^3 in close proximity to the Talinga gas processing facility.

- The main contribution to the predicted exceedance is from the existing Talinga gas processing facility. The proposed gas turbines, gas well engines and background sources contribute a relatively small amount.

- Predicted maximum 1-hour average ground-level concentrations of NO_2 due to gas wells, temporary power stations and background sources, assessed in isolation, are below the EPP (Air) air quality objective at any location within the modelled domain

- Predicted maximum 1-hour average ground-level concentration of NO_2 at all sensitive receptors due to all Scenario 2 sources is below the EPP (Air) objective of 250 µg/m^3

- Predicted annual average ground-level concentrations of NO_2 due to all Scenario 2 sources are well below the EPP (Air) air quality objective at all locations within the modelled domain. Talinga stack emission monitoring is currently underway to verify the model results.

Cumulative impact with third party gas proponents

- Cumulative ground-level concentrations of NO_2 due to both the proposed third party infrastructure in the *'Undullah Nose'* region, the existing activities and the Australia Pacific LNG Project are unlikely to cause exceedances of the objectives at any of the existing sensitive receptors.

- Compliance with the maximum 1-hour NO_2 EPP (Air) objective at the two receptors closest to Talinga gas processing facility would be marginal. The application of NOx control technologies, such as non-selective catalytic reduction (NSCR), which was contemplated in the EIS would reduce the potential impact on air quality of the existing facilities at Talinga to well below the EPP (Air) objective.

9. References

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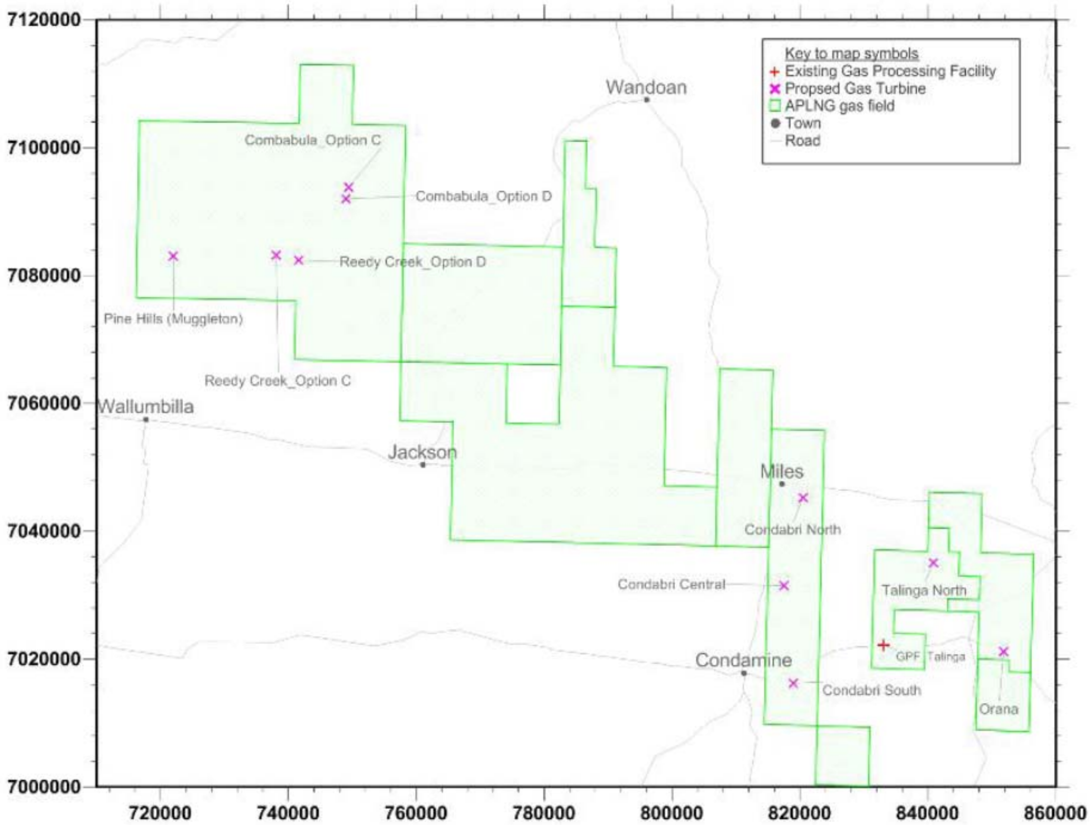

Figure 1 **Map showing the proposed location of revised pre-FEED design air emission sources**		
Location: South central Queensland	**Data source:** GIS data supplied by WorleyParsons	**Units:** Australian Map Grid coordinates – MGA94 1994 AMG Zone 55 (in metres)
Type: Site map	**Prepared by:** Andrew Vernon	**Date:** July 2010

