Government of **Western Australia**
Department of **Environment Regulation**

Your ref	L5491/1984/18
Our ref	NWK1988-19
Enquiries	Fiona Esszig
Phone	9182 2036
Fax	9144 1118
Email	fiona.esszig@der.wa.gov.au

Mr Phil Reid
General Manager Production – Karratha Gas Plant
Woodside Energy Ltd
PO Box 517
KARRATHA WA 6714

Dear Mr Reid

***ENVIRONMENTAL PROTECTION ACT 1986*: LICENCE GRANTED**

Premises
Woodside Onshore Gas Treatment Plant
De Witt Location 199, 197, 379 and 380, Burrup Peninsula
Licence Number: L5491/1984/18

A licence under the *Environmental Protection Act 1986* (the Act) has been granted for the above premises. The Department of Environment Regulation will advertise the issuing of this licence in the public notices section of *The West Australian* newspaper.

The licence includes attached conditions. Under section 58(1) of the Act, it is an offence to contravene a condition of a licence. This offence carries a penalty of up to $125,000 and a daily penalty of up to $25,000.

In accordance with section 102(1)(c) of the Act, you have 21 days to appeal the conditions of the licence. Under section 102(3)(a) of the Act, any other person may also appeal the conditions of the licence. To lodge an appeal contact the Office of the Appeals Convenor on 6467 5190 or by email at admin@appealsconvenor.wa.gov.au.

Where a licence is issued for more than one year it requires payment of an annual fee and will cease to have effect if the fee is unpaid. It is the occupier's responsibility to lodge a fee application and pay the annual fee in sufficient time to avoid incurring a late payment fee and for processing to be completed before the licence anniversary date.

If you have any queries regarding the above information, please contact Fiona Esszig on 9182 2036.

Yours sincerely

Danielle Eyre
Officer delegated under section 20
of the *Environmental Protection Act 1986*

Thursday, 26 September 2013

The Atrium, 168 St Georges Terrace, Perth WA 6000
Phone (08) 6467 5000 Fax (08) 6467 5562
Postal Address: Locked Bag 33, Cloisters Square, Perth WA 6850
www.der.wa.gov.au

Government of Western Australia
Department of Environment Regulation

LICENCE FOR PRESCRIBED PREMISES

Environmental Protection Act 1986

LICENCE NUMBER: L5491/1984/18 **FILE NUMBER:** NWK1988-19

LICENSEE AND OCCUPIER OF PREMISES

Woodside Energy Ltd
Woodside Plaza
240 St Georges Terrace
PERTH WA 6000
ABN: 63 005 482 986
ACN: 005 482 986

NAME AND LOCATION OF PREMISES

Woodside Onshore Gas Treatment Plant
De Witt Location 199, 197, Part lot 379 & 380
BURRUP PENINSULA WA 6714
(as depicted in Attachment 2)

PRESCRIBED PREMISES CATEGORY

Schedule 1 of the Environmental Protection Regulations 1987

CATEGORY	DESCRIPTION	PREMISES PRODUCTION OR DESIGN CAPACITY
10	Oil and gas production from wells	31,500,000 tonnes per annum
34	Oil or gas refining	31,500,000 tonnes of processed gas (LNG, LPG, Domestic Gas, propane, butane and condensate)
52	Electric power generation	226.8 MW
54	Sewage facility	132 m3 per day

CONDITIONS OF LICENCE

Subject to the conditions of licence set out in attached 10 pages.

Officer delegated under section 20
of the *Environmental Protection Act 1986*

ISSUE DATE: Thursday, 26 September 2013
COMMENCEMENT DATE: Tuesday, 1 October 2013
EXPIRY DATE: Friday, 30 September 2016

CONDITIONS OF LICENCE

Environmental Protection Act 1986

LICENCE NUMBER: L5491/1984/18 **FILE NUMBER** NWK1988-19

DEFINITIONS

In these conditions of licence, unless otherwise specified in the subject matter:

"Administration Drain" means the discharge located where the Administration Drain enters No Name Creek at N7722120, E475560;

"AGRU" means Acid Gas Removal Unit;

"aMDEA" means activated Methyl-di-ethanolamine solvent;

"AS/NZS5667 or Australian Standard 5667" means the most recent version and the relevant parts of the Australian and New Zealand series of guidance standards on Water Quality Sampling;

"calendar quarter" means the period during 1 January to 31 March, 1 April to 30 June, 1 July to 30 September and 1 October to 31 DERember;

"CTM-030" means the United States Environmental Protection Agency conditional test method CTM-030 titled *Determination of Nitrogen Oxides, Carbon Monoxide, and Oxygen Emissions from Natural Gas-Fired Engines, Boilers and Process Heaters Using Portable Analyzers*;

"Director" means Director, Environmental Regulation Division of the Department of Environment Regulation for and on behalf of the Chief Executive Officer as delegated under Section 20 of the *Environmental Protection Act 1986*;

"Director" for the purpose of correspondence means:

Regional Leader, Industry Regulation, Karratha Office
Department of Environment Regulation
PO Box 835 Telephone: (08) 9182 2000
KARRATHA WA 6714 Facsimile: (08) 9144 1118;

"g/s" means grams per second;

"LNG 4" refers to all infrastructure constructed as part of works approval W3469/1984/1 and construction of infrastructure subsequent to this works approval;

"LNG 5" refers to all infrastructure constructed as part of works approval W4088/1984/1 and construction of infrastructure subsequent to this works approval;

"Jetty Outfall" means the discharge point leading from the holding basin T6701 via the discharge pipe and diffuser located on the LNG jetty at N7723320, E475196;

"mg/L" means milligrams per litre;

"mg/m^3" means milligrams per cubic metre, expressed at 0°Celsius, 101.325 kilopascals and dry;

"m^3/s" means cubic metres per second, expressed at 0°Celsius, 101.325 kilopascals and dry;

"NTU" means Nephelometric Turbidity Units;

"pumpout" any single discharge of wastewater from the T6701 holding basin to the Jetty Outfall;

"Ringelmann Number" refers to the application of the Australian Standard AS 3543-1989 Use of standard Ringelmann and Australian Standard miniature to determine the darkness of smoke and assign a shade number;

"Ringelmann 1" refers to a shade on the Australian Standard AS 3543-1989 Ringelmann Chart and means smoke which, if compared with the chart, would appear to be as dark as, or darker than, shade 1;

"Ringelmann 3" refers to a shade on the Australian Standard AS 3543-1989 Ringelmann Chart and means smoke which, if compared with the chart, would appear to be as dark as, or darker than, shade 3;

"Standard Methods for Examination of Water and Wastewater" means the most recent edition of the "Standard Methods for Examination of Water and Wastewater" as published by the American Public Health Association (APHA), the American Water Works Association (AWWA) and the Water Environment Federation (WEF), generally abbreviated to APHA-AWWA-WEF;

"total oil" means total oil measured in accordance with the *Total Oil Analytical Method PN 216;*

"µg/L" means micrograms per litre; and

"µS/cm" means microsiemens per centimetre.

EMISSIONS TO AIR

1. The licensee shall operate and maintain emission sampling points for each emission point in column 1 of Table 1.

2. Subject to condition 1, the licensee shall not exceed the emission limits in column 3 of Table 1 for the parameters in column 2 of Table 1 at the emission points in column 1 of Table 1.

Table 1: Waste gas concentration emission limits

Column 1 Emission points	Column 2 Parameter	Column 3 Emission limit [2]	Column 4 Method
Gas turbines and furnace exhaust stacks (Pre LNG 4) ▪ 3KT1410 (Mixed refrigerant compressor/turbine) ▪ 3KT1420 (Mixed refrigerant compressor/turbine) ▪ 3KT1430 (Propane compressor/turbine) ▪ 3KT1440 (Propane compressor/turbine include AGRU off gas) ▪ 2KT1450 (Flash gas compressor/turbine) ▪ GT4001 ▪ GT4003 Exhaust stacks on the following units (Pre LNG 4) ▪ 2F2001 ▪ 3F2001	Oxides of Nitrogen[1]	350 mg/m^3	CTM-030

Column 1 Emission points	Column 2 Parameter	Column 3 Emission limit [2]	Column 4 Method
▪ 4F2001 ▪ 5F2001 ▪ 6F2001 (LNG 5)	Oxides of Nitrogen[1]	350 mg/m^3	CTM-030
Gas Turbines & Furnaces (LNG 4) ▪ 4KT1410 ▪ 4KT1430 ▪ GT4007 ▪ GT4008	Oxides of Nitrogen[1]	100 mg/m^3	CTM-030
Gas Turbines and Furnaces (LNG 5) ▪ GT4009 ▪ GT4010 ▪ 5KT1410 ▪ 5KT1430	Oxides of Nitrogen[1]	100 mg/m^3	CTM-030

Note 1: Oxides of Nitrogen expressed as NO2, at a 7% oxygen reference level for process furnaces and at a 15% oxygen reference level for gas turbines.
Note 2: Gaseous emission concentrations shall be expressed at 0 degrees Celsius and 1.0 atmosphere pressure (101.325 kilopascals).
Note 3: GT4009 and GT4010 are exempt from Oxides of Nitrogen emission limits during the Dry Low Emission Mapping period and other such commissioning activities prior to start up of these units.

MONITORING CONDITIONS

3. The licensee shall monitor each of the parameters listed in column 2 of Table 1 at each of the emission points listed in column 1 of Table 1, at a frequency of every calendar quarter, using the methods listed in column 4 of Table 1.

4. The licensee shall determine the volume of wastewater discharged monthly to each of the Administration Drain and Jetty Outfall points.

5. (a) Subject to condition 5(c), the licensee shall conduct monitoring of the wastewater from the Jetty Outfall at the frequency listed in column 3 of Table 2, for the parameters listed in column 1 of Table 2.
   (b) Subject to condition 5(c), the licensee shall conduct monitoring of the wastewater from the Administration Drain at the frequency listed in column 4 of Table 2, for the parameters listed in column 1 of Table 2.
   (c) All samples taken in accordance with condition 5(a) and 5 (b) of this licence shall be:
      (i) collected and preserved in accordance with the *Australian Standard 5667:1998*;
      (ii) submitted to a laboratory that holds current National Association of Testing Authorities accreditation for the parameters specified; and
      (iii) analysed in accordance with the current *Standard Methods for Examination of Water and Wastewater-APHA-AWWA-WEF.*

6. The licensee shall conduct monitoring to determine the Ringelmann Number of all dark smoke emissions of a shade greater than Ringelmann 1 emitted for a period of 30 minutes or more in any 24 hour period.

Table 2: Wastewater monitoring parameters and frequency of analysis

Column 1	Column 2	Column 3	Column 4
		Frequency	
Parameter	Unit	Jetty Outfall	Administration Drain
		Per Pump out	Per calendar month
Chemical Oxygen Demand	mg/L		
Conductivity	µS/cm		
Total Nitrogen	mg/L		
Total Phosphorus	mg/L		
Glycol	mg/L		
pH			
Sulphate	mg/L		
Sulphides	mg/L		
Anionic Surfactants	mg/L		
Total suspended solids	mg/L		
Turbidity	NTU		
aMDEA	mg/L		
Copper	µg/L		
Zinc	µg/L		
Cadmium	µg/L		
Lead	µg/L		
Mercury	µg/L		

REPORTING CONDITIONS

7. The licensee shall provide to the Director, a report of all dark smoke emissions of a shade of Ringelmann 3 or greater emitted for a continuous period of 30 minutes or more. This report is to be provided to the Director within 24 hours of becoming aware of such an emission.

ANNUAL ENVIRONMENTAL REPORT

8. (a) The licensee shall submit to the Director an Annual Monitoring Report, which shall cover the period from 1 July of the preceding year to 30 June of the reporting year, by 31 October each year. Two copies shall be submitted, one electronic copy and one hardcopy.

(b) The report required pursuant to condition 8(a) shall contain:

(i) the concentration data in mg/m^3 for the parameters listed in column 2 of Table 1 at the emission points listed in column 1 of Table 1, as determined pursuant to condition 3;

(ii) the average volume in cubic meters of the wastewater discharged through each of the Administration Drain and Jetty Outfall points per calendar month, as determined pursuant to condition 4;

(iii) the analytical results for the monitoring conducted at the Jetty Outfall for the parameters listed in column 1 of Table 2, in the units listed in column 2 of Table 2, as determined pursuant to condition 5(a);

(iv) the analytical results for the monitoring conducted at the Administration Drain for the parameters listed in column 1 of Table 2, in the units listed in column 2 of Table 2, as determined pursuant to condition 5(b); and

(v) an analysis of the data reported pursuant to conditions 8(b)(i)(ii)(iii) and (iv) against historical data to determine trends, as well as a comparison of the data against the emission limits set in this licence to assess compliance with licence conditions.

9. The licensee shall by 31 October in each year, provide to the Director an Annual Audit Compliance Report in the form in Attachment 1 to this licence, signed and certified in the manner required by Section C of the form, indicating the extent to which the licensee has complied with the conditions of this licence, and any previous licence issued under Part V of the Act for the premises, during the period beginning 1 July the previous year and ending on 30 June in that year.

EXCEEDANCE REPORTING CONDITIONS

10. (a) The licensee shall, within 24 hours of becoming aware that an emission limit listed in column 3 of Table 1 has been exceeded, notify the Director in writing.

(b) The written advice required by condition 10(a) shall include the date and time at which the emission limit was exceeded.

11. The licensee shall conduct an investigation into each exceedance of any emission limit listed in column 3 of Table 1 and, within fourteen days of becoming aware of that occurrence, and provide a written report to the Director which shall include:

(i) the date, time of the exceedance;

(ii) the reason for the exceedance;

(iii) the duration of time during which the exceedance occurred;

(iv) the total volume of the discharge in cubic metres, the average flow rate in m^3/s, the average concentration in mg/m^3 and the emissions rate in g/s over the period during which exceedance occurred;

(v) corrective action taken, or planned to be taken, to reduce emissions to comply with the limit; and

(vi) corrective action taken, or planned to be taken, to prevent a recurrence of the exceedance, including a timeline for the implementation of the corrective action.

