APPENDIX F
Greenhouse Gas Inventory by WorleyParsons

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AUSTRALIAN PIPELINE TRUST

Bonaparte Gas Pipeline

Greenhouse Gas Inventory

BGP-01-EN-RP-001

2 March 2007

WorleyParsons Komex
Level 6, QV1 Building
250 St Georges Terrace
Perth WA 6000 Australia
Tel: +61 8 9278 8111
Fax: +61 8 9278 8110
www.worleyparsons.com
WorleyParsons Services Pty Ltd
ABN 61 001 279 812

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PROJECT BGP-01-EN-RP-001 - BONAPARTE GAS PIPELINE

REV	DESCRIPTION	ORIG	REVIEW	WORLEY-PARSONS APPROVAL	DATE	CLIENT APPROVAL	DATE
A	Issued for internal review	R Kennedy	T Graham	N/A	27-Feb-07	N/A	
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GLOSSARY AND ABBREVIATIONS

AGO	Australian Greenhouse Office
BGP	Bonaparte Gas Pipeline
CO_2	Carbon Dioxide
CO_2-e	Carbon Dioxide Equivalents – A unit of greenhouse gas emissions calculated by multiplying the actual mass of emissions by the appropriate Global Warming Potential. This enables emissions of different gases to be added together and compared with carbon dioxide
CH_4	Methane
EPA	Environmental Protection Agency
GJ	Gigajoules (equivalent to 10^9 Joules)
kPag	Kilopascal gauge
Mg	Megagrams (equivalent to tonnes)
MJ	Megajoules (equivalent to 10^6 joules)
Mtpa	Megatonne per annum (equivalent to 10^6 tonnes per year)
N_2O	Nitrous Oxide
NPI	National Pollutant Inventory
NT	Northern Territory
PJ	Petajoules (equivalent to 10^{15} joules)
Pg	Petagram (equivalent to 10^{15} grams)
t	Tonnes
t/y	Tonnes per year
TJ/day	Terrajoules per day (equivalent to 10^{12} joules per day)
USEPA	United States Environmental Protection Agency

1. EXECUTIVE SUMMARY

The proposed Bonaparte Gas Pipeline (BGP), which is to be developed by the Australian Pipeline Trust (APT), will run from the proposed Eni Wadeye onshore gas processing plant to a connecting station on the Amadeus to Darwin Pipeline (ABDP), with a tie-in near Ban Ban Springs. A map showing the route can be found in Appendix A. The BGP is proposed to be 280 km long, with a maximum operating pressure of 15,300 kPag, and will initially transport an average of 104 TJ/day (based on the typical gas composition as shown in Appendix B).

The predicted greenhouse gas emissions for the construction, commissioning, and operations phases of the BGP have been estimated, and compared to greenhouse gas emissions from both the Northern Territory and its associated sources as well as National emissions.

Total carbon dioxide equivalent emissions for the project will be of the order of 4,500 t CO_2-e for the constructions phase, 53 t CO_2-e for commissioning phase, and 31 t CO_2-e per year for the operations phase. It should be noted that the scope of this emissions assessment was limited to direct emissions from the plant at this stage of the project's development, and that emissions estimates from the clearing of vegetation have not been included. Emissions estimates from the clearing of vegetation have been evaluated by Ecoz and are presented elsewhere in the PER. APT is committed to actively promoting the regrowth of disturbed vegetation to achieve rehabilitation and to significantly offset any emissions from the initial clearing. Future expansion of the pipeline has also been excluded from this assessment.

The emissions from the BGP are very low compared with aggregate emissions at the National scale and at the Northern Territory scale. Construction emissions represent the largest source of greenhouse gas emissions, with the dominant source diesel engines. Emissions from the operations stage have been minimised through the use of solar / battery systems to provide power at the service sites, only relying on diesel generators for backup and external lighting where required. Additionally, the construction of the gas pipeline allows for further utilisation of natural gas as a fuel source, replacing other sources (such as fuel oil at the Gove refinery) which have higher carbon dioxide equivalent emissions footprints.