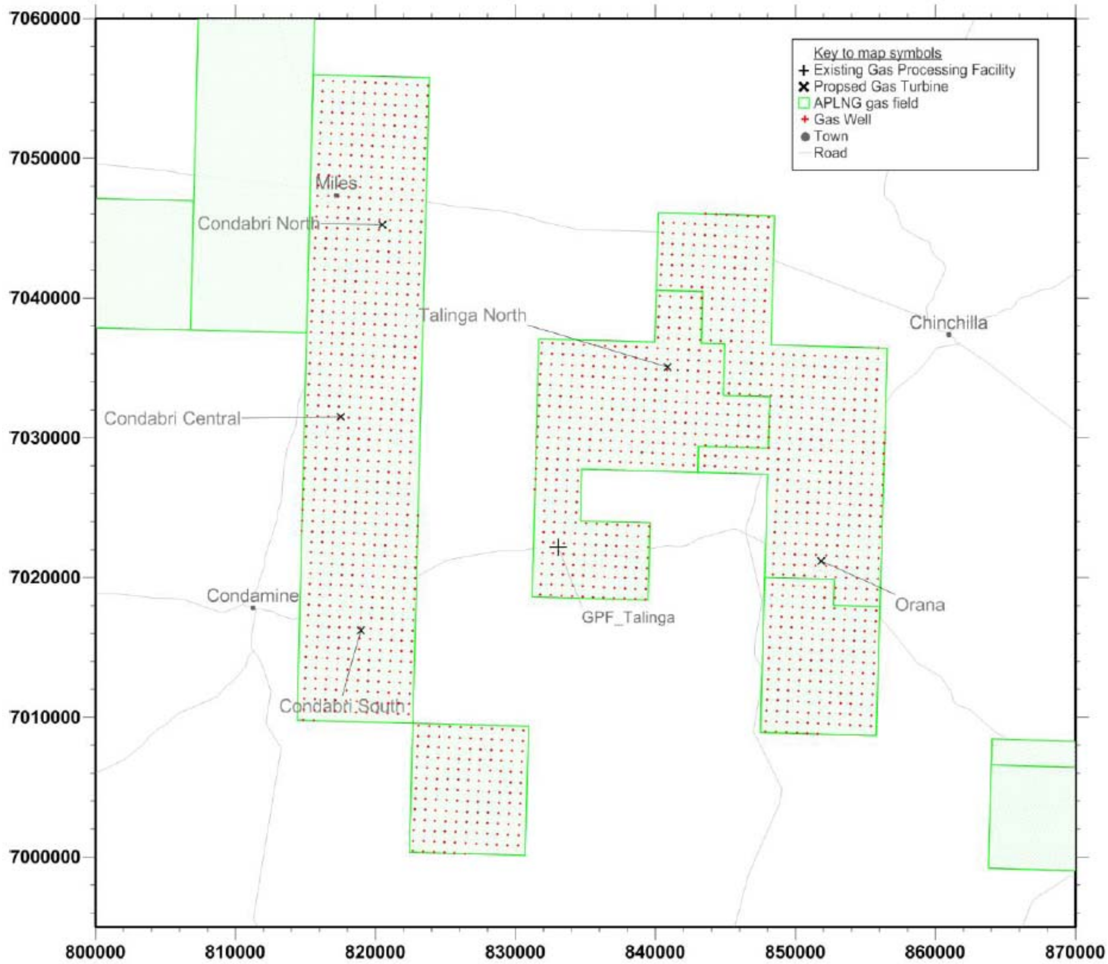

Figure 2 Map showing the proposed location of gas wells in the Talinga, Orana and Condabri Australia Pacific LNG tenements

Location: South central Queensland	**Data source:** GIS data supplied by WorleyParsons	**Units:** Australian Map Grid coordinates – MGA94 1994 AMG Zone 55 (in metres)
Type: Site map	**Prepared by:** Andrew Vernon	**Date:** July 2010

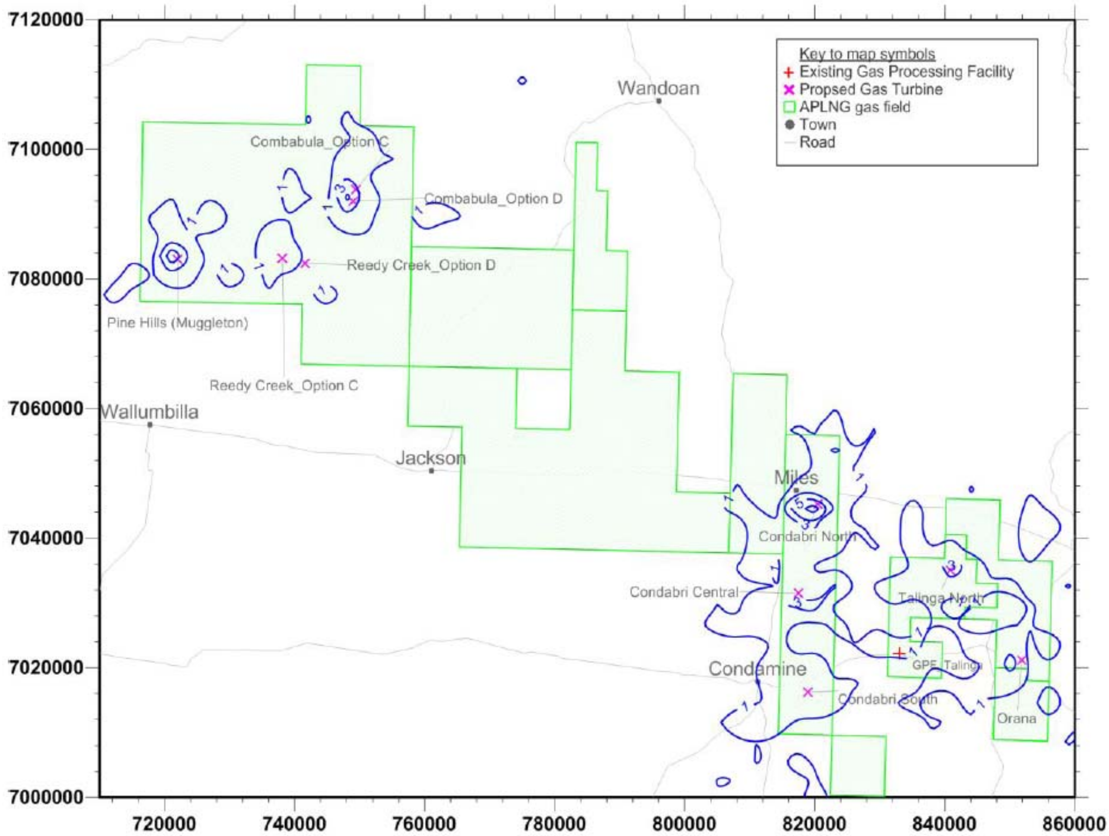

Figure 3 **Predicted maximum 1-hour average ground-level concentrations for NO_2 from eight TM2500+ gas turbines**