LICENCE NUMBER: L5491/1984/18 **FILE NUMBER** NWK1988-19

SECTION A

LICENCE DETAILS

Licence Number:	Licence File Number:
Company Name: Trading as:	ABN:
Reporting period: _____ to _____	

STATEMENT OF COMPLIANCE WITH LICENCE CONDITIONS

1. Were all conditions of licence complied with within the reporting period? (please tick the appropriate box)

Yes □ Please proceed to Section C
No □ Please proceed to Section B

Each page must be initialed by the person(s) who signs Section C of this annual audit compliance report

INITIAL:_____

SECTION B

DETAILS OF NON-COMPLIANCE WITH LICENCE CONDITION.
Please use a separate page for each licence condition that was not complied with.

a) Licence condition not complied with?	
b) Date(s) when the non compliance occurred, if applicable?	
c) Was this non compliance reported to DER?	
☐ Yes ☐ Reported to DER verbally Date _____ ☐ Reported to DER in writing Date _____	☐ No
d) Has DER taken, or finalised any action in relation to the non compliance?	
e) Summary of particulars of compliance non compliance, and what was the environmental impact?	
f) If relevant, the precise location where the non compliance occurred (attach map or diagram)	
g) Cause of non compliance	
h) Action taken or that will be taken to mitigate any adverse effects of the non compliance	
i) Action taken or that will be taken to prevent recurrence of the non compliance	

Each page must be initialed by the person(s) who signs Section C of this annual audit compliance report

INITIAL:_____

SECTION C

SIGNATURE AND CERTIFICATION

This Annual Audit Compliance Report must only be signed by a person(s) with legal authority to sign it. The ways in which the Annual Audit Compliance Report must be signed and certified, and the people who may sign the statement, are set out below.

Please tick the box next to the category that describes how this Annual Audit Compliance Report is being signed. If you are uncertain about who is entitled to sign or which category to tick, please contact the licensing officer for your premises.

If the licence holder is		The Annual Audit Compliance Report must be signed and certified:
An individual	☐	by the individual licence holder, or
	☐	by a person approved in writing by the Chief Executive Officer of the Department of Environment Regulation to sign on the licensee's behalf.
A firm or other unincorporated company	☐	by the principal executive officer of the licensee; or
	☐	by a person with authority to sign on the licensee's behalf who is approved in writing by the Chief Executive Officer of the Department of Environment Regulation.
A corporation	☐	by affixing the common seal of the licensee in accordance with the Corporations Act 2001; or
	☐	by two directors of the licensee; or
	☐	by a director and a company secretary of the licensee, or
	☐	if the licensee is a proprietary company that has a sole director who is also the sole company secretary – by that director, or
	☐	by the principal executive officer of the licensee; or
	☐	by a person with authority to sign on the licensee's behalf who is approved in writing by the Chief Executive Officer of the Department of Environment Regulation.
A public authority (other than a local government)	☐	by the principal executive officer of the licensee; or
	☐	by a person with authority to sign on the licensee's behalf who is approved in writing by the Chief Executive Officer of the Department of Environment Regulation.
a local government	☐	by the chief executive officer of the licensee; or
	☐	by affixing the seal of the local government.

It is an offence under section 112 of the *Environmental Protection Act 1986* for a person to give information on this form that to their knowledge is false or misleading in a material particular. There is a maximum penalty of $50,000 for an individual or body corporate. I/We DERIare that the information in this annual audit compliance report is correct and not false or misleading in a material particular.

SIGNATURE: _____
NAME:
(printed) _____

POSITION: _____

DATE: _____/_____/_____
SEAL (if signing under seal)

SIGNATURE: _____
NAME:
(printed) _____

POSITION: _____

DATE: _____/_____/_____

ATTACHMENT 2: PLAN OF PREMISES

LICENCE NUMBER: L5491/1984/18 **FILE NUMBER** NWK1988-19

Government of Western Australia
Department of Environment Regulation

ENVIRONMENTAL ASSESSMENT REPORT

LICENCE NUMBER: L5491/1984/18
LICENCE FILE NUMBER: NWK1988-19
APPLICATION DATE: 17 July 2013
EXPIRY DATE: 30 September 2014

LICENSEE AND OCCUPIER OF PREMISES

Woodside Energy Ltd
Woodside Plaza
240 St Georges Terrace
PERTH WA 6000
ACN: 005 482 986

NAME AND LOCATION OF PREMISES

Woodside Onshore Gas Treatment Plant
De Witt Location 199, 197, Part lot 379 & 380
BURRUP PENINSULA WA 6714

PRESCRIBED PREMISES CATEGORY

Table 1: Prescribed Premises Summary.

Category Number	Category Description*	Category Production or Design Capacity*	Premises Production or Design Capacity #	Premises Fee Component Throughput classification**
10	Oil and gas production from wells	5,000 tonnes or more per year	31,500,000 tonnes per annum	>2,000,000 tonnes per year
34	Oil or gas refining	Not applicable	31,500,000 tonnes of processed gas (LNG, LPG, Domestic Gas, propane, butane and condensate)	>2,000,000 tonnes per year
52	Electric power generation	20 MW or more	226.8 MW	>200MW
54	Sewage Facility	>100 m^3 per day	132 m^3 per day	<200 m^3 per day

* From Schedule 1 of the Environmental Protection Regulations 1987
# From application
** From Schedule 4 of the Environmental Protection Regulations 1987

This Environmental Assessment Report (EAR) has been drafted for the purposes of detailing information on the management and mitigation of emissions and discharges from the prescribed premises. The objective of the EAR is to provide a risk assessment of emissions and discharges, and information on the management of other activities occurring onsite which are not related to the control of emissions and discharges from the prescribed premises activity. This does not restrict the Department of Environment Regulation (DER) to assessing only those emissions and discharges generated from the activities that cause the premises to become prescribed premises.

This EAR includes risk assessment of complex emissions that require a degree of technical information to be presented. To ease reading and understanding of technical issues some technical information has been presented in Appendix A.

Basis of Assessment

The Karratha Onshore Gas Treatment Plant (KGP) has been assessed as a "prescribed premises" for category numbers 10, 52, 54, 73 and 81 under Schedule 1 (Table 1). This assessment is based on maximum production or design capacity of the facilities in question, not current use.

For the July 2011 - June 2012 KGP had an annual production of 23,831.426 tonnes per annum. This was a decrease of 3,131,786 tonnes from the previous reporting period.

Categories that require licensing

Category 10 – *Oil or gas production from wells: premises, whether on land or offshore, on which crude oil, natural gas or condensate is extracted from below the surface of the land or the seabed, as the case requires, and is treated or separated to produce stabilised crude oil, purified natural gas or liquefied hydrocarbon gases at a capacity of 5000 tonnes or more per year.*

Gas is extracted from offshore production well facilities and piped to the onshore KGP where it is processed.

Category 34 – *Oil or gas refining: premises on which crude oil, condensate or gas is refined or processed.*

The KGP processes hydrocarbon gas and liquids piped onshore from offshore production well facilities to produce Liquid Natural Gas (LNG), Liquid Petroleum Gas (LPG), domestic gas (domgas), propane, butane and condensate. Approved design capacity for the KGP is 18,500,000 tonnes LNG per annum (EPA, August 2006).

Category 52 – *Electric power generation: premises on which electrical power is generated using a fuel at a capacity of 20 megawatts (MW) or more in aggregate (using natural gas) or 10 MW or more in aggregate (using a fuel other than natural gas).*

The KGP generates electric power from a natural gas power plant with a design capacity of 226.8 MW.

Category 54 – *Sewage facility: premises on which over 100 cubic metres or more per day of sewage is treated (excluding septic tanks) or is discharged onto land or into waters.*

The KGP has a sewage facility that treats and discharges sewage at a design capacity of 132 cubic metres per day.

Categories that aren't required to be listed on the licence

Category 73 – *Bulk storage of chemicals, etc: premises on which acids, alkalis or chemicals that contain at least one carbon to carbon bond; and are liquid at STP (standard temperature and pressure), are stored at a capacity of 1,000 cubic metres in aggregate.*

The KGP stores condensate in four tanks with total capacity of 258,000 cubic metres. Note that LNG and LPG are not liquid at STP. As this material is stored in association with another prescribed premises, this category is not required on the licence.

Schedule 2 has been removed from the Environmental Protection Regulations 1987. While a registration for Abrasive Blasting is no longer required, KGP will however, be required to conduct any abrasive blasting activities on the premises in accordance with the Environmental Protection (Abrasive Blasting) Regulations 1998. Category 81 – Metal Coating was previously listed on the licence. Given that metal coating is not the primary business on the premises, these activities are not considered to meet this category and therefore has been removed from the licence.

1. BACKGROUND

1.1 GENERAL COMPANY DESCRIPTION

Woodside Energy Ltd (Woodside) is Australia's largest publicly traded oil and gas exploration and production company. The Company was formed in 1954 and has a headquarter in Perth, Western Australia.

Woodside operates the KGP on behalf of the North West Shelf Venture (NWSV). This is Australia's largest resource project with 450,000 barrels of oil equivalent produced each year in five products; LNG, domgas, propane, butane and condensate. Woodside also operates more than 75 joint ventures on behalf of 39 participants across Australia, Africa and the United States.

Products from the KGP go to domestic and international markets with long term sales to Japan and spot sales to United States, Spain and Korea.

1.2 LOCATION OF PREMISES

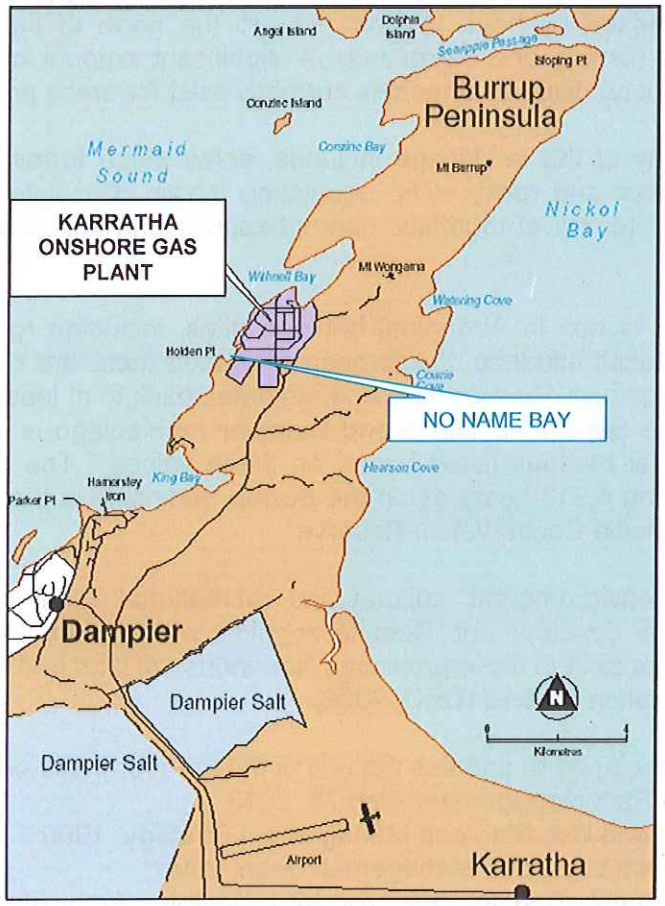


Figure 1. Location of the Karratha Onshore Gas Plant

The Burrup Peninsula is located on the northwest Pilbara coast and extends 20 kilometres (km) into the Dampier Archipelago. Until the mid-1960s the Burrup Peninsula was known as Dampier Island and was separated from the mainland by shallow tidal waters and mudflats. It is now joined to the mainland by a causeway constructed to provide road and rail access to the port facilities in Dampier.

The KGP is located 30 km by road from Karratha at South Withnell Bay, on the Burrup Peninsula in the Burrup Industrial Park[1]. It is bordered to the north and west by Withnell Bay and Mermaid Sound,

[1] Burrup Peninsula Land Use Plan and Management Strategy, 1996.

respectively, to the east by Freehold land (Conservation, Heritage and Recreation) and to the south by Industrial land (Figure 1).

The Withnell Bay plant site was chosen over another potential site in Searipple Passage, based on a comparison which included the costs of dredging, roadworks and pipeline construction. The Searipple Passage site was also more environmentally sensitive, being nearer a Nature Reserve and having a greater abundance of Aboriginal heritage sites.

The total plant site covers 230 hectares (ha) and is surrounded on the land side by a buffer zone of approximately 90 ha. Outside of this buffer zone is predominantly Crown land which is open to the public. On the seaward side of the plant, a 700 metre (m) radius general public exclusion exists around the LNG/condensate and LPG/condensate loading jetties. This exclusion zone also extends into Withnell Bay due to the location of the Trunkline Onshore Terminal vent (TOT).

The marine and coastal environment surrounding the remainder of the KGP consists of shallow bays and mangroves. No Name Bay is a shallow embayment experiencing significant flushing from tidal movements and a surrounding mangrove community. No Name Bay is not accessible to the public by road but can be accessed by boat. Withnell Bay to the north of the plant is regularly used for recreational purposes (fishing and swimming). A significant amount of tidal flushing occurs within these adjacent bays but no dispersion models currently exist for areas proximate to the KGP jetty.

The rugged topography of the landscape includes; scree slope terrain (or rocky hills) of terraces, plateaux, gorges, valleys and rocky cliffs; undulating terrain of isolated rocky outcrops and valley floors; and low coastal terrain of mudflats, sandy beaches and associated landforms of the coastal area[2].

The Burrup Peninsula is rich in Aboriginal heritage sites, including rock engravings (petroglyphs), ceremonial sites, and shell middens. It has been estimated there are over 1,000,000 petroglyphs in the Dampier Archipelago and Aboriginal occupation dates back to at least 7,000 years before present. Cultural heritage of the Burrup Peninsula and Dampier Archipelago is internationally acknowledged and have been national heritage listed based on these values. The Murujuga National Park was created in 2012 covering 4,913 hectares on the Burrup Peninsula in the areas formally known as the proposed Burrup Peninsula Conservation Reserve.

The area is of high environmental, cultural and recreational value as well as of high strategic importance to industrial development. Despite zonation of the plant as an industrial site, sensitive environmental receptors exist in close proximity. Non-industrial land of the Burrup Peninsula has been proposed as a conservation reserve (DEC, 2006).

Management plans developed to address the use of the area for these purposes are:

- Murujuga National Park Management Plan 78, 2013
- Burrup Peninsula Land Use Plan and Management Strategy, 1996;
- Burrup Industrial Park Land Use Management Plan, 2004;
- Indicative Management Plan for the proposed Dampier Archipelago Park and Cape Preston Marine Management Area, 2005; and
- Burrup draft Management Plan, 2006 (DEC, 2006).