2. INTRODUCTION

The proposed Bonaparte Gas Pipeline (BGP), which is to be developed by the Australian Pipeline Trust (APT), will run from the proposed Eni Wadeye onshore gas processing plant to a connecting station on the Amadeus to Darwin pipeline (ABDP), with a tie-in near Ban Ban Springs. The BGP is proposed to be 280 km long, with a maximum operating pressure of 15,300 kPag, and will initially transport an average of 104 TJ/day (based on the typical gas composition as shown in Appendix B).

This report details the greenhouse gas emissions associated with the construction, hook-up and commissioning, and operations of the BGP.

3. GREENHOUSE GASES OVERVIEW

Greenhouse gases represent a class of gases which absorb long-wave radiation thus giving rise to the Greenhouse Effect. Greenhouse gas emissions are regulated based upon the contribution of the emissions to the Greenhouse Effect. This anthropogenic contribution to the Greenhouse Effect is called the Enhanced Greenhouse Effect.

3.1 The Greenhouse Effect

The Greenhouse Effect is a natural phenomenon where light energy from the sun passes through the atmosphere and heats the earth's surface. Greenhouse gases in the atmosphere include carbon dioxide, water vapour, methane, nitrous oxide, non-methane volatile organic compounds, halocarbons, carbon monoxide and sulphur hexafluoride. These gases within the atmosphere trap heat reflected from the earth's surface thereby maintaining temperatures at a level capable of supporting life.

Human activities such as combustion of fossil fuels and land clearing activities have resulted in an increase in the concentration of greenhouse gases in the earth's atmosphere. This is widely believed to cause an enhanced greenhouse effect leading to an increase in the average temperature of the earth's surface.

Six greenhouse gases are specifically covered by the Kyoto Protocol; these being carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulphur hexafluoride (SF_6), perfluorocarbons (PFCs), and hydrofluorocarbons (HFCs). Other greenhouse gases exist which are not specifically covered by the Kyoto protocol. These include water vapour (H_2O), chlorofluorocarbons (CFCs), ozone (O_3), and non-methane volatile organic compounds (NMVOCs). The main anthropogenic greenhouse gas is carbon dioxide, as such it attracts much of the attention regarding greenhouse gases. The main greenhouse gases associated with LNG plants and pipelines are carbon dioxide and methane, and to a lesser extent nitrous oxide.

To give a common base for considering the impact of the various greenhouse gas emissions, the greenhouse gases are usually expressed in terms of carbon dioxide equivalents (CO_2-e), where the potential of each gas to increase heating in the atmosphere is expressed as a multiple of the heating potential of carbon dioxide. This is known as the 'global warming potential'. A list of the global warming potentials for the main greenhouse gases is presented in Table 3-1.

Table 3-1: Global Warming Potentials (AGO 2006)

Gas	Chemical formula	IPCC 1996 Global Warming Potential
Carbon dioxide	CO_2	1
Methane	CH_4	21
Nitrous oxide	N_2O	310
Hydrofluorocarbons HFCs		
HFC-23	CHF_3	11,700
HFC-32	CH_2F_2	650
HFC-41	CH_3F	150
HFC-43-10mee	$C_5H_2F_{10}$	1,300
HFC-125	C_2HF_5	2,800
HFC-134	$C_2H_2F_4$ (CHF_2CHF_2)	1,000
HFC-134a	$C_2H_2F_4$ (CH_2FCF_3)	1,300
HFC-143	$C_2H_3F_3$ (CHF_2CH_2F)	300
HFC-143a	$C_2H_3F_3$ (CF_3CH_3)	3,800
HFC-152a	$C_2H_4F_2$ (CH_3CHF_2)	140
HFC-227ea	C_3HF_7	2,900
HFC-236fa	$C_3H_2F_6$	6,300
HFC-245ca	$C_3H_3F_5$	560
Hydrofluoroethers (HFEs)		
HFE-7100	$C_4F_9OCH_3$	500
HFE-7200	$C_4F_9OC_2H_5$	100
Perfluorocarbons PFCs		
Perfluoromethane (tetrafluoromethane)	CF_4	6,500
Perfluoroethane (hexafluoroethane)	C_2F_6	9,200
Perfluoropropane	C_3F_8	7,000
Perfluorobutane	C_4F_{10}	7,000
Perfluorocyclobutane	c-C_4F_8	8,700
Perfluoropentane	C_5F_{12}	7,500
Perfluorohexane	C_6F_{14}	7,400
Sulphur hexafluoride	SF_6	23,900
Indirect gases		
Carbon monoxide	CO	not applicable
Oxides of nitrogen	NO_x	not applicable
Non-methane volatile organic compounds (NMVOCs)	various	not applicable

3.2 Carbon Dioxide

Carbon dioxide is the primary anthropogenic greenhouse gas, and is assigned a global warming potential of 1. Other greenhouse gases are compared to carbon dioxide and given a global warming potential which is a multiple of carbon dioxide's so as to provide a means to compare total greenhouse gas emissions in terms of their radiative forcing effects. These are termed carbon dioxide equivalent emissions.