Location: Australia Pacific LNG gas field, south central Queensland	**Averaging period:** 1-hour	**Data source:** CALPUFF	**Units:** µg/m³
Type: Contour plot	**Objective:** EPP(Air) 250 µg/m³	**Prepared by:** Andrew Vernon	**Date:** July 2010

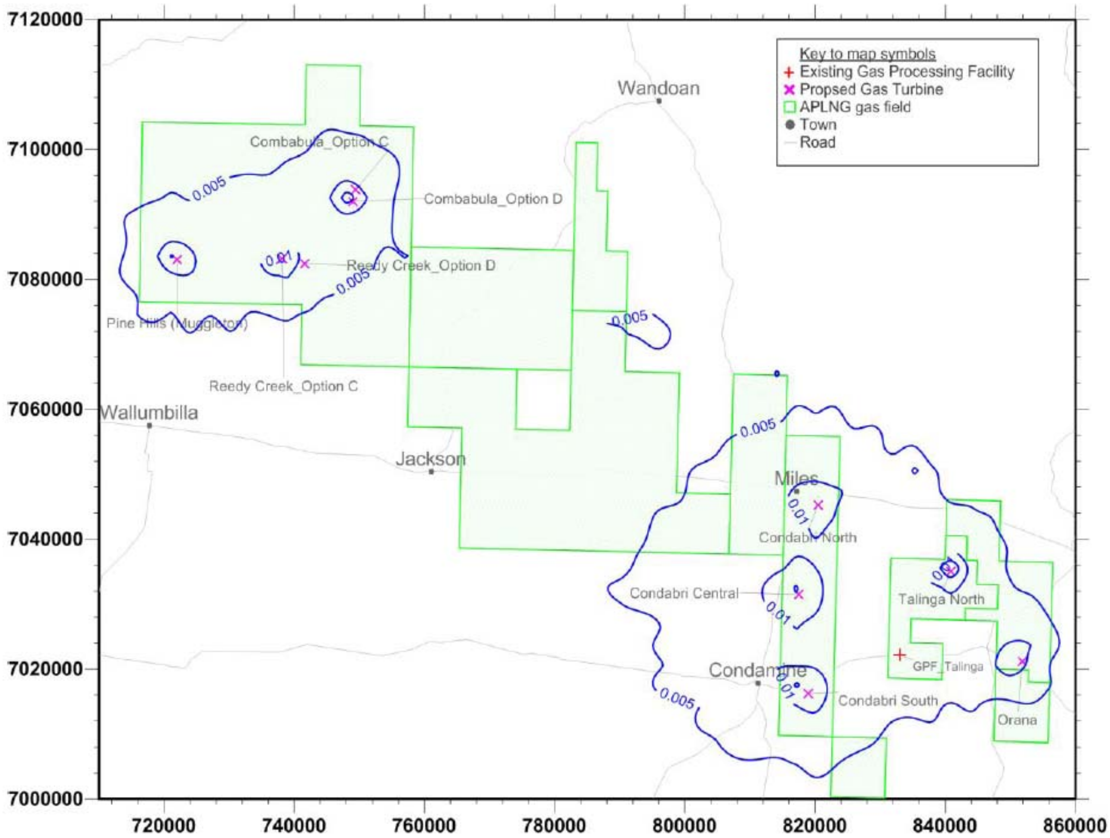

Figure 4 Predicted annual average ground-level concentrations for NO_2 from eight TM2500+ gas turbines			
Location: Australia Pacific LNG gas field, south central Queensland	**Averaging period:** Annual	**Data source:** CALPUFF	**Units:** µg/m³
Type: Contour plot	**Objective:** EPP(Air) 62 µg/m³	**Prepared by:** Andrew Vernon	**Date:** July 2010