1.3 ENVIRONMENTAL SETTING

Climate

The climate is commonly described as having two seasons: fine, warm dry winters from May until November, and hot, wetter summers with cyclonic events from December to April. High temperatures and low humidity are moderated by the influence of the sea which surrounds the Burrup Peninsula.

[2] Burrup Industrial Park Land Use Management Plan, 2004

The microclimate of the Peninsula is cooler and more humid than the inland Pilbara due to persistent ambient moisture forming from dew. The Australian Bureau of Meteorology rain images show rain along the Burrup and some surrounding islands. These images are false echoes on the radar due to strong low level inversions created by temperature differentials and high winds. As there are complex interactions, such rain images are only used in conjunction with satellite imagery to get a true measure of the metrological conditions.

Hydrogeology

There are no permanent surface water features on the Burrup Peninsula, with rainfall dependent intermittent surface water storage in rock pools and creeks. Surface water runoff after rain is high due to the impervious nature of the terrain. Hypersaline groundwater occurs under coastal flats and a tidal influenced aquifer of salt water occurs in low-lying coastal soils.

Woodside have conducted a hydrogeological survey of the KGP. Below ground contours have been mapped and predicted flow paths described and illustrated. Groundwater monitoring conducted by Woodside has been based on these contour maps.

Marine environment

The marine and coastal environment of the Dampier Archipelago/Cape Preston Region, with its unique combination of offshore islands, intertidal and subtidal reefs, mangroves, macroalgal communities and coral reefs, was identified in the Marine Parks and Reserve Selection Working Group (1986) report as having very high conservation values.

The Dampier Archipelago was proposed as a Marine Park (as outlined in the indicative Management Plan for Proposed Dampier Archipelago Marine Park and Cape Preston Marine Management Area, CALM, 2005). The boundary of the reserve lies immediately to the north of the KGP and to the opposite side of Mermaid Sound.

A coastal water quality consultation process has been conducted in order to recommend to the Environmental Protection Agency (EPA) a set of Environmental Values and Environmental Quality Objectives for marine waters in the Pilbara (DoE, 2006). The report recommended that a high level of ecological protection be afforded to Mermaid Sound to reflect the conservation significance and community expectations for the area. Some industrial use areas, including around the KGP loading jetties, were recommended for a moderate level of ecological protection.

1.4 CURRENT OPERATIONS

The KGP consists of gas processing facilities for hydrocarbon gas and liquids piped onshore from offshore production wells; Goodwyn 'A', North Rankin 'A' and Wanaea Cossack. Gas treatment facilities were installed in 1984 to process gas from offshore platforms to Domestic Gas specifications and subsequent export to the Domestic Gas pipeline (Dampier to Bunbury Natural Gas Pipeline). In 1989, facilities were added to enable the LNG export phase of the project to commence. This included major facilities for two LNG trains (LNG 1 and 2), four LNG tanks, a dedicated flaring system and a loading jetty.

In 1993 LNG processing capacity was further extended to be able to process the richer gas and extra liquid products (condensate) from the Goodwyn 'A' platforms. Following on in 1995, facilities were added for processing and export of propane and butane associated with the production from the Wanaea and Goodwyn wells.

A fourth LNG train (LNG 4) was completed in 2004 with the TOT being expanded to cater for the additional phase fluid recovered from a new trunkline. A fifth LNG train (LNG 5) was completed in 2008 as part of the Phase V LNG Expansion project (Phase V project). Following completion of the Phase V project, an additional (sixth) Stabiliser Unit was constructed in 2009 to cater for additional condensate from the Phase V and Angel projects. Other infrastructure ancillary to the prescribed

activities include; a workshop, office buildings, laboratory, storage sheds, minor fuel storage areas, LNG and LPG loading jetties.

These successive expansions have resulted in a mixture of historical and modern infrastructure. This is a major consideration in determining appropriate DER regulation of emissions and discharges from the KGP.

A works approval for the cessation of the Thermal Combustion Unit (TCU) was issued in June 2010. The TCU was in place to combust the acid gases and was originally designed for use of sulfinol solvent due to the other hydrocarbons being absorbed into the solvent. A solvent change out project was completed by Woodside in 2006 on the AGRU units for Trains 4 and 5 resulting in a reduction in benzene emissions. Due to a significant reduction in hydrocarbons being absorbed by the aMDEA solvent, operation of the TCU no longer provided the best overall environmental outcome for greenhouse gas emissions management. Cessation of the TCU has resulted in an overall reduction of greenhouse gases. Any reference to the TCU has been removed from the licence. A shutdown of train 4 then occurred in 2012.

1.4.1. Karratha Gas Plant Environmental Achievements

Woodside has shown a commitment to good environmental practice at the KGP and has a proven record of communications with DER who consider Woodside to have an open and accountable approach to environmental practice at the KGP and a pro-active manner in seeking community and government comment and input.

Woodside achieved ISO14001 accreditation at the KGP for their environmental management system on 24 May 2004. The ISO 140001 standard requires auditing on a biannual basis with a full re-accreditation process every three years. Woodside's 5 year Environmental Management Plan for the KGP outlines continuous improvement objectives and targets for environmental performance (WEL, 2005a).

Formal meetings between Woodside and DER occur biannually to discuss various aspects of environmental management and regulation amongst managers, technical staff and environmental officers, as required. This has proved a useful tool for communications between KGP and DER.

Completed Initiatives and Improvements

- Solvent change out project (which received a Greenhouse Challenge Award) to achieve reduced emissions of greenhouse gases by 8% and Benzene, Toluene, Ethylene, Xylene (BTEX) by up to 80%. Project completed in May 2006.
- Low NOx liners project to achieve reduced emissions of oxides of nitrogen from power generation and gas turbine facilities. Project completed September 2006.
- A cumulative impact study was commissioned in August 2005. This project assessed the cumulative impacts of NWSV activities. While the study's primary focus was on offshore components, such as impact of Produced Formation Water (PFW) from offshore rigs, it also looked at cumulative air emissions on the Burrup Peninsula from the KGP.
- In 2005, a fugitive emissions study was undertaken which identified areas in which improvements to such emissions could be achieved. One of these systems was in the seal gas recovery system.
- A Dark Smoke Review was completed by Woodside in February 2007, which identified a potential reduction of dark smoke emissions from the KGP of up to 30%. The review, which was requested by DER, resulted in the development of a Dark Smoke and Flaring Improvement Plan, indicating various improvement actions to be progressed by Woodside with the aim of reducing flaring and dark smoke emissions. In the 2008/09 reporting period there were no dark smoke events with a Ringlemann shade greater or equal to 3 and which lasted for over 30 minutes. This was an improvement on the previous reporting period during which there were seven dark smoke events.

- In the 2009/2010 reporting period, six dark smoke events with a Ringlemann shade greater or equal to 3 and which lasted for over 30 minutes occurred. There was no trend identified as to the increase in dark smoke events.
- During the 2011/2012 reporting period three dark smoke events with a Ringlemann shade greater or equal to 3 lasting over 30 minutes occurred.

At the biannual meeting between DER and KGP in October 2011, Woodside presented DER with a proposal to not progress the installation of the Air Assist Storage and Loading Flare Project. This project was a component of the Dark Smoke and Flaring Improvement Plan, as a result of the review in 2008 requested by DER.

Having completed a review of the project, Woodside determined the significant safety risk for personnel working in close proximity to the flare stack during installation of the new flare tip was too high. Woodside has instead chosen to focus on the root cause of dark smoke events, that being, further improvements in operational reliability to reduce the need for flaring. DER determined that this approach was justified and advised Woodside accordingly.

In the 2010/2011 AER, the reduced dark smoke trend was further reduced with plant reliability being a main focus and increasing to over 97%. Associated with this, has been a reduced need to flare and a steady improvement in dark smoke events. For the 2010/11 reporting period there were three dark smoke events with a Ringlemann shade greater or equal to 3 and which lasted for 30 minutes or longer.

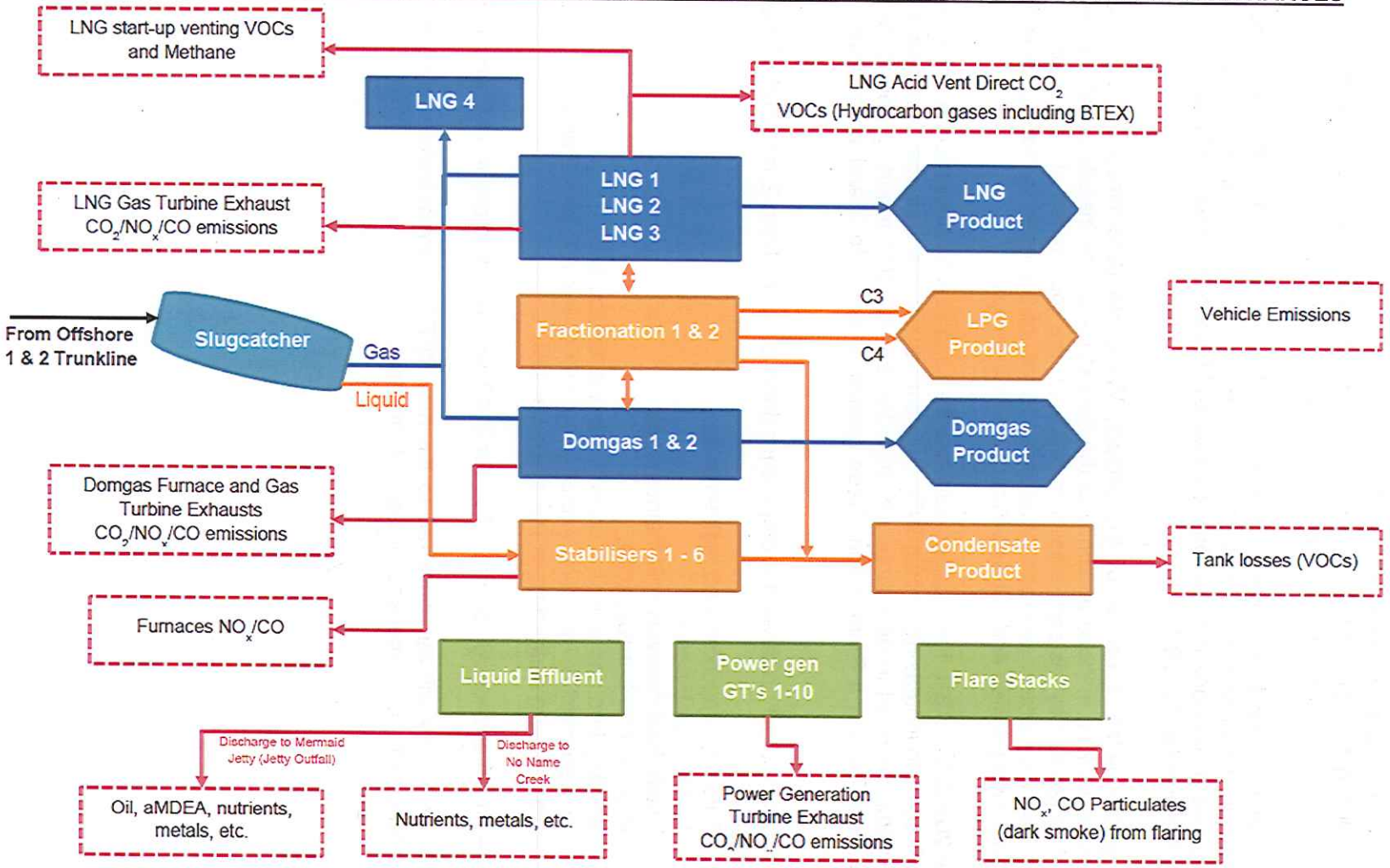
In May 2013, KGP underwent a major shut down on LNG Train 2 for refurbishment, the main works included:

- Turbine inspections and maintenance;
- MCHE maintenance;
- Waste heat recovery unit maintenance;
- Internal vessel inspections;
- Mercury bed and dehydration bed catalyst replacement;
- Replacement of insulation and cladding on vessels and pipes; and
- Blasting and re-painting of pipes and vessels.

Planned maintenance will occur in October 2013, with works to occur on Trains 1, 3, 4 and 5.

The KGP licence will be converted to the new REFIRE format before the end of 2013, to ensure consistency with other licenses throughout the state.

1.4.2. **Summary schematic of KGP operatoins: PROCESS DESCRIPTION and ASSOCIATED EMISSIONS AND DISCHARGES**



KGP Process Emissions and Discharges

1.5 REGULATORY CONTEXT

1.5.1. Part III *Environmental Protection Act 1986*, Environmental Protection Policies

No Environmental Protection Policies currently exist over the Karratha, Dampier and Burrup Peninsula areas.

1.5.2. Part IV *Environmental Protection Act 1986*, Environmental Impact Assessment

Successive stages in the development of the KGP have been assessed by the EPA under Part IV of the *Environmental Protection Act 1986.*

A joint EIA between the EPA and Environment Australia of the Commonwealth Government was undertaken for addition to the KGP of LNG 4 and LNG 5, increasing the LNG capacity of the plant from 7.5 million tonnes per annum to 15.5 million tonnes per annum, and a jetty spur connected to the ship loading facility. A level of Assessment was set at a Public Environmental Review (PER) for the States *Environmental Protection Act 1986,* and a Public Environmental Report for the *Commonwealth Environment Protection (Impact of Proposals) Act 1974.* The EPA Bulletin with recommendations to the minister of the environment was released in December 1999 (Bulletin No. 962, EPA, 1999). Ministerial approval was given in February 2000 with Conditions in Ministerial Statement 536. Ministerial Conditions relevant to the Part V licence (No.5491) are:

- Effluent discharges from the LNG operation to protect the marine environment;
- Installation of NOx burners to all new gas equipment to minimise potential for photochemical smog generation; and
- Appropriate disposal of mercury bed material to prevent mercury losses to the environment.

A notification of project change was submitted to the EPA in May 2006, under Section 46c of the *Environmental Protection Act 1986,* for an increase in capacity from 15.5 million tonnes per annum to 18.5 million tonnes per annum. Proposed changes are the result of improved efficiency from all gas trains and the installation of additional equipment installation such as a new Boil Off Gas compressor. The EPA determined that the proposed changes would not result in a significant, detrimental effect on the environment and approved the change to the original project without requiring a revised proposal be submitted (August 29th, 2006).