Atmospheric carbon dioxide derives from multiple natural sources including volcanic out gassing, the combustion of organic matter, and the respiration processes of living aerobic organisms; man-made sources of carbon dioxide come mainly from the burning of various fossil fuels for power generation and transport use. It is also produced by various micro-organisms from fermentation and cellular respiration.

3.3 Methane

Methane is the principal component of natural gas, and is also naturally abundant in the atmosphere. Methane in the Earth's atmosphere is an important greenhouse gas with a global warming potential 21 times that of carbon dioxide. Its concentration has increased by about 150% since 1750 and it accounts for 20% of the total radiative forcing from all of the long-lived and globally mixed greenhouse gases

The major source of methane is extraction from geological deposits (i.e. natural gas fields). Apart from gas fields an alternative method of obtaining methane is via biogas generated by the fermentation of organic matter including manure, wastewater sludge, municipal solid waste, or any other biodegradable feedstock, under anaerobic conditions. It is also caused by cows' natural gas.

3.4 Nitrous Oxide

Unlike the other oxides of nitrogen, nitrous oxide is a major greenhouse gas. Nitrous oxide has a global warming potential 310 times that of carbon dioxide. Behind carbon dioxide and methane, nitrous oxide is the third most important gas that contributes to global warming.

Nitrous oxide is naturally emitted by bacteria in soils and oceans. Agriculture is the main source of human-produced nitrous oxide: cultivating soil, the use of nitrogen fertilisers, and animal waste handling can all stimulate naturally occurring bacteria to produce more nitrous oxide. Industrial sources make up only about 20% of all anthropogenic sources, and include the production of nylon and nitric acid and the burning of fossil fuel in internal combustion engines.

The global anthropogenic nitrous oxide flux is about 1 petagram of carbon dioxide carbon-equivalents per year; this compares to 2 petagrams of methane carbon dioxide carbon-equivalents per year, and to an atmospheric loading rate of about 3.3 petagrams of carbon dioxide carbon-equivalents per year.

4. LEGISLATION

4.1 Greenhouse Gases

Greenhouse gas emissions are covered by legislative and policy requirements at both State and Commonwealth levels. These include:

- United Framework Convention on Climate Change
- National Greenhouse Strategy
- Northern Territory Strategy for Greenhouse Action
- Northern Territory Environmental Impact Assessment Guide to Greenhouse Gas Emissions
- Kyoto Protocol (although not ratified by Australia)
- Greenhouse Challenge – this is a voluntary program between government and industry to abate greenhouse gas emissions

The 1990 Inter-Governmental Panel on Climate Change (IPCC) scientific report led to 186 countries endorsing the United Nations Convention on Climate Change (UNFCCC) at the Earth Summit in Rio de Janeiro in 1992. This Convention, a legally binding instrument, came into effect in 1994 and aims to stabilise atmospheric greenhouse gas concentrations at levels below which unacceptable impacts would occur. The 1997 Kyoto Protocol established a greenhouse gas accounting framework and defined targets for greenhouse gas emissions for developed countries for the period 2008 and 2012, as a proportion of their 1990 emissions. Australia's target is to emit not more that 108% of its 1990 levels.

As a signatory to the United Nations Framework Convention on Climate Change (UNFCCC), Australia annually reports its total net greenhouse gas emissions according to internationally set inventory accounting rules. These require the reporting of all human induced greenhouse gas emissions and removals. Under the Kyoto Protocol, the inventory accounting rules have a more limited scope. They specify only six greenhouse gases, allow choice of base year for the synthetic gases (1990 or 1995) and provide for a limited set of forestry activities. Although Australia has not ratified the Kyoto Protocol, the Australian National Greenhouse Gas Inventory includes annual emission factors based on Kyoto accounting rules to estimate progress against Australia's Kyoto target.