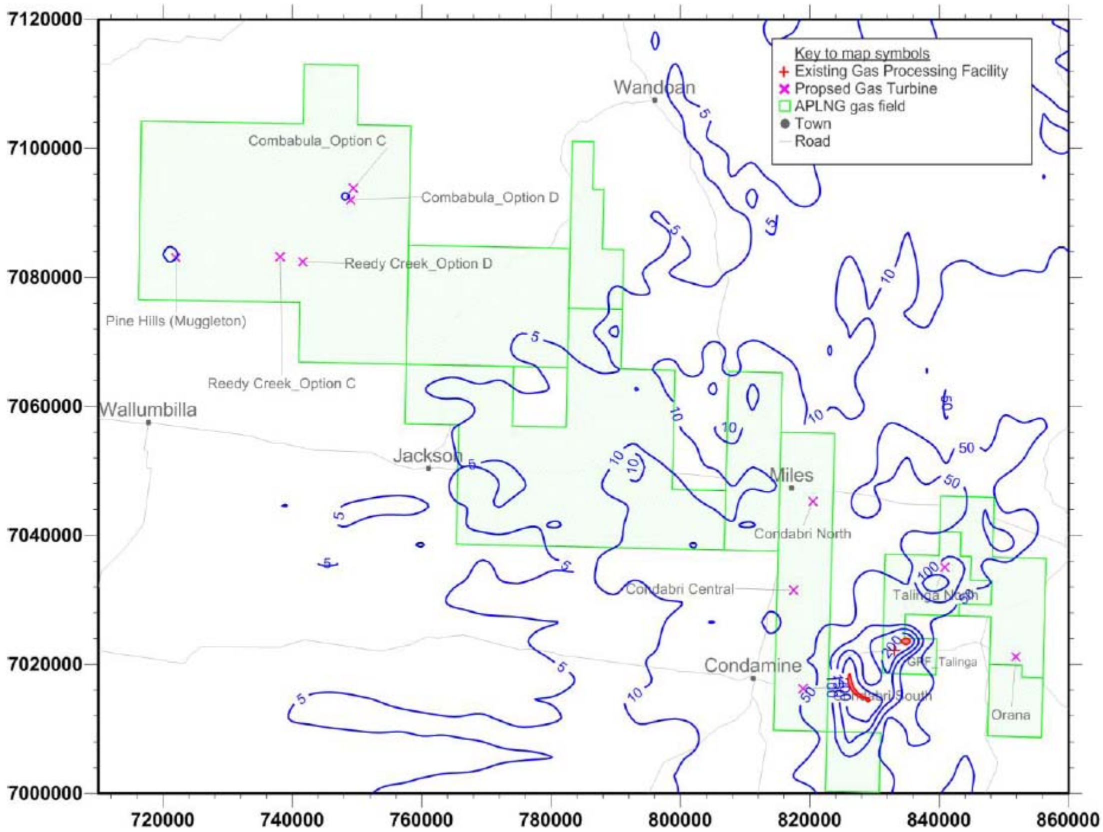

Figure 5 **Predicted cumulative maximum 1-hour average ground-level concentrations for NO_2 from all Scenario 1 sources**

Location: Australia Pacific LNG gas field, south central Queensland	**Averaging period:** 1-hour	**Data source:** CALPUFF	**Units:** µg/m³
Type: Contour plot	**Objective:** EPP(Air) 250 µg/m³ (red contour line)	**Prepared by:** Andrew Vernon	**Date:** July 2010

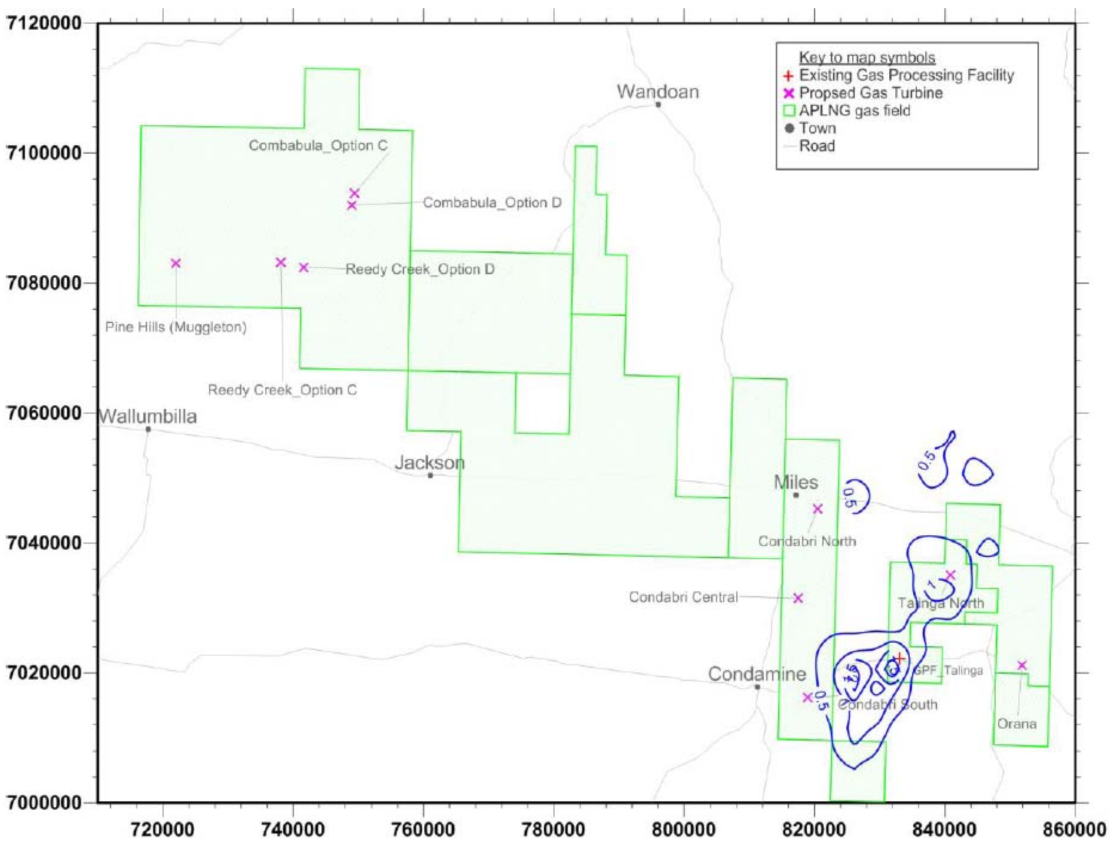

Figure 6	**Predicted cumulative annual average ground-level concentrations for NO_2 from all Scenario 1 sources**		
Location: Australia Pacific LNG gas field, south central Queensland	**Averaging period:** Annual	**Data source:** CALPUFF	**Units:** µg/m³
Type: Contour plot	**Objective:** EPP(Air) 62 µg/m³	**Prepared by:** Andrew Vernon	**Date:** July 2010