1.5.3. *North West Gas Development (Woodside) Agreement Act 1979*

Under the Agreement Act, Woodside are required to submit a report to the Department of Mines and Petroleum (formerly the Department of Industry and Resources) on an annual basis detailing environmental aspects of the KGP's operations. This includes an outline of the 'Source, Nature and Quantity of Gaseous Emissions' from the plant and data from Chemical and Ecological Monitoring of Mermaid Sound (CheMMS) which has been conducted since 1985. CheMMS reports data on the intertidal and sub-tidal marine environment adjacent to and in the vicinity of Woodside operated facilities in Mermaid Sound. Areas covered within this program include the KGP, the LNG and LPG offloading jetties and King Bay supply base[3].

1.5.4. Part V *Environmental Protection Act 1986*, Environmental Management

The original Licence number 5491 under Part V of the *Environmental Protection Act 1986* was issued in September 2000 and subsequent licences were issued on an annual basis. The current licence is due to expire on 30 September 2014. The *Environmental Protection Act 1986* works approvals issued are briefly summarised in Table 2.

[3] The King bay supply base is not included in the licence for the onshore gas plant. It has a registration for chemical blending.

Table 2: Summary of works approvals issued for the Woodside Karratha Gas Plant

Works Approval No	Description	Status
W33/84/1	LPG Expansion Project	Complete
W33/84/2	Liquid Expansion Project (Condensate and LPG)	Complete
W33/84/3	LNG 4 crushing and screening and WWTP (Stage 1)	Complete
W33/84/4	LNG 4 gas processing train and two additional power units (Stage 2)	Complete
W33/84/5	LNG 4 extension of nitrogen system	Complete
W33/84/6	Trunkline Shore Terminal (TOT)	Complete
W33/84/7	LNG 5 gas processing train	Complete
W4660/2010/1	Decommissioning of the TCU	Complete

Compliance and site inspections

The DER has on an annual basis undertaken a review of compliance (2000-2011) for Woodside's operation of the KGP. In addition to formal inspections during this period, communications between the DER and Woodside are regular. Inspections conducted and issues raised are summarised in Table 3.

Table 3. Summary of Inspections conducted and issues identified

Inspection year	Issues identified
Nov 2000 (Licence 5491/4)	Environmental management was observed to be very good as well as the overall condition of the site. The following recommendations were made from the site inspection with regard to general management of the site: (a) Woodside should consider installing a flow recording device at the point where discharge from the wastewater treatment system enters the Admin drain. (b) Woodside should consider opportunities for re-use of wastewater onsite to reduce discharge from the site.
January 2003 (works approval W33/84/6)	An inspection of the Trunkline Onshore Terminal (TOT) determined that Woodside were substantially compliant with works approval conditions.
December 2004 (incident investigation)	Following loss of containment of AOCW which was contained within interceptor pit.
January 23rd and 24th 2006 (Licence 5491/10)	Inspection against licence conditions and general site assessment prior to commencement of the licence review. Woodside were generally compliant with licence conditions but some areas of improvement in housekeeping issues were highlighted. These issues were rectified within a short period of time to the satisfaction of the DER.
July 28th 2009 (Licence L5491/1984/13)	Inspection was conducted of the site. As the licence mainly focuses on monitoring and reporting, the inspection was a general site assessment. Woodside were compliant.
August 10th 2010 (Licence L5491/1984/14)	Inspection was conducted of the site. As the licence mainly focuses on monitoring and reporting, the inspection was a general site assessment. Woodside were compliant.
Oct 2011 (Licence 491/1984/16)	Annual inspection was conducted of the KGP operations. The AER was submitted in October. The data was reviewed and Woodside were found compliant with conditions of licence L5491/1984/16.
Nov 2012 (Licence	Annual inspection was conducted at the site. No non-compliances were

L5491/1984/17)	identified. Excessive vegetation growth was observed in the Administration Drain. DER requested that vegetation be removed to promote flushing. Woodside addressed this item in December 2012.

Incident Reports and Woodside Management Response

All incidents that occur at the KGP related to the environment are reported by Woodside to the DER, as required under the EP Act, as soon as practicable if pollution has occurred, or has the potential to occur. Woodside also report incidents in an Annual Environmental Report (AER) submitted to DER. To date, Woodside has demonstrated compliance with their successive licences and have shown good environmental performance.

Air emission incidents

Dark smoke events occur irregularly at the KGP and are reported to the DER. This is done through a standard report emailed directly to DER from the Operations Shift Controller. As noted earlier, in the 2011/2012 reporting period there were three dark smoke events with a Ringlemann shade greater or equal to 3 and which lasted for 30 minutes or longer. This is equal to the 2011/2012 period, however, is an improvement on the 2009/2010 reporting period during which there were six dark smoke events. Further discussion regarding frequency and management of dark smoke can be found in Appendix A, Section 1.

Accidental Oil Contaminated Water system (AOCW)

The AOCW was originally designed to capture any leaks and spills from the whole site. It essentially consists of a number of concrete tunnels under the plant below the KGP plant infrastructure which channel any potentially contaminated water to the holding basins and oil removing equipment (triple interceptors).

Investigations following incidents in 1987, 1996 and 2004 found that the AOCW was leaking into the subsurface water. Woodside initiated monitoring and abstraction systems in response to these incidents. Procedures were modified to ensure that oils are directed into the AOCW in an emergency, ensuring a permanent solution to the management of oil contaminated water draining from production areas of the KGP.

Woodside also has a groundwater monitoring program which includes regular sampling and analysis of water from a series of monitoring bores. The bores are located on major underground flow paths based on a hydrogeological survey and at the eastern boundary where groundwater is know to migrate to a nearby tidal mangrove creek on the eastern edge of the KGP.

Other incidents

Incidents of discharges to water have been minor and periodic causing elevated nutrient levels in No Name Creek from the wastewater treatment plant (3 exceedences of licence conditions 2001-2005). Given consistently low average levels for the majority of the time and the nature of the receiving environment, the exceedences were assessed as having minimal impact on the receiving marine environment (see Appendix A, Section 2 for more detail).

May 2010

Several dead fish were found in the administration drain outlet in May 2010. DER visited the site, though only active fish could be seen. Water samples were all clear though the drainage area was overgrown and isolated with reeds. The cause of the fish deaths was likely a natural event with the fish being trapped in the freshwater by the reeds and previous high tides likely depositing salt water resulting in stratification and low dissolved oxygen. No further deaths were observed. Woodside has subsequently implemented an annual cleanout of the drain and thinning of the reeds to allow better flow through the drainage area.

August 2011
Woodside notified DER on the 3rd of August 2011 of a suspected subterranean hydrocarbon leak which was confirmed by pressure testing the associated pipes. A site visit to assess the incident was conducted by DER. Following additional fuel being added to diesel tanks, this additional pressure had then caused leakage from an underground pipe. A small amount of diesel was found to then be trickling through the ground to an expansion joint, into the administration drain. Woodside implemented a full response and immediately set up skimmers and booms. No hydrocarbon was released from the premises, as was confirmed by regular sampling results. The booms were monitored and continuously changed.

Woodside provided DER with a Diesel Spill Remediation Strategy Report in April 2012. Following an additional eight bores being drilled to further assess the contamination, subsequent results showed only two bores with levels of hydrocarbon above the level of reporting. The exact plume was unable to be defined, but was known to be within a defined area.

The key risk is the migration of contamination into receptors, which include marine sediment, surface water and mangroves. Woodside considered the best initial approach to manage the hydrocarbon plume, to be continued monitoring of the additional bores on a quarterly basis. Set triggers have been defined and if necessary, further investigation may need to occur. This may include increased monitoring, geophysical survey, mechanical remediation or other activity as deemed necessary. Woodside will continue to provide updates regarding this issue to DER.

January 2013
Approximately 28 m^3 of an aqueous solution containing aMDEA was released from Gas Turbine (GT) Stacks 5 and 6 of the KGP. The solution was vapourised out of the Stacks and then fell in such a way that the majority of the solution fell immediately below the Stacks and over Stabiliser's 1 and 2. It was estimated that a small proportion of the solution was discharged beyond the premises boundary. Evidence of the misting was found in small quantities on leaves on the eastern side of the Burrup Rd. Despite this, the environmental impact was deemed to be negligible. Woodside conducted daily inspections of mangroves, as well as soil testing at 47 locations on the KGP lease area. Results of offsite testing show that impacts to soil is negligible, however, 11 areas onsite were identified to have concentrations about the nominated soil assessment criteria. An archaeological inspection was conducted and did not identify any residue or any distance as a result of the incident. Woodside continues to provide updates to DER on the monitoring and remediation.

1.5.5. Other Environmental Protection Regulations

Woodside, as operators of the KGP are also subject to the following regulations:

- Environmental Protection (Unauthorised Discharges) Regulations 2004;
- Environmental Protection (Controlled Waste) Regulations 2004;
- Environmental Protection (Noise) Regulations 1997;
- Environmental Protection (Clearing of Native Vegetation) 2004; and
- Environmental Protection (NEPM-NPI) Regulations 1998.

National Pollution Inventory (NPI) regulations require that all facilities handling more than a specified quantity of an NPI substance report the total emissions of that substance. The emissions profile for the KGP is consistent with the emissions expected from petroleum exploration and production activities, primarily consisting of combustion products. Relevant figures for total amounts discharged can be found in Appendix A, Table 7.

All NPI reports from Woodside have been submitted on time. However, concerns were raised in March 2003 that Woodside had been under-reporting their NOx emissions from the KGP. This prompted EPA assessment under a Section 16 (e) of the *Environmental Protection Act 1986* to

advise the Minister for Environment on whether previously conducted modelling Pre March 2003 still accurately reflected the ambient levels in the Karratha-Dampier-Burrup area (EPA, 2004).

1.5.6. *Explosive and Dangerous Goods Act 1961*

Department of Mines and Petroleum (DMP) regulate the storage of chemicals and dangerous goods through the *Explosive and Dangerous Goods Act 1961* and *Regulations 1992*. The KGP has a Dangerous Goods Storage Licence (DGS010009). Licence conditions on the Dangerous Goods licence, require compliance with the National Standard for the control of Major Hazard Facilities [NOHSC:1014 (2002)] and the commitments and provisions of the Woodside KGP Health Safety and Environment (HSE) Case Rev. 4, April 2005 (Document No. W9000-AF-041).

1.5.7. *Rights in Water and Irrigation Act 1914*

Woodside do not use groundwater at the KGP and therefore are not licensed under the *Rights in Water Irrigation 1914.*

1.5.8. *Natural Heritage of Australia Act 1997*

Aboriginal Heritage issues are not directly relevant to this licence review and assessment of current operations so they will not be considered in detail. The potential impact of air emissions from industry on the Burrup Peninsula to nearby Rock Art is being investigated through the ongoing Burrup Peninsula Air Pollution Study being undertaken by CSIRO on behalf of the Burrup Rock Art Monitoring Management Committee (BRAMMC). The latest CSIRO reports, 'Field Studies of Rock Art Appearance (March 2007)' and 'Summary of Interim Report Air Quality Monitoring (July 2007)' identified no measurable changes in mineralogy to engraved and non engraved rock surfaces which have been exposed to accelerated weathering processes and extremely high levels of air pollution (up to 10 times the maximum predicted levels on the Burrup Peninsula). The reports, which have been endorsed by BRAMCC, also indicated that acidity of rainfall on the Burrup Peninsula is naturally variable and generally similar to other remote areas of the planet. Another report, 'Burrup Peninsula Aboriginal Petroglyphs: Colour and Spectra Change 2004–2011 (2012)', relating to the monitoring of petroglyphs conducted by CSIRO using spectrometers, determined that over the 8 year period, no observed colour contrast was detected.

1.6 STAKEHOLDER CONSULTATION

1.6.1. Community context

Local communities of Dampier and Karratha are within a radius of 7 to 20km respectively, of the KGP (Figure 1). Nearby industrial neighbours within 7 km are the Dampier Port Authority, businesses in the King Bay Industrial Area, and the Yara Fertilisers Ammonia Plant.

As the basis for identifying community concerns associated with the KGP operation, DER (in co-operation with Woodside) has used the existing Woodside community liaison group. This group consists of other decision making authorities, businesses and interested community members. No major issues arose during a meeting of this group in August 2006 at which DER discussed the licence review process and invited input regarding concerns about emissions from the KGP. However, complaints have previously been received formally and informally by the DER Karratha office regarding dark smoke from the Woodside facility. Complainants have questioned Woodside generating smoke when weather conditions are such that the resulting haze stays in the air over the Dampier community. There is a level of unease regarding the composition of this haze.

Parliamentary questions raised to date are detailed in Table 4 below.

Table 4: Summary of Parliamentary Questions with reference to Woodside KGP.

Question content	Response	Date
General question on discharges from Woodside and likely constituents and quantities	NPI pollution inventory quoted.	June 2003
Levels of Benzene, Toluene and Xylene emissions and comparison with standards Question on general emissions and abatement methods	NPI Levels quoted and decreases noted, solvent changeout process described.	June 2004
Dark smoke emissions-constituents, likely impacts and investigations by DoE	Licence conditions quoted, no breaches of licence conditions had occurred in reported period.	August 2005
Dark smoke emissions in previous weeks were questioned	No breaches of licence conditions had occurred in preceding weeks, Woodside also conducting dark smoke review.	July 2006

SUBMISSIONS RECEIVED DURING 21 DAY PUBLIC COMMENT PERIOD

The Application for the Licence details for this facility were advertised in The West Australian newspaper on 28 August 2013 as a means of advising stakeholders and to seek public comments. No submissions were received during the subsequent 21 day period.

Implication for the management / licensing

Concerns regarding air emissions can be adequately addressed through the continued requirements by DER for Woodside to comply with limits and monitoring requirements set out in their KGP licence and monitoring requirements. In addition, DER are seeking improved management by Woodside of key community concerns such dark smoke.

DER and the community have high expectations for Woodside to take all reasonable and practicable measures to reduce air emissions from the KGP.

2. PRIMARY IMPACTS FROM EMISSIONS AND DISCHARGES

DER considers that conditions should focus on regulating emissions and discharges of significance. Where appropriate, emissions and discharges that are not significant should be managed and regulated by other legislative tools or management mechanisms.

The following section assesses the environmental risk of potential emissions and discharges from the KGP. In order to determine appropriate environmental regulation, a risk assessment was conducted of the KGP using the environmental risk matrix outlined in Appendix B. The results of this assessment are detailed in Tables 5a – 5d under the following headings:

5a. Air emissions;
5b. Land and Water Discharges;
5c. Other discharges; and
5d. Waste and Fuel/Chemical Storage.

Quantitative assessment of risk

Where an accurate quantitative profile of emissions is available and there is an applicable standard, a quantitative assessment of environmental risk has been determined using Table 9 in Appendix B.

Semi-quantitative assessment of risk

Where there is insufficient quantitative information or no standard is applicable, a semi-quantitative assessment has been used to determine the significance of each emission. Significance of each emission or discharge is determined by assessing the likelihood and frequency of the emission, its potential consequence on the receiving environment and control measures and management measures in place.

More detailed descriptions of significant emissions can be found in Appendix A. A detailed aerial map of the location of emissions and discharge points is not presented here for security purposes. Where it is necessary to refer to an emission or discharge point, this is done so by naming the unit or giving GPS coordinates.

Table 5a. Summary of the risk assessment and DER management for air emissions from the KGP (risk derived from Appendix B)

Source of air emission	Significance of emission/discharge				Determination of DER management response		
	Nature of emission	Likelihood (frequency) (Table 12)	Consequence (Table 13)	Controls and Management	Risk Assessment (Table 9 or 9a)	Socio political context (Table 10)	DER Management (reference in Appendix A)
Air Emissions (Appendix A, Section 1)							
Unit name and number of each type of unit: Propane Refrigerant compressor/turbine (8) Mixed refrigerant compressor/turbine (8) Flash gas turbine (3) Domgas compressor turbines (K2420 and K2430) (4) Power Gen Units (10 Gas Turbines) Stabiliser reboil furnace stack (6) Domgas regeneration furnace stack (2)	Oxides of Nitrogen (NOx).	Almost certain (continuous).	Consequence and risk determined in Table 7 and 9, comparing modelling of emissions against ambient standards. NOx emissions >50% of ambient standard (NEPM).	Low NOx burners fitted on all units. Considered best available technology (EC, 2003). Quarterly stack sampling and annual reporting of emissions. Monitored for internal benchmarking purposes. Emissions reported through NPI.	2 - Medium Risk.	High level of public interest with respect to potential impact on rock art.	C - Licence condition maintaining current limits and monitoring requirements. (See Appendix A, Section 1) General provisions of the *EP Act 1986*.
	Oxides of Sulphur (SO_x).	Unlikely.	Consequence and risk determined in Table 7 and 9, comparing modelling of emissions against ambient standards. <20% of ambient standard (NEPM)	Reported through NPI. Amount emitted mostly below detection levels as low levels are present in the feed gas resulting in low levels in exhaust gas. Monitored for internal benchmarking purposes.	1 - Low risk.	High level of public interest with respect to potential impact on rock art.	D - No licence condition, other management mechanisms suitable. Recommend internal monitoring of amounts and management of community perception General provisions of the *EP Act 1986*.
	Particulates.	Possible.	Minor Possible contribution to generation of secondary pollutants in the atmosphere.	Reported through NPI.	1 - Low Risk.	Low level of public interest as not visible from these sources.	E - No licence condition. General provisions of the *EP Act 1986*.

	Significance of emission/discharge				Determination of DER management response		
Source of air emission	**Nature of emission**	**Likelihood (frequency) (Table 12)**	**Consequence (Table 13)**	**Controls and Management**	**Risk Assessment (Table 9 or 9a)**	**Socio political context (Table 10)**	**DER Management (reference in Appendix A)**
Unit name and number of each type of unit: Propane Refrigerant compressor/turbine (8) Mixed refrigerant compressor/turbine (8) Flash gas turbine (3) Domgas compressor turbines (K2420 and K2430) (4) Power Gen Units (10 Gas Turbines) Stabiliser reboil furnace stack (6) Domgas regeneration furnace stack (2).	CO_2.	Almost certain (continuous).	Not applicable. Has the potential for environmental impact on a global scale.	Reported by Woodside through Greenhouse challenge which is voluntary reporting scheme. CO_2 and other greenhouse gases monitored for internal benchmarking purposes.	Not within scope of this assessment.	Little/No local interest. High level of national and global interest with respect to Global warming issues.	Outside of the scope of this assessment as this potential pollutant is not currently regulated under Part V of the *EP Act 1986*.
	CO.	Almost certain (frequent).	Negligible. Low levels in exhaust gases, localised extent but has potential for health and safety impacts.	Reported through NPI.	1 - Low risk.	Little/No interest.	E – No regulation, other management mechanisms suitable. Occupational Safety and Health Regulations 1996 (WA). General provisions of the *EP Act 1986*.
AGRU (V1104) vents (3) and AGRU start-up vents (3).	NO_x, particulates, CO_2, CO, SO_2.	Almost certain (continuous).	Consequence and risk determined in Table 7 and 9, comparing modelling of emissions against ambient standards.	Reported through NPI as for emissions discussed above. Quarterly stack sampling of emissions from: AGRU vents.	2 – Medium risk.	High level of public interest with regards to pollutant impacts on rock art (NOx and SO_2).	Licence conditions as above for NOx. No licence conditions for other parameters. General provisions of the *EP Act 1986*.
	Benzene, Toluene, Xylene (BTX).	Almost certain (continuous).	Consequence and risk determined in Table 9, comparing ambient monitoring against ambient standards. <20% of ambient standard (NEPM).	Reported through NPI. NPI results as for BTX and hydrocarbons have reduced considerably following solvent changeout.	1 - Low Risk.	Medium level of public interest with respect to potential for public health concern.	No licence condition (See Appendix A, Section 1). General provisions of the *EP Act 1986*.

	Significance of emission/discharge				Determination of DER management response		
Source of air emission	**Nature of emission**	**Likelihood (frequency) (Table 12)**	**Consequence (Table 13)**	**Controls and Management**	**Risk Assessment (Table 9 or 9a)**	**Socio political context (Table 10)**	**DER Management (reference in Appendix A)**
	Methane and Volatile Organic Compounds (VOCs).	Almost certain (regular).	Minor. Potential contribution to generating photo oxidants in the atmosphere. Also potential for health concerns.	VOCs monitored for internal benchmarking purposes. NPI results as for BTX and hydrocarbons have reduced considerably following solvent changeout.	2 - Medium risk.	Little/No interest.	No licence condition as long-term reductions internally driven by Woodside. General provisions of the *EP Act 1986.*
Boil-off compressor seal vents (LNG and Domgas, 67 vents), Fractionation Compressor seal vents (6).	Methane and VOCs.	Almost certain (continuous).	Minor.	As above for emissions from AGRU vents.	2 - Medium risk.	Little/No interest.	E - No licence condition as improvements to achieve long-term reductions are being internally driven by Woodside. General provisions of the *EP Act 1986.*
Condensate tanks, loading operations, Misc seal gas.	Methane and VOCs.	Almost certain (continuous fugitive).	Negligible. Low relative volumes emitted.	Fugitive emissions study conducted in 2005 (WEL, 2005c) found 153 tonnes methane emissions. Fugitive emissions monitored for internal benchmarking purposes.	1 - Low risk.	Little/No interest.	E - No licence condition as improvements to achieve long-term reductions are being internally driven by Woodside. General provisions of the *EP Act 1986.*
Loading and storage Flare, LPG Flare, Operational Flare, LNG and Domgas Emergency Flare.	NO_x CO, CO_2, SO_2.	Likely (regular).	As above for detailed description of associated impacts of emissions.	Flaring Reduction Program in place, continued decrease in flaring with focus being root causes for flaring. Concentration of NOx emitted through flaring likely to be more than burning through turbines and power generators. However, the relative contribution of NOx emissions from flaring in mass terms is estimated to be 1-3% of total NOx (WEL, 2006 and DER Air Quality Branch *Pers Com).*	1 - Low risk	Medium High interest as flaring is highly visible from the Karratha and Dampier townships. Woodside implement radio and local paper advertising to better inform the community during shut down events with the potential for flaring.	D - No specific licence condition in reference to combustion gases from flaring. See above for NOx licence conditions on other emission sources. (See Appendix A Section 1). General provisions of the *EP Act 1986.*

	Significance of emission/discharge				Determination of DER management response		
Source of air emission	**Nature of emission**	**Likelihood (frequency) (Table 12)**	**Consequence (Table 13)**	**Controls and Management**	**Risk Assessment (Table 9 or 9a)**	**Socio political context (Table 10)**	**DER Management (reference in Appendix A)**
	Particulates (smoke).	Likely (regular).	Minor. Uncertain contribution to <PM_{10} particulate matter.	Indirect reduction through reduction in total volume of gas flared. Installation of assist gas system on Operational and Emergency Flare leading to more efficient burning and reduction in dark smoke. Additional Fractionation unit and BOG compressor for LNG V, operator training and increased operating margins in fractionation have also reduced dark smoke incidents.	1 - Low risk	Medium level of public interest with respect to the potential for reduced visual amenity and public nuisance.	E - Licence reporting condition on black smoke generation. Continued reporting of all events recommended. Recommendation for continual implementation and review of flaring mitigation measures as identified in the Dark Smoke and Flaring Improvement Plan (See Appendix A, Section 1). General provisions of the *EP Act 1986*.

Table 5b. Summary of the risk assessment and DER management for water and land discharges from the KGP of various potential contaminants.

	Significance of emission/discharge				Determination of DER management response		
Source of discharge	**Nature of discharge**	**Likelihood (frequency) (Table 12)**	**Consequence (Table 13)**	**Controls and Management**	**Risk Assessment (Table 9 or 9a)**	**Socio political context (Table 10)**	**DER Management (reference in Appendix A)**
Discharge to Water (Appendix A, Section 2)							
Process waste streams to Jetty Outfall.	Anionic surfactants, Glycol, Oils, aMDEA, Nutrients, Sulphate, Sulphide, Suspended solids, metals, nutrients.	Almost certain (controlled discharge, sometimes continuous).	Moderate.	Holding basin system with aeration going to interceptor that separates oils from water. Each discharge if sampled prior to discharge.	2 - Medium risk.	Medium to high interest in water quality of Mermaid Sound, but not specific to each contaminant.	C - Licence condition for monitoring and reporting conditions. (Appendix A, Section 2) General provisions of the *EP Act 1986*. EP (Unauthorised Discharges) Regulations 2004.
WWTP effluent to Administration Drain into No Name Creek.	Nutrients, metals, E. coli., Oils, Sulphates and sulphides, Suspended solids.	Almost certain (continuous).	Moderate.	Secondary treated plus chlorination which eliminates solids, excess nutrients and E.Coli from the waste stream.	2 - Medium risk.	Medium to high interest in water quality of Mermaid Sound, but not specific to each contaminant.	Licence condition requiring monitoring of metals and nutrients. (Appendix A, Section 2). General provisions of the *EP Act 1986*. EP (Unauthorised Discharges) Regulations 2004.
Demineralisation plant to Administration Drain into No Name Creek.	Sulphates, metals	Almost certain (regular).	Moderate.	Discharged to No Name Creek.	2 - Medium risk.	Medium to high interest in water quality of Mermaid Sound, but not specific to each contaminant.	C - Licence condition requiring monitoring on sulphates and sulphides. (Appendix A, Section 2). General provisions of the *EP Act 1986*. EP (Unauthorised Discharges) Regulations 2004.

	Significance of emission/discharge				Determination of DER management response		
Source of discharge	**Nature of discharge**	**Likelihood (frequency) (Table 12)**	**Consequence (Table 13)**	**Controls and Management**	**Risk Assessment (Table 9 or 9a)**	**Socio political context (Table 10)**	**DER Management (reference in Appendix A)**
Stormwater drainage channels from Domgas to North East mangrove and to Administration Drain into No Name Creek.	Oil in water, BOD5, metals.	Possible (intermittent).	Minor.	Sampled monthly and as necessary.	1 - Low risk.	Medium to high interest in water quality of Mermaid Sound, but not specific to each contaminant.	D - No licence conditions, other management mechanisms suitable. General provisions of the *EP Act 1986.* EP (Unauthorised Discharges) Regulations 2004.
Discharge to Land (Appendix A, Section 2)							
AOCW loss of containment.	Oil in water, hydrocarbon, condensate, glycol, aMDEA, BOD5, metals.	Possible (intermittent).	Minor.	Management of spills and redirection of oils from AOCW. Groundwater monitoring to trigger management response as required. Collected in interceptor basin, and tested periodically, then discharge to T6701.	1 - Low risk.	Medium to high interest in water quality of Mermaid Sound, but not specific to each contaminant.	No licence condition Adequate management control through prevention of contaminant input into AOCW. *Contaminated Sites Act 2003.*

Table 5c Summary of the risk assessment and DER management for other emissions from the KGP.

	Significance of emission/discharge				Determination of DER management response		
Source of emission	**Nature of emission**	**Likelihood (frequency) (Table 12)**	**Consequence (Table 13)**	**Controls and Management**	**Risk Assessment (Table 9 or 9a)**	**Socio political context (Table 10)**	**DER Management (reference in Appendix A)**
Dust Emissions							
Vehicle movements.	Particulates.	Almost certain (continuous fugitive).	Negligible.	No treatment, some dust suppression for minor construction activities.	1 - Low Risk.	Little/No interest.	E - No licence condition (not part of prescribed activity).
Odour Emissions							
Vents.	VOCs.	Almost certain (continuous fugitive).	Negligible.	Stack emission, no further treatment.	1 - Low Risk.	Little/No interest.	E - No licence condition. General provisions of the *EP Act 1986.*
T6701	Noxious Odour.	Likely (repeated).	Negligible.	Regular qualitative monitoring.	1 - Low Risk.	Little/No interest.	E - No licence condition. General provisions of the *EP Act 1986.*
WWTP	Noxious emissions.	Possible (fugitive).	Negligible.	Odour reduced via sewage treatment process.	1 - Low Risk.	Little/No interest.	E - No licence condition. General provisions of the *EP Act 1986.*
Noise Emissions							
General operational noise.	Approximately 85dB in operational areas.	Almost certain (continuous)	Minor.	Acquisition of equipment was based on achieving acceptable level for operational workers.	1 - Low Risk.	Little/No interest.	E - No licence condition. *EP (Noise) Regulations 1997* applicable.
Light Emissions							
General lighting to facilitate continual operation.	Night hours.	Almost certain (continuous overnight).	Negligible.	No treatment.	1 - Low Risk.	Little/No interest.	E - No licence condition. General provisions of the *EP Act 1986.*

Table 5d. Summary of the risk assessment and DER management for Waste and Storage at the KGP.