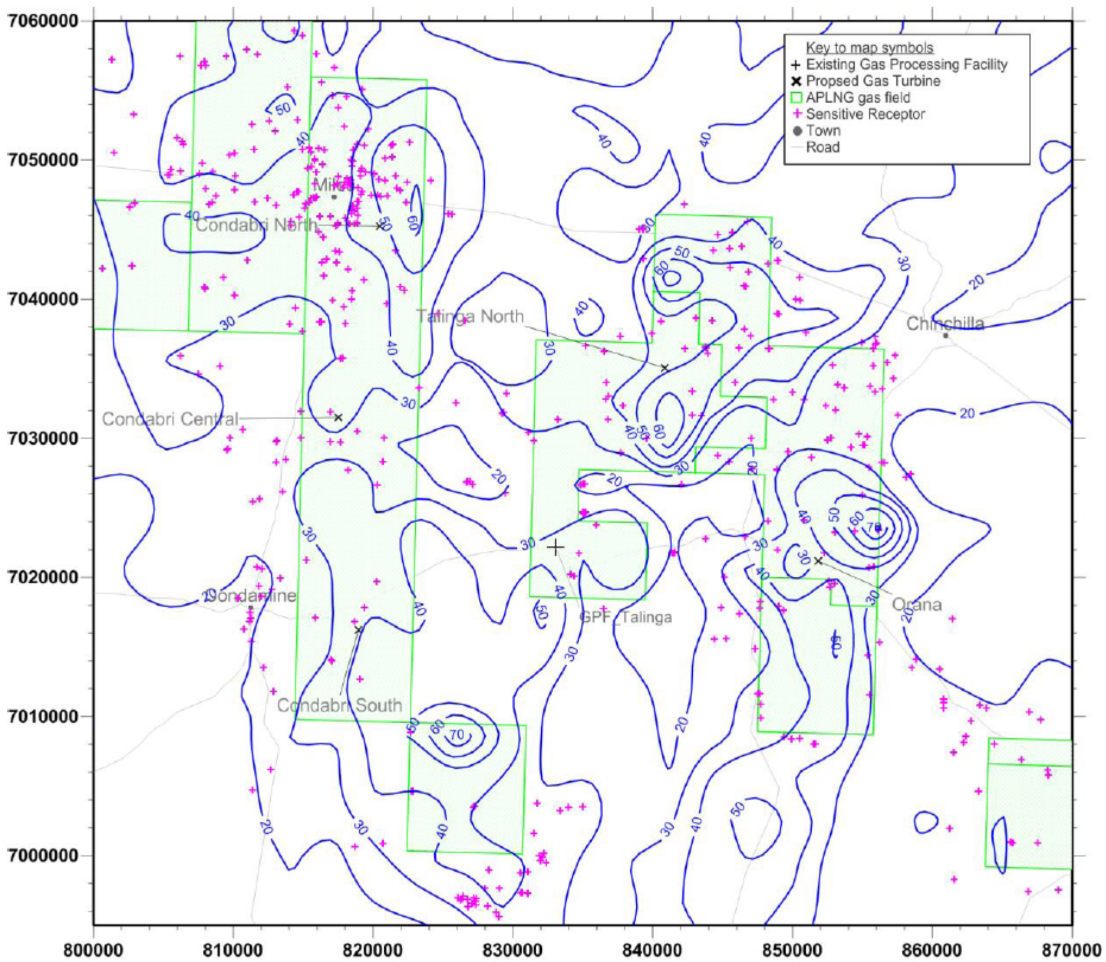

Figure 7	**Predicted maximum 1-hour average ground-level concentrations for NO_2 from 1,750 gas wells**

Location: Australia Pacific LNG gas field, south central Queensland	**Averaging period:** 1-hour	**Data source:** CALPUFF	**Units:** µg/m³
Type: Contour plot	**Objective:** EPP(Air) 250 µg/m³	**Prepared by:** Andrew Vernon	**Date:** July 2010