	Significance of emission/discharge				Determination of DER management response		
Source	**Nature of emission/discharge**	**Likelihood (frequency) (Table 12)**	**Consequence (Table 13)**	**Controls and Management**	**Risk Assessment (Table 9 or 9a)**	**Socio political context (Table 10)**	**DER Management (reference in Appendix A)**
Solid Waste							
Inert solid waste.	Various.	Almost certain (regular ongoing, but quantity varies).	Negligible.	Sourced from administration buildings, minor construction areas. Removal off-site, to landfill or recycling.	1 - Low risk.	Little/No interest.	E - No licence condition (not part of prescribed activity).
Hazardous/low hazardous waste.	Various	Almost certain (regular, ongoing but quantity varies).	Negligible.	Removal off-site, Hazardous Wastes to appropriate waste facility, Low hazardous wastes to landfill.	1 - Low risk.	Little/No interest.	E – Standard licence conditions relating to storage of environmentally hazardous substances. EP (Controlled Waste) Regulations 2004.
Contaminated Liquid Wastes							
Aqueous liquid wastes.	Oils, Hydrocarbon contaminated sludges, aMDEA, mercury contaminated waste.	Unforeseen (regular ongoing but quantity varies).	Negligible.	Removal off-site, Disposed of to appropriate waste facility.	1 - Low risk.	Little/No interest.	E - No licence condition. General provisions of the *EP Act 1986.* EP (Unauthorised Discharges) Regulations 2004.
Storage of Solid/liquid Wastes							
Storage tanks/packaged wastes.	Potential spill hazards of packaged wastes.	Unlikely.	Negligible.	Appropriately stored, transported off site to an approved facility.	1 - Low risk.	Little/No interest.	E - No licence condition. General provisions of the *EP Act 1986.* EP (Unauthorised Discharges) Regulations 2004.

3.0 GENERAL SUMMARY AND RECOMMENDATIONS

Woodside has operated the Onshore Karratha Gas Plant (KGP) since 1984. The KGP processes hydrocarbon gas and liquids piped onshore from the North-West Shelf Venture's offshore facilities and produces approximately 27 million tonnes of gas and liquid products in the form of LNG, LPG, Domestic gas, Propane, Butane and Condensate. The plant requires power generation through gas turbines and has a sewage facility. The KGP requires an *Environmental Protection Act 1986* (EP Act) licence as it meets the prescribed activity requirements for Category 10, 34, 52 and 54 under Schedule 1 of the Environmental Protection Regulations 1987.

This Environmental Assessment Report (EAR) aims to identify and document the environmental impacts associated with the operation of the KGP and to ensure Woodside has adopted appropriate procedural and management mechanisms to minimise these environmental impacts. Tables 5a, 5b, 5c and 5d demonstrate that some emissions and discharges from the KGP are considered of 'medium' or 'low' significance based on either; comparison of emissions with relevant standards and guidelines or a risk assessment considering the nature, likelihood and consequence of an emission with regard to Woodside's existing controls and management measures. Some primary point source emissions that have been assessed as requiring licence conditions include oxides of nitrogen, dark smoke flaring and wastewater discharges. Other emissions and discharges from the KGP have been assessed as not requiring licence conditions as they are considered to be managed by Woodside through design, operational procedures and management plans, or can be appropriately regulated through other legislation and/or environmental protection mechanisms outside of the licence.

Despite the 'medium' and 'low' significance afforded to emissions and discharges from the KGP, the premises has been classified as 'high priority' in accordance with DER's Licensing Priority Management Framework due to the nature of its operations, size and location. As such, the licence shall be reissued for a period of one year and inspections by DER officers carried out accordingly to ensure Woodside are in compliance with the relevant legislative requirements.

In addition, based on this EAR, DER have the following key recommendations for improvements in management and understanding of the impact of the KGP operational emissions and discharges.

Air emissions recommendations

DER recommends Woodside conduct investigations into the mass load of NOx being generated under different operating conditions for each unit at the KGP. This would provide a more meaningful measure of total NOx emitted and would assist in validating ambient modelling.

Water discharges recommendations

In 2010/11 Woodside conducted a detailed investigation into the dilution rates and mixing zones at both the Admin Drain and Jetty outfall discharge points. Results of the investigation clearly indicate that for both discharge points the chemical concentration of the parameters measured (including hydrocarbons, metals and nutrients), were below levels required for protection of moderately disturbed marine aquatic systems at the edge of their respective mixing zones (50m from discharge). Woodside will be providing a report to the DER detailing the results of this investigation.

Also in 2011 Woodside installed a flowmeter on the Jetty Outfall discharge point to more accurately measure flows of both batched and continuous discharges.

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APPENDICES

APPENDIX A: AIR EMISSIONS AND WATER DISCHARGES

1. AIR EMISSIONS

1.1.1. Emission Sources

Primary emissions discharged continuously from the sources below are waste gases from combustion (NO_x, particulates, CO_2, CO, SO_x) and venting of waste hydrocarbon gases (methane and Volatile Organic Compounds VOCs which include BTX). The composition of the waste gases from their respective sources are summarised in Table 5a and discussed in further detail below.

Primary point sources of air emissions from the KGP:

- Propane refrigerant compressor/turbine (8 units)
- Mixed refrigerant compressor/turbine (8 units)
- Flash gas turbine (3 units)
- Domgas compressor gas turbines (K2420) (2 units)
- Domgas compressor gas turbines (K2430) (2 units)
- Power generation gas turbines (10 units)

Other emission points include:

- Stabiliser reboil furnace stack (6 units)
- Domgas regeneration furnace stack (2 units)
- AGRU(V1104) vent (3 vents)
- AGRU startup vent (3 vents)
- Boil-off compressor seal vents (6 vents)
- Fractionation compressor seal vents (6 vents)
- Auxiliary water heater
- Trunkline Onshore Terminal (TOT) vent

Flaring:

- Liquid burner and operational flare
- Plant LNG and Domgas emergency flares
- Storage and loading flare

1.1.2. Composition of air emissions

Oxides of Nitrogen (NOx)

The major source of NOx production from nitrogen-bearing fuels such as gas, is the conversion of fuel bound nitrogen to NOx during combustion within the turbines and compressors.

In the atmosphere, oxides of nitrogen are rapidly oxidised to nitrogen dioxide (half-life about 50 days), which dissolves in water to produce dilute nitric acid which can precipitate with rain. Thus, high levels of NOx can contribute to 'acid rain'. NOx in air may also have a direct effect on vegetation, affecting plant growth, however there are no adequate standards to assess potential cumulative effects to Pilbara vegetation (Murray et al, 1991 in EPA 2004).

Humidity and condensation on surfaces acts to dissolve NOx, possibly increasing acidity that may impact on vegetation and surface water. Deposition of dissolved acids on rock may also cause weathering, although recent CSIRO reports, 'Field Studies of Rock Art Appearance (March 2007)' and 'Summary of Interim Report Air Quality Monitoring (July 2007)', identified no measurable changes in mineralogy to engraved and non engraved rock surfaces which have been exposed to accelerated weathering processes and extremely high levels of air pollution (up to 10 times the maximum predicted levels on the Burrup Peninsula). NOx is also a major greenhouse gas (IPCC list of greenhouse gases).

Cumulative impacts of NOx are an important consideration in determining appropriate DER management. Other industries on the Burrup Peninsula also produce NOx (Pluto LNG Project, Yara Ferilisers, Pilbara Iron Power generation and shipping) and there are prospective projects that are set to increase ambient NOx levels (Dampier Nitrogen Ammonia-Urea Plant and increased shipping).

Volatile Organic Compounds (VOCs as Benzene, Toluene, Xylene)
Hydrocarbons are vented from the Woodside KGP as a waste gas stream. The majority of these hydrocarbons are unreactive hydrocarbons however, a small quantity of reactive hydrocarbons, mainly aromatic, Benzene, Toluene and Xylene (BTX), are also emitted. These aromatic hydrocarbons are of concern as they may represent a significant risk to human and fauna health if found in elevated quantities above their associated NEPM standard.

Particulate sources (<PM_{10})
Particulates are generated through incomplete/inefficient combustion of fuel gases. When burnt within power generation units, furnaces and compressors, natural gas burns efficiently (i.e. 'cleanly'), and limited particulates are generated. When burnt through the flare however, incomplete combustion of flared gases, in particular propane and butane, is more common due to the variability in a range of factors required for efficient combustion (i.e. variable flow rate and composition of gases to flare).

Particulates less than 10 micrometre (<PM_{10}) can be drawn deep into the lungs. Larger particles tend to be trapped in the nose, mouth or throat. Particulates from combustion of fuel gases visually manifest themselves as smoke (particulates and water vapour) with the volume and intensity of particulates effecting the colour of the emission. Dust in general, not specifically PM_{10}, affects the aesthetics and utility of areas through visibility reduction and may effect buildings and vegetation. The specific affects of the dust depend on its composition, concentration and the presence of other pollutants such as acid forming gases. Particulate emissions in the form of dark smoke flaring also have the potential for a public amenity and nuisance factor.

Photochemical Oxidants
Photochemical smog (Ozone, aldehydes and Peroxyacetylnitrate (PAN)) may be generated in the atmosphere as a secondary pollutant in the presence of NOx, hydrocarbons, particulates and sunlight. Yellow/brown plumes are a visual indicator of photochemical smog. There is limited information available on the interactions and synergistic effects that result in the generation of photochemical smog. However it is known that the resulting secondary pollutant chemicals can be environmentally hazardous and cause short duration health impacts. Potential effects of both primary and secondary pollutants on flora and fauna on the Burrup Peninsula has not been studied in detail.

1.1.3. Controls and management for minimising air emissions

Reduction of NOx
Low NOx burners installed on LNG4 are designed to ensure levels no greater than 70 mg/Nm^3 are emitted which is the prescribed level in EPA Guidance Statement No 15 for 'Emissions of Oxides of Nitrogen from Gas Turbines' (EPA, 2000). Ministerial Statement 536 also required that any new equipment installed on LNG trains 4 and 5 should have low NOx burners to minimise air emissions that lead to the formation of photochemical smog, i.e. NOx, hydrocarbons and particulates.

Control measures have been taken by Woodside to achieve the lowest NOx emissions possible within the operational efficiency of the current equipment, i.e. what the equipment was originally designed to achieve. Trains 1-3 have poorer thermal efficiency (21%) and produce more NOx than modern turbines. All of the older turbines have had low NOx liners retrofitted (see Section 1.4.1).

Operational controls at the plant can also vary the NOx levels, however such manipulation of levels has the potential to compromise operational integrity and has limited ability to manage overall volumes of NOx. The North West Shelf Joint Venture has also implemented an Environmental

Improvement Plan during 2005 targeting long term environmental improvements at the KGP, especially reduction of contaminants in air emissions. Actions laid out in this plan include investigation into further emission reduction options, including NOx and Flare reduction.

Reduction of VOCs (BTX)
A solvent change-out project (replacing sulphinol with "N- methyldiethanolamine activated" (aMDEA) has significantly reduced emissions from the KGP of VOCs and therefore BTX. A target of 70% reduction of BTX was committed by end Q1 2006 (Karratha Gas Plant 5 year Environmental Management Plan, 2005). The solvent change out project is complete and the reduction in VOCs and BTX emissions has been verified by Woodside through monitoring of the AGRU vent gases. Reductions are also reported through the NPI reports.

Reduction of dark smoke flaring (particulates)
Minimisation of dark smoke at the KGP via a 'control at source' policy has previously been advocated by Woodside as being the most practical and achievable strategy. Woodside have indicated that an overall reduction of hydrocarbon flaring from elevated and ground flares would have the associated benefit of reducing dark smoke emissions. This indirect relationship is corroborated by comparing the tonnes of gas flared with the number of reported dark smoke events.

Direct measures taken to reduce dark smoke production from flaring include implementation of an assist gas system on the Operational and Emergency Flare, which led to more efficient burning and replacement of flare tips in 2003 for Domgas and LNG emergency flares. The new tips are designed to minimise coke formation and maximise clean burning of hydrocarbon gas.

Investigation into other direct measures to reduce dark smoke have also been pursued by Woodside as part of the *Dark Smoke Review and Dark Smoke and Flaring Improvement Plan*. The Review found that up to 30% of dark smoke events from the KGP were controllable and the Improvement Plan identified numerous management controls and improvement actions to reduce flaring and dark smoke to minimum practicable levels. These improvement actions included;

- Formation of Operation Reliability Integrity Steering Committee and Trip Corrective Action Team to review, investigate and increase plant reliability to reduce trips.
- Operator training and awareness to increase operating margin of LNG Fractionation during periods of high ambient temperature (to prevent trips of refrigerant compressor motor).
- Commissioning of an extra Fractionation Unit and Boil Off Gas Compressor as part of the Phase V project (to reduce amount of boil off gas from warm ships being diverted to flare).

One of the commitments made by Woodside in the *Dark Smoke and Flaring Improvement Plan* was the installation of the air assist component to the Storage and Loading Flare. DER has reviewed the *Storage and Loading Flare Report*, specifically the risk assessment review, to enable installation of the air assist flare tip, duct and blower package. DER has considered the safety concerns identified by Woodside in this investigation and acknowledges that it is warranted for Woodside to not progress with installation of the air assist component. With a focus on maintenance to address the root cause of problems and system trips, dark smoke events have continued to steadily declined.

1.1.4. Point Source monitoring and reporting

Stack monitoring technology employed
Monitoring of stack emissions has been conducted quarterly as a requirement of Woodside's licence (No. 5491) for the KGP from 2000 onwards. Monitoring is conducted using a Testo 350 Analyser for onsite measurement of stack emissions for the following parameters: NO_2, NO, SO_2, O_2, and CO.
The Testo 350 is used for compliance testing in the United States (US). Portable emission analysers are not "approved" by the USEPA rather they publish test methods for specific applications. The test methods contain performance specifications the analyser must meet during the actual test in order for

the test to be valid. This requires the operator of the analyser to be competent and knowledgeable regarding the test method and the analyser. US EPA's Conditional Test Method 030 is a test method developed for portable electrochemical emission analysers (USEPA, CMT- 030, 1997). The Testo 350 meets the performance specification of these methods. In addition, the Testo 350 analyser has been verified by USEPA's Environmental Technology Verification Program under the Advanced Monitoring System (Air) (EPA, 2003).

NOx monitoring

Quarterly monitoring data is reported in the AER and shows that Pre LNG 4 equipment regularly achieves a NOx concentration of below 250mg/m^3. Insufficient information was presented in the 2004-2005 Annual Report to determine what concentrations are being achieved by LNG 4 equipment (AER KGP 2001 through to 2005). This monitoring should indicate reliability of the units monitored and compliance with current licence conditions.