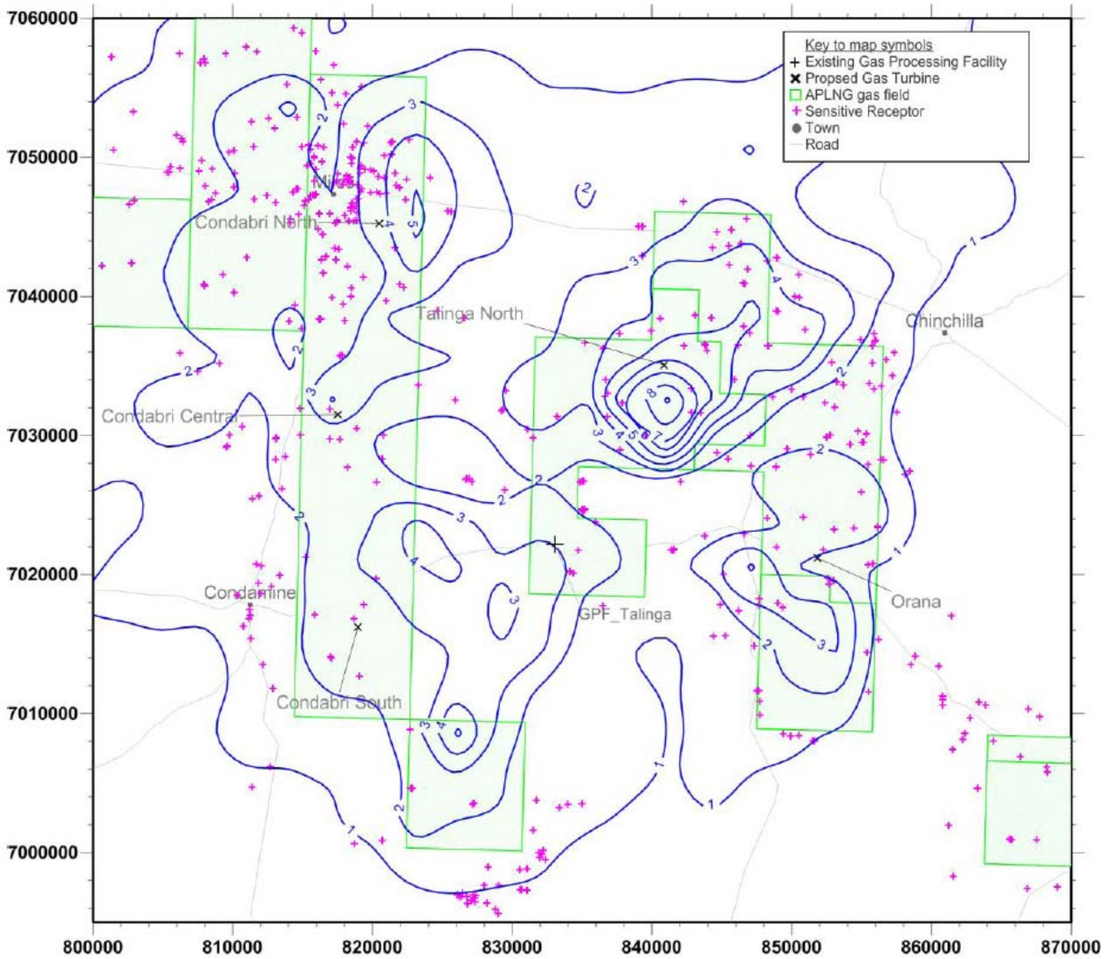

Figure 8 Predicted annual average ground-level concentrations for NO_2 from 1,750 gas wells

Location:	**Averaging period:**	**Data source:**	**Units:**
Australia Pacific LNG gas field, south central Queensland	Annual	CALPUFF	µg/m³
Type:	**Objective:**	**Prepared by:**	**Date:**
Contour plot-	EPP(Air) 62 µg/m³	Andrew Vernon	July 2010

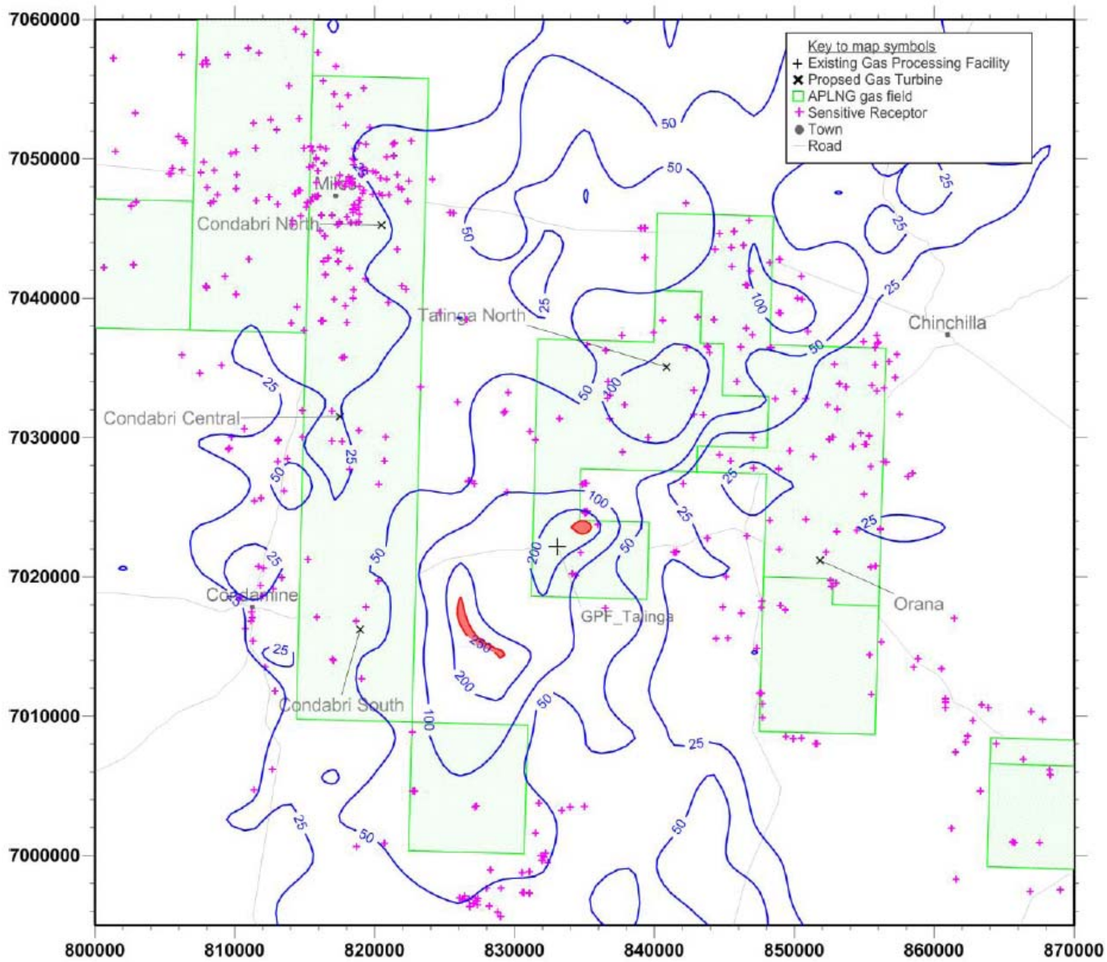

Figure 9 Predicted maximum 1-hour average ground-level concentrations for NO_2 from the existing Talinga gas processing facility (90TJ/day)

Location: Australia Pacific LNG gas field, south central Queensland	**Averaging period:** 1-hour	**Data source:** CALPUFF	**Units:** µg/m³
Type: Contour plot	**Objective:** EPP(Air) 250 µg/m³ (red contour line)	**Prepared by:** Andrew Vernon	**Date:** July 2010