The following stacks have sampling ports on gas turbines and furnace exhaust stacks, representing 20 out of 38 stacks on the KGP site.

Pre LNG 4

- 3KT1410, 3KT1420 (Mixed refrigerant compressor/turbine)
- 3KT1430, 3KT1440 (Propane compressor/turbine including AGRU offgas)
- 2KT1450 (Flash gas compressor/turbine)
- GT4001, GT4008, 2F2001, 3F2001, 4F2001, 5F2001.

LNG 4

- 4KT1410, 4KT1430, GT4007, GT4008

LNG 5

- GT4009 and GT4010
- 5GT1430 (Mixed refrigerant gas turbine compressor)
- 5GT1410 (Propane refrigerant gas turbine compressor)

NOx limits

Limits on the earlier Licence (5491/10) are as follows with an explanation of how these original limits were derived.

Pre LNG 4 & LNG 5: 350mg/m^3

This limit was derived from the Victorian EPA State Environmental Protection Policy (SEPP) for Air Quality Management (Gazetted by Vic EPA, 2001). In Appendix B of the SEPP, Emission Limits for New Stationary Sources in Air Quality Control Regions stipulates that the emission limit for stationary sources generating Oxides of Nitrogen from fuel burning units is 0.35 g/m^3 (350 mg/m^3).

LNG 4 & LNG 5 equipment and all equipment constructed subsequent to LNG 4: 100mg/m^3.

This limit was derived from the EPA Guidance Statement No 15 (detailed in Table 6) indicating 70 mg/m^3 as a level to be achieved under normal operations. A 30mg/m^3 allowance was placed on the licence as an equipment guarantee specified 100mg/m^3 as a maximum.

Table 6. National Guidelines for Emissions of Oxides of Nitrogen from Gas Turbines.

	Rated Electrical Output	Oxides of Nitrogen* g.m^{-3}	Approximate ppmv
Gaseous fuels	less than 10 MW	0.09	44
	greater than 10 MW	0.07	34
Other fuels	less than 10 MW	0.09	44
	greater than 10 MW	0.15	73

*Calculated as NO_2 at a 15 per cent oxygen reference level, dry, at STP. Source: AEC/NHMRC, National Guidelines for the Control of Emissions of Air Pollutants from New Stationary Sources (1985).

Thermal Combustion Unit (TCU) NOx limits

A solvent change out project was completed by Woodside in 2006 on the AGRU units for Trains 4 and 5 (and other Trains). The solvents purpose is to remove CO_2 from gas being processed to prevent solid CO_2 formation in later LNG stages when conditions become cryogenic. Sulfinol was replaced by aMDEA, which absorbs acid gases, however, reduces the co-absorption of BTEX from the gas stream by 80%. This BTEX was previously released to the atmosphere along with the CO_2.The solvent change out project has resulted in a reduction in benzene emissions from 1,200 tonnes/a (3 operational Trains) to 230 tonnes/a (5 operational Trains). The TCU was in place to combust the acid gases and was originally designed for use of sulfinol solvent due to the other hydrocarbons being absorbed into the solvent. Due to significant reduction in hydrocarbons being absorbed by the aMDEA solvent, operation of the TCU no longer provides the best overall environmental outcome for greenhouse gas emissions management. Switching off the TCU has resulted in an overall reduction of greenhouse gases.

Dark smoke monitoring

Dark smoke is generated from the KGP flares. Waste gases cannot currently be burned in any other manner due to the limits of current infrastructure.

In order to determine whether all reasonable and practicable measures to minimise dark smoke emissions are being taken at the KGP, the DER recommend Woodside undertake a review of dark smoke from the preceding year. This dark smoke review is currently in progress and will be submitted for 2011/2012 in the 2012 AER.

The Australian Standard (AS 3543-1989) sets out procedures for the use of the standard Ringelmann and Australian Standard Miniature smoke charts for the estimation of the blackness of smoke using a visual blackness technique.

The Ringelmann scale is a visual measure of the quality of the flue gas immediately as it leaves the emissions stack, i.e. the amount of particulates emitted. 'Light smoke (Ringelmann 1-2)' is generally indicative of low concentrations of particulates through to 'black smoke (Ringelmann 3-5)' with a high concentration of particulates. The charts were originally designed to measure the optical density of stack emissions calculated from a ratio of path length (distance from eye to chart) to chimney diameter. The scale derived from the Ringelmann chart is also a function of the brightness and colour of the sky. The US EPA require that, in order to accurately monitor opacity and use this information as evidence, the person conducting the monitoring be trained and certified to use their reference methods (USEPA Method 9, 1990).

However, it is practically difficult to use the Australian Standard and Ringelmann scale for smoke emissions from flaring due to the intermittent and diffuse nature of the emission. As such, dark smoke conditions based on different shades of the Ringelmann scale applied to flare emissions are not enforceable. The USEPA recommend an assessment of the presence or absence of visible smoke, using a reference method that outlines a visual technique that does not require prior training and certification (USEPA Method 22).

1.1.5. Ambient monitoring

Predictive models and ambient modelling of air emissions have been carried out by the NWSJV through successive expansions of the KGP. These models take into account the complex meteorological conditions present on the Burrup Peninsula. The following documents have provided the source of information to focus on those substances and sources that present potential risk. In order to assess the risks associated with air emissions from the KGP, ambient modelling and monitoring can be compared against the relevant ambient standards (NEPM) (Table 7).

- WEL, 2006. *Notification of Project Change NWSJV OGP LNG Production Capacity Increase.* This report details the most recent modelling study of NOx based on a maximum production capacity of 18.5 million tonnes per annum (WEL 2006). This is the most conservative and up to date estimate of ambient air emissions.

- WEL, 2003. *BTX Monitoring Programme: Ambient Air Monitoring 2003-2004* A study commissioned by Woodside monitored ambient levels of BTX for 2003-2004. The report was peer reviewed (WEL, 2005b, Toxicos, 2005) and outcomes presented at community meetings. The 'BTX Monitoring Program' report details of the monitoring results from independently conducted sampling of sites near the KGP (2 sites), Dampier townsite (3 sites) and Karratha township (3 sites) for BTX emissions. For each site, air samples were collected in accordance with accredited Australian and internationally accepted standards, methods and guidelines. Samples were sent to NATA accredited laboratories (SGS Environmental Services/Chemistry Centre of WA) for chemical analysis. Results showed that ambient levels were well below the ambient standard (see Table 7 for more detail).

- CSIRO 2003. *Woodside LNG expansion Project - Modelling Existing and Proposed Emissions on the Burrup Peninsula using TAPM.* Sources used to model ambient levels exclude flaring as CSIRO determined flaring to be infrequent. This was questioned by DER Air quality branch (DER Air quality Management Branch, *pers comm).* However, Woodside have indicated that, based on estimated gas burnt to flare, NOx emissions from the flares represent less than 1.7% of total NOx emissions from the gas plant. In the absence of models that include flaring, the determination of the significance of the emission was based on the models and the primary emission sources at the plant.

- EPA 2004. *Cumulative impacts of oxides of nitrogen from existing and proposed industries.* This investigation was prompted by Woodside's underreporting of NOx emissions prior to March 2003 in the NPI. The modelling of cumulative impacts considered not only existing industries of the Woodside's KGP, Pilbara Iron and current Shipping, but also prospective projects such as Burrup Fertilisers Ammonia Plant and future shipping. The EPA recognised the potential for environmental degradation and emphasised the need for best practicable measures as defined in EPA Guidance Statement No 55 (EPA 2003).

- DoE August 2006. *Pilbara Air Quality Study Summary Report.* Reported results from ambient monitoring over the period (1998-2000) summarised in Table 7 and stated the need for ongoing surveillance of emissions.

Table 7 outlines the most recent data on modelled and ambient monitoring of air emissions from the KGP and compares levels against appropriate standards. This table also gives an indication of the scale of the emission from NPI reporting.

Table 7. Summary of available data and applicable standards

Pollutant	Averaging period	NEPM Standard: Maximum concentration	Predicted/actual ambient concentration	NPI annual discharge (2011-2012)
Nitrogen Dioxide (NO_2)	1 hour 1 year	**120 ppb**	**66 ppb** (maximum modelled level WEL 2006).	13,000,000 kg/annum
SO_2	1 hour	**200 ppb**	Insignificant number in comparison to standard so not given.	87,000 kg/annum
Benzene	Annual Average	**3ppb**	**0.46 ppb** (maximum monitored Karratha township) (WEL, 2005b).	240,000 kg/annum
Toluene	Annual Average	**100ppb**	**8.5 ppb** (maximum monitored Dampier township) (WEL, 2005b).	360,000 kg/annum
Xylene	Annual Average	**200ppb**	**4.2 ppb** (maximum monitored Karratha township) (WEL, 2005b).	130,000 kg/annum
Particulates as less than PM_{10}	24 hours	**50 ug/m^3**	**6 ug/m^3** (maximum monitored-probable exceedences attributed to iron ore handling near Dampier DoE, 2004).	130,000 kg/annum
Photochemical oxidants (as ozone)	1 hour	**100 ppb**	**60 ppb** (maximum monitored during Pilbara Air quality study, DoE 2004, most likely attributable to bush fires (DoE, 2004).	Not directly discharged.

1.2 AIR EMISSIONS RISK ASSESSMENT

Table 5a and 7 describe the number of sources of air emissions, their associated significance in comparison against ambient standards and the residual risk after consideration of controls and management and socio-political context.

Quantitative assessment of risk (using Table 9, Appendix B)

Monitoring and modelling of SO_2 and BTX emissions has indicated ambient levels of <20% of the NEPM ambient standard (Column 4, Table 7). As such they have been assessed as low risk.

Modelling of emissions indicates that NOx may be in excess of 50% of the NEPM ambient standard. As such NOx emissions are assessed as medium risk.

Semi-quantitative assessment of risk (using Tables 10, 12 and 13, Appendix B)

The quantitative contribution of KGP dark smoke flaring to particulates is uncertain given the existence of other sources such as bush fires, shipping and iron ore handling. Using a semi-quantitative approach, dark smoke emission have been assessed as low risk. In addition, local community concern regarding dark smoke flaring is generally medium to high. This is mostly due to a perception that dark smoke generation indicates poor environmental performance. This creates unease within the community about the operation of the KGP.

1.3 RECOMMENDED STRATEGY FOR MANAGING AIR EMISSIONS

DER Management of NOx

Licence conditions for limits and monitoring of NOx emissions are recommended. According to DER Policy Statement 'Limits and Targets for Prescribed Premises' (DoE 2006), "for emissions likely to fall between 50-110% of an emission standard, or result in 50-110% of an ambient standard, it is appropriate to set a limit and require compliance monitoring".

As a complete emissions profile is not available, the concentration limits as set out in the earlier licence (L5491/1984/10) should be maintained. These limits have been derived based on the infrastructure design and the Victoria EPA SEPP on Air Quality Management (see section 1.1.4).

Future investigations should focus on the regulation of NOx emissions based on mass load instead of concentration. This would provide a more meaningful measure of total NOx produced from the KGP and would assist in validating the ambient modelling. In order to achieve this, further data is required on mass loads from individual power generation units and turbines. This would require an investigation into loading rates at different operating conditions.

DER Management of dark smoke flaring

Conditions should be placed on the licence requiring reporting of dark smoke. Due to the difficulty in applying the Ringelmann scale and Australian Standard AS3543-1989 for flaring, limits on dark smoke generation are problematic.

The purpose of including licence conditions for reporting is to ensure that all reasonable and practicable steps are being taken to reduce dark smoke. Evaluation of all significant events on an annual basis would show if improvements in management and infrastructure are leading to tangible reductions in the precursors to photochemical smog (detailed as a recommendation to the Minister of the Environment in the EPA Bulletin 1999). Reporting will also allow for more effective responses to community concerns.

A licence condition requiring reporting of dark smoke is consistent with the DoE Policy Statement 'Regulatory monitoring requirements for prescribed premises' under 'Purpose for monitoring - community right to know and continuous improvement' (DoE 2006). Conditions for reporting of dark smoke should be separated into two categories based on whether or not visible dark smoke is produced for a period of 30 minutes or more. Events that are less than 30 minutes in duration are low risk because of limited capacity to contribute to particulates and are less of a concern to the community.

Reporting condition should include the following:

- All events leading to dark smoke above Ringelmann 1 for more than 30 minutes should be reported within the Annual Environmental Report;
- Events leading to dark smoke above Ringelmann 3 for more than 30 minutes should be reported within 24 hours of the Licensee becoming aware of the emission; and
- Reports should include: date, time and reason for the event, extent of the discharge and corrective actions taken and planned to prevent recurrence.

DER would expect that Woodside continue to develop solutions into the future to ensure dark smoke events are minimised to as low as practicable in an effort to deliver best practice performance at the KGP.

2. DISCHARGES TO WATER

2.1.1. Sources and discharge points

Process waste streams and effluent from the KGP discharge at two points into the marine environment, from the Jetty Outfall into Mermaid Sound and from the Administration drain (Admin drain) into No Name Bay via No Name Creek.

Jetty Outfall (into Mermaid Sound at Northing 38321 and Easting 90196)
Discharge from the T6701 holding basin typically occurs periodically as a batched discharge but occasionally as a continuous discharge. Inputs into the T6701 holding basin include the AOCW, dewatering from condensate tanks and slop oils. Areas of the KGP with potential for spills during maintenance and shutdowns drain into several other basins. Oils are skimmed from the surface of the water and are recovered for sale. The remaining wastewater is then passed to a storage tank, then to T6701 where it is tested for contaminants prior to discharge via a diffuser into Mermaid Sound.

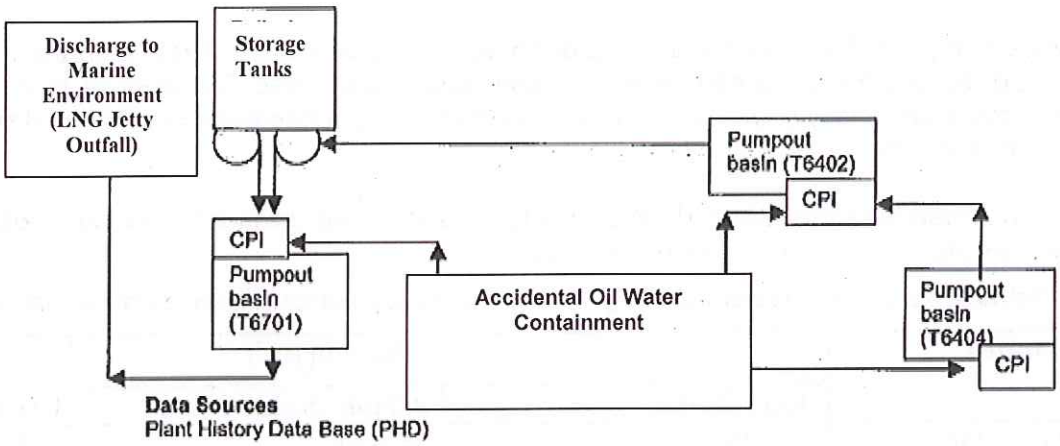

Figure 3. Sources of discharge via to the LNG Jetty outfall from the Accidental Oil Water Containment (AOCW) and treatment of oily water.