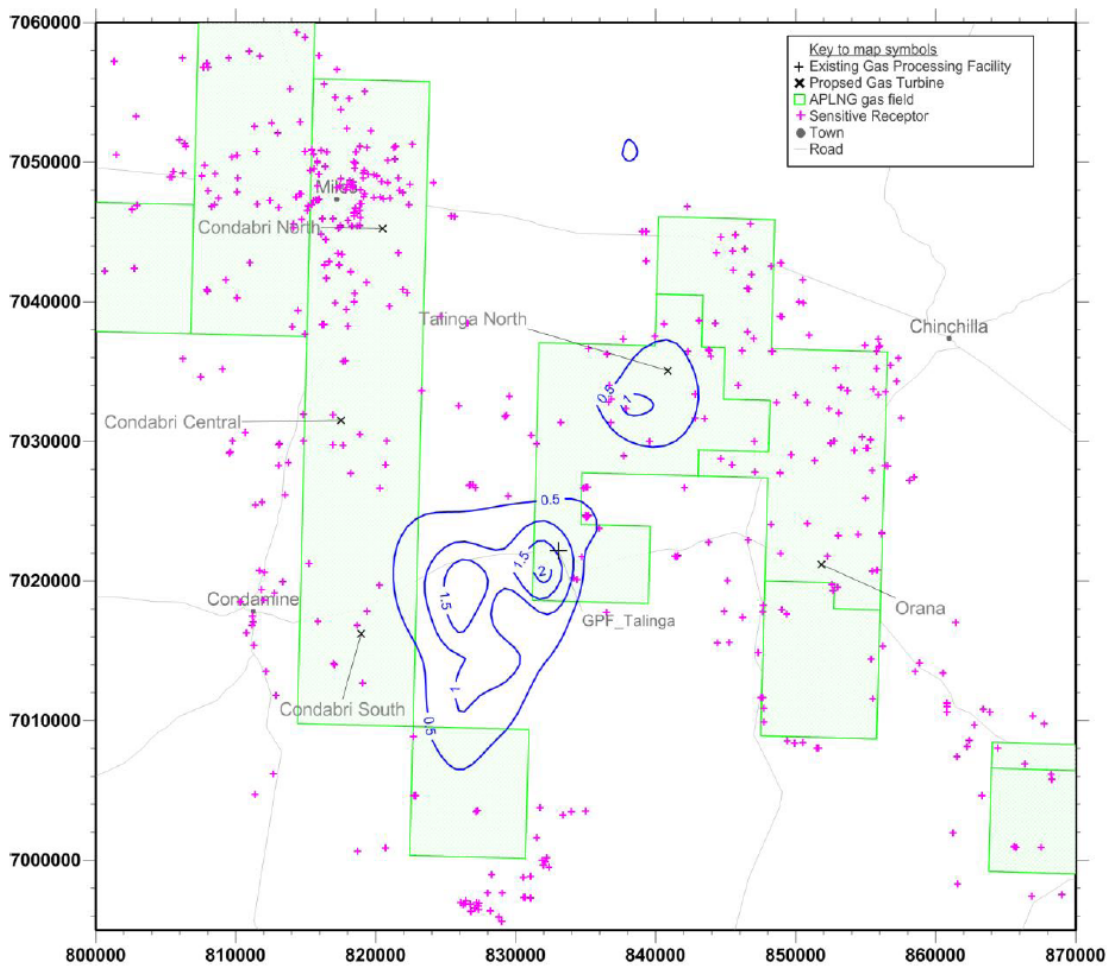

Figure 10 Predicted annual average ground-level concentrations for NO_2 from the existing Talinga gas processing facility (90TJ/day)

Location: Australia Pacific LNG gas field, south central Queensland	**Averaging period:** Annual	**Data source:** CALPUFF	**Units:** µg/m³
Type: Contour plot	**Objective:** EPP(Air) 62 µg/m³	**Prepared by:** Andrew Vernon	**Date:** July 2010

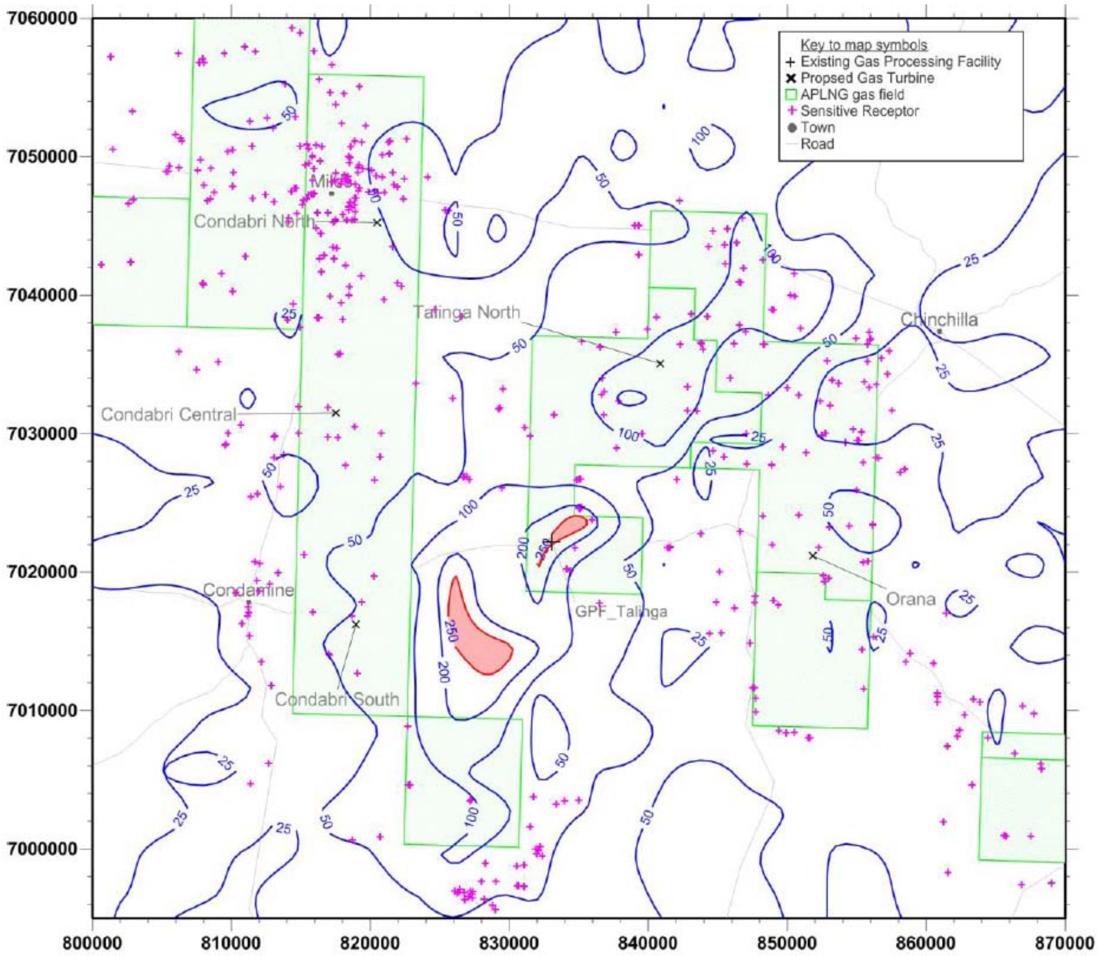

Figure 11 Predicted maximum 1-hour average ground-level concentrations for NO_2 from all Scenario 2 sources			
Location: Australia Pacific LNG gas field, south central Queensland	**Averaging period:** 1-hour	**Data source:** CALPUFF	**Units:** µg/m³
Type: Contour plot	**Objective:** EPP(Air) 250 µg/m³ (red contour line)	**Prepared by:** Andrew Vernon	**Date:** July 2010

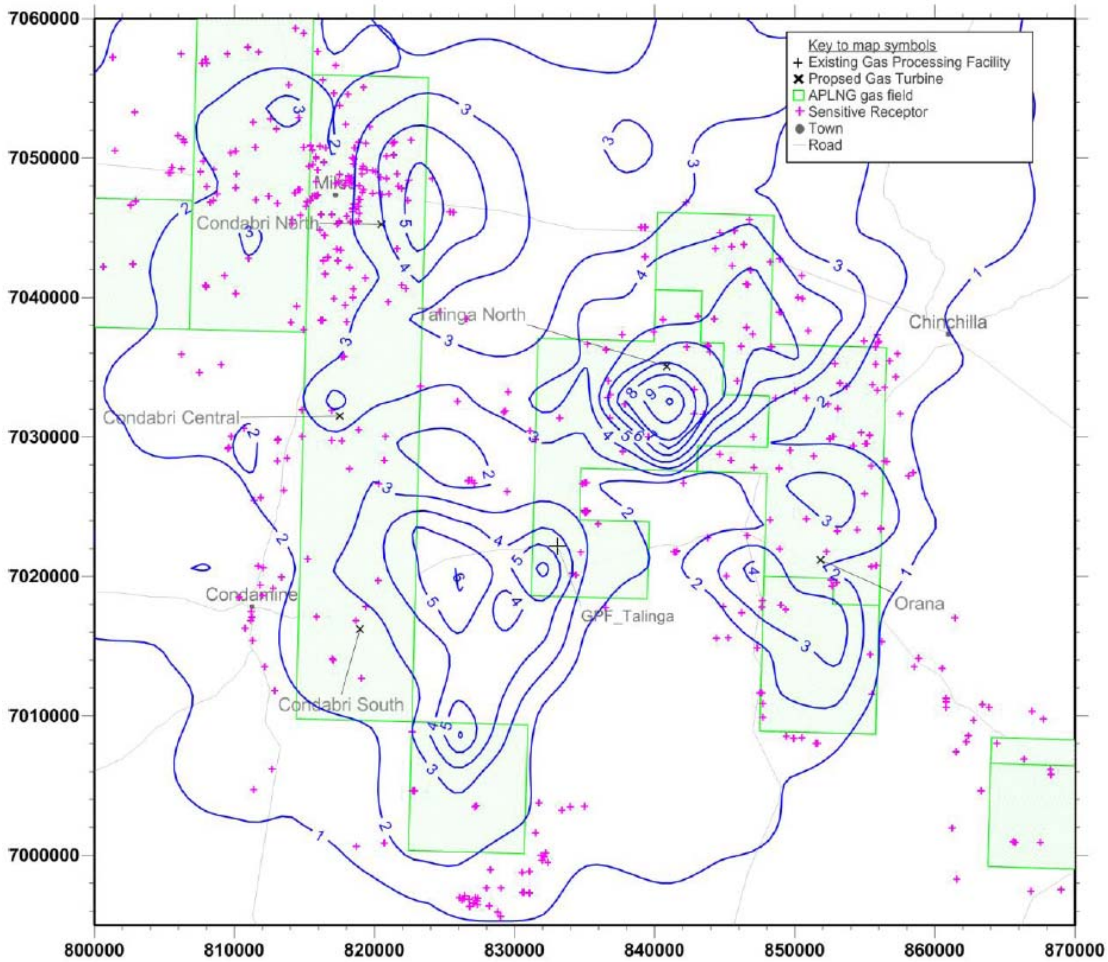

Figure 12 **Predicted annual average ground-level concentrations for NO_2 from all Scenario 2 sources**			
Location: Australia Pacific LNG gas field, south central Queensland	**Averaging period:** Annual	**Data source:** CALPUFF	**Units:** µg/m³
Type: Contour plot	**Objective:** EPP(Air) 62 µg/m³	**Prepared by:** Andrew Vernon	**Date:** July 2010