Administration Drain Discharge (into No Name Creek at Northing 37239, Easting 90872)
Continuous discharge of wastewater from the sewage treatment plant (tertiary treated, sequenced batched reactor built in 2004), demineralisation plant and stormwater occurs into the upper section of No Name Creek. No Name Creek contains a healthy freshwater ecosystem that acts as an additional natural attenuation process for nutrients in the effluent stream prior to discharge into the marine environment.

2.1.2. Composition of water discharges

A range of parameters are monitored from both discharge points as originally required under the earlier Licence (L5491/1984/10). Monitoring results from the Jetty Outfall and Admin Drain discharges have been presented in Annual Environmental Reports since 2000. Also, reports are received if elevated levels of contaminants or unplanned discharges from the T6701 holding basin or sewage treatment plant occur.

The most likely contaminants in discharges to water are: oils, anionic surfactants, glycol, nutrients, sulphates and sulphides, suspended solids, metals and the solvent "N- methyldiethanolamine activated" (aMDEA). Trends in levels of contaminants are further discussed in Section 2.1.4 below.

2.1.3. Controls and Management

Sampling is conducted prior to discharge from the holding basin T6701. Discharge only occurs when oil and aMDEA content is found to be below limits as set out in the Licence. Results from metal sampling occur post discharge so do not inform the decision to discharge or not to discharge. Other contaminants are compared against average levels previously achieved and, given a dilution rate of 100 at the diffuser, levels are compared against the Australian Water Quality Guidelines (ANZECC, 2000). It is relevant to note that this dilution rate has not be validated by dispersion modelling at the discharge point.

Liquid wastes not directed to the Jetty Outfall are disposed of to licensed liquid waste disposal facilities when the constituents exceed Licence or KGP environmental targets. If contaminated, Woodside assess other treatment or disposal options. The system provides several barriers and controls against discharge of wastewater with elevated contaminants. This ensures that contaminant levels in the T6701 holding basin and the final discharge to the marine environment do not pose significant environmental risk.

Woodside have improved management of the discharge of process waste streams to the Jetty Outfall by decreasing the volume of contaminated process waste discharged. Volumes of process wastes sent offsite have significantly increased in recent years meaning a decrease in volumes discharged to the marine environment.

Volumes discharged from the Admin drain and jetty are measured using a flowmeter. Total volumes of liquid wastes discharged to date are given in Table 8.

Table 8: Volumes of water discharged via the Jetty Outfall and Administration Drain

Dates	Volume (m^3)		
	Jetty Outfall	Admin Drain	Total
July 2011 – June 2012	12,430	16,870	29,300
July 2010 – June 2011	26,506	13,901	40,407
July 2009 – June 2010	19,869	19,892	39,761
July 2008 – June 2009	27,801	23,510	51,311
July 2007 – June 2008	25,979	29,309	55,288
July 2006 – June 2007	13,975	24,316	38,291
July 2005 – June 2006	38,258	32,691	70,949
July 2004 - June 2005	12,890	17,478	30,368
July 2003 - June 2004	11,894	33,643	45,537
July 2002 - June 2003	27,350	26,649	53,999
July 2001 - June 2002	34,549	42,017	76,566

Periodically, during cyclonic events it is necessary to continuously discharge from the holding basins to manage stormwater for emergency purposes. Prior to discharge, the holding basins and storage tanks are sampled and results generated before discharge commences.

2.1.4. Monitoring and reporting

Continuous discharge at the Admin Drain leading to No Name Creek is monitored on a monthly basis. Monitoring of the Jetty Outfall occurs at each 'Pumpout'. A pumpout can be defined as any single discharge of wastewater from the T6701 holding basin to the LNG Jetty Outfall. Average and maximum figures with standard deviations are detailed in the Annual Environmental Report submitted to the DER in October each year. Woodside conduct monitoring in-house within a NATA accredited Laboratory. Where samples are required to be taken by operators, appropriate training is given.

The following parameters are monitored at both discharge points: Total oil, Chemical Oxygen Demand, Conductivity Glycol, pH, Total Nitrogen and Phosphorus, Sulphates and sulphides, Anionic surfactants, Suspended solids, Turbidity, Metals (Cadmium, Copper, Lead, Zinc) and "N-methyldiethanolamine activated" (aMDEA).

Parameters have shown consistency over the reporting period to date, with periodic elevations of some parameters such as metals and nutrients.

Discharge limits
Discharges of Total Oil and aMDEA have been effectively regulated through limits set out in the licence and managed by Woodside. Discharge does not occur unless the concentrations are below the limits as set out below.

Total Oil
Limits set on concentration of Total Oil discharges are as follows:

- Maximum permitted concentration (mg/L): 60
- Maximum average concentration for calendar year (mg/L): 10
- Maximum number of discharges per calendar year for which the concentration is greater than 30 mg/L but less than 60mg/L: 6

The original justification for the setting of these limits is not available although average concentration of Total Oil have been consistently below 10mg/L.

aMDEA
The aMDEA solvent substitutes sulfinol as the absorbent of carbon dioxide from the gas stream. It was highlighted by the EPA as a contaminant of concern if disposed of to the marine environment. The original limit was set in the 2003 Licence as:

- Maximum permitted concentration (mg/L): 100
- Maximum number of incidents per calendar year for which the concentration is equal to or greater than 45mg/L but less than 100mg/L: 2.

This limit was based on studies conducted on the toxicity of aMDEA by the MDEA manufacturer (BASF, 2000). These studies indicate that in coastal marine environments, a concentration of 1mg/L must persist in the receiving environment to have harmful effects. Using the estimated dilution factor of 100, an upper limit of 100mg/L aMDEA in the T6701 holding basin was recommended to prevent concentrations in the receiving environment being any higher than 1mg/L.

Average aMDEA concentrations have been below 30mg/L to date.

2.1.5. Ambient monitoring

Ambient monitoring of marine sediment for metals and hydrocarbons is conducted as part of the Chemical and Ecological Monitoring of Mermaid Sound (CheMMS) reported through the Annual Report to the State government on Environmental Investigations and Monitoring (WEL, 2005c). In the 2005 report, metal concentrations in marine sediment in the vicinity of the KGP were generally similar to those recorded at the Conzinc Bay reference sites. Hydrocarbons were not detected in sediments and no saturated or Polycyclic aromatic hydrocarbons were detected in oysters at any of the sites.

2.2. DISCHARGES TO WATER RISK ASSESSMENT

Quantitative assessment

Monitoring data exists for discharges to water for the last five years (2001-2005) for a range of parameters. Although a dilution rate of 100 has previously been used, this figure has not been validated with dispersion modelling from the discharge point and by assigning a mixing zone for a Lower Ecological Protection Area (LEPA). As such, quantitative risk cannot be determined. In the absence of complete information, a semi-quantitative risk assessment has been conducted.

Semi-quantitative assessment of risk (using Tables 10, 12 and 13, Appendix B)

Discharge of liquid wastes to the Admin drain and to the Jetty Outfall discharge points are assessed as a medium risk. The primary factor in this risk determination is the uncertainty associated with the discharge where elevated levels of nutrients and contaminants above ANZECC guidelines are released periodically. Medium risk has been assigned as a precautionary measure until further investigations are conducted on the discharge. Oil and aMDEA discharges, if not adequately managed, have the potential to pose a medium to high risk. Adequate management of these parameters by Woodside will ensure that the risk of potential impact is low.

2.3. RECOMMENDED STRATEGY FOR MANAGING DISCHARGES TO WATER

It is recommended that monitoring conditions on the Licence be maintained on both the Jetty Outfall and Admin Drain discharge points for the parameters required for previous Licences. Limits for oils and aMDEA as set out in the earlier licence version have not been maintained as Woodside can adequately manage the quality of the discharge through internal environmental targets.

Mermaid Sound has been recommended as an area to be designated as high environmental value and areas of the Dampier Archipelago are proposed as a Marine Conservation Reserve (DoE, 2006). Monitoring of discharges from industry is required to assess possible impacts on this sensitive environment. Monitoring of discharge quality and volumes serves the purpose of triggering intervention and management responses and for assessing cumulative impacts on Mermaid Sound. This is especially important as Industry on the Burrup Peninsula is set to expand with further inputs into the marine environment proposed in the proximity of the KGP.

In order to undertake a quantitative assessment of the risks associated with discharges to water, it is recommended that Woodside conduct investigations into dispersion and mixing zones at both the Admin Drain and Jetty outfall discharge points. These investigations should consider hydrocarbon, metals and nutrient loading and the cause and effect pathway at the marine outfalls. For example, dispersion modelling of the receiving environment could be undertaken and a mixing zone established; reference and control sites could be put in place to establish base information and appropriate monitoring regime designed and conducted.

When conducting investigations Woodside should, utilising information such as flow rate, the type of diffuser, the water depth at the discharge point, initial dilutions achieved on plume rise, physio – chemical characteristics of TWW (salinity (density), pH, temp), toxicant concentrations (e.g. heavy metals), nutrients and bacterial concentrations, propose a small LEPA about the diffuser. The LEPA boundary defines the area beyond which monitoring should be undertaken against criteria for high ecological protection [e.g. median of monitoring site data versus 80th percentile of reference site data for physical chemistry stressors (salinity, pH, temp, nutrient related indicators) and ANZECC 99% species protection guideline values for contaminants].

In addition, it is recommended that, through their environmental management system, Woodside implement a program for No Name Creek to ensure that it is not adversely impacted by current and potential operations, including discharges. This should include limiting sediment and silt build up within the creek system and continued monitoring for nutrients and contaminants.

APPENDIX B: EMISSIONS AND DISCHARGES RISK ASSESSMENT MATRIX

Note: These matrix are taken from the DEC Officer's Guide to Emissions and Discharges Risk Assessment *(2006).*

Table 9: Quantitative assessment of Significance of Emissions

Emissions as a percentage of the relevant emission or ambient standard		Worst Case Operating Conditions (95th Percentile)			
		>100%	50 – 100%	20 – 50%	<20%*
Normal Operating Conditions (50th Percentile)	>100%	5	N/A	N/A	N/A
	50 – 100%	4	3	N/A	N/A
	20 – 50%	4	3	2	N/A
	<20%*	3	3	2	1

*For reliable technology, this figure could increase to 30%

Table 10: Semi-quantitative determination of significance of emission of assessment (where no relevant standard or emissions profile is available)

		Consequence of Emissions (Impact) (see Table 6)				
		Catastrophic	Major	Moderate	Minor	Negligible
Likelihood (see Table 4)	Almost certain	5	5	4	3	2
	Likely	5	5	4	3	2
	Possible	5	4	4	2	1
	Unlikely	5	4	3	2	1
	Unforeseen	4	3	2	1	1

Assumptions made in determination of semi-quantitative risk: Tables used for determination of risk are derived from the Welker Review, 2003 (Welker, 2003) and Australian Standard: AS/NZ 4360:2004 Risk Management.

Table 10 Socio-Political Context of Each Regulated Emission

		Relative proximity of the interested party with regards to the emission				
		Immediately Adjacent	Adjacent	Nearby	Distant	Isolated
Level of Community Interest or Concern*	5	High	High	Medium High	Medium	Low
	4	High	High	Medium High	Medium	Low
	3	Medium High	Medium High	Medium	Low	No
	2	Low	Low	Low	Low	No
	1	No	No	No	No	No

Note: These examples are not exclusive and professional judgement is needed to evaluate each specific case
*This is determined by DER using the *Officer's Guide to Emissions and Discharges Risk Assessment* (2006).

Table 11: Emissions Risk Reduction Matrix

		Significance of Emissions				
		5	4	3	2	1
Socio-Political Context	High	A	A	B	C	D
	Medium High	A	A	B	C	D
	Medium	A	B	B	D	E
	Low	A	B	C	D	E
	No	B	C	D	E	E

PRIORITY MATRIX ACTION DESCRIPTORS
A = Do not allow (fix)
B = licence condition (setting limits + EMPs - short timeframes)(setting targets optional)
C = licence condition (setting targets + EMPs - longer timeframes)
D= EIPs, other management mechanisms/licence conditions (monitoring/reporting)/other regulatory tools
E = No regulation, other management mechanisms

Table 12: Likelihood

Likelihood (frequency)	Example only (context required)
Almost certain (regular/continuous)	• Stack emissions, discharge to tailings dam, dewatering discharge.
Likely (irregular/repeated)	• Dark smoke emissions under non-standard operation, desludging of treatment pond.
Possible (intermittent)	• Over topping of treatment pond in extreme rainfall event.
Unlikely	• Discharge of contaminated water to marine environment.
Unforeseen	• Major spillage, catastrophic failure of chemical storage.

Table 13: Ecological Impact Consequence on Identified Environmental Receptor(s)

Consequence (impact)	Examples only (context required)
Catastrophic	• Large-scale destruction of flora/fauna. • Large-scale coral and/or fish deaths from contaminated water discharge to marine environment.
Major	• Major spill of cyanide to native vegetation community causing $10,000 damage/death of flora. • Toxic air emissions leaving site and affecting residential areas. • Large process solution spill/discharge (eg copper, nickel) to surrounding environment. • Contamination of public drinking water supply. • Long-term dust emissions impacting on health and amenity on residential areas.
Moderate	• Discharge of saline dewatering water to ephemeral creek bed. • Once off spill of metallic ore/concentrate to marine environment. • Odour emissions impacting on residents. • Dark smoke emissions and flaring.
Minor	• Hydrocarbon or sewage spill contained on Premises. • Air emissions from gas turbines
Negligible	• Dust coatings on surrounding flora from dust emissions. • Contaminated stormwater runoff contained on Premises

Source + Receptor + Pathway = Impact
The level of impact is dependent on the (i) environmental significance of the receptor, (ii) the nature and extent of the discharge/emission and (iii) the pathway availability for discharge to reach receptor