Australia developed a National Greenhouse Strategy (NGS) in 1998, which provides the strategic framework for advancing Australia's Greenhouse response. There are no State or project-specific requirements in the national strategy, although the strategy does indicate responsibility for measures for the Commonwealth and State governments. In 1998 the Commonwealth government established a central greenhouse agency, the Australian Greenhouse Office (AGO), to coordinate Commonwealth action on climate change matters.

The Northern Territory Strategy for Greenhouse Action (NT 2006) establishes short term goals and actions and sets the basis for ongoing effective long term programs and engagement by all sectors of the community. The Northern Territory Government's objective for managing greenhouse gas emissions from new and expanding operations is to minimise emissions to a level that is as low as practicable.

The Northern Territory Environmental Impact Assessment Guide to Greenhouse Gas Emissions (NT 2006b) describes the information required to assess the impact of greenhouse gas emissions from proposed projects during assessment under the *Northern Territory Environmental Assessment Act 1994*, as required under Action 6.4 of the Northern Territory Strategy for Greenhouse Action 2006.

5. PROJECT DESCRIPTION

The BGP, which is to be developed by APT, will run from the proposed Eni Wadeye onshore gas processing plant to a connecting station on the Amadeus to Darwin Pipeline (ABDP), with a tie-in near Ban Ban Springs. The ADBP currently transports gas from the Palm Valley and Mereenie gas fields, approximately 150 km and 300 km west of Alice Springs respectively, to electricity generating plants primarily located at Tennant Creek, Katherine, Pine Creek, and Darwin. The Amadeus fields are near their end of life and most of the current long-term contracts for gas supply are due to expire in 2009.

The BGP is proposed to be 280 km long, with a maximum operating pressure of 15,300 kPag, and will initially transport an average of 104 TJ/day (based on the typical gas composition as shown in Appendix B). The inlet station adjacent to the Eni gas processing plant will consist of a pig launcher and isolation valves. The interconnection with the ABDP will consist of a meter and regulator station and the connection to the ABDP will be via hot tap, or connect into the existing ABDP station piping. The pipeline is to be designed for future compression; however there will be no compression facilities for the initial operations.

At the meter station, a solar / battery based electrical reticulation system will be installed, with a 72-hour backup under full cloud cover. A portable diesel generator will be available should this system fail, as well as for external lighting, where required.

Solar systems will also be utilised at the construction sites, where practicable, with portable diesel generators used elsewhere and as backup. At those sites where power is supplied by solar generation, the site huts will be double skinned, passively cooled buildings.

5.1 Route of Pipeline

The BGP begins at the Eni onshore gas processing facility, 3 km inland from the proposed beach landing location and follows the Wadeye to Daly River Road for around 130 km before branching away. In doing so, the alignment stays south of the Wadeye township, skirts around the northern end of the Sugarloaf Range, and then sits between the Macadam Range on the south and the black soil plains and swamps that drain north to the Moyle River.

The BGP follows the north side of Richards Hill before traversing open plains for around 40 km, before entering the range of hills to the west of the Daly River, bisected by the Chilling Creek. The pipeline travels northeast from here, passing Tipperary Station, before reaching the Stuart Highway. The terrain in this area is predominantly undulating open woodland. The pipeline meets the Amadeus pipeline 3 km south of Ban Ban Springs Station before following an existing gas pipeline from the Burnside Mine to the Scraper Station on the Amadeus Pipeline.

A map showing the route can be found in Appendix A. For a more detailed route definition, refer to the Bonaparte Gas Pipeline Basis of Design (BGP/01/PM/BD/001 D).

6. GREENHOUSE GAS EMISSIONS

6.1 Project Emission Sources

Greenhouse gases will be emitted throughout the lifecycle of the BGP project. The emissions will vary according to the stage of the project. The main phases of the project are:

- Construction;
- Hook-up and Commissioning; and
- Operations.

During construction, the main emission source will be the burning of diesel fuel by the mobile equipment required to carry out the construction work. Additional emission sources include burning of diesel fuel in portable generators for power production (where the solar / battery systems are not yet in place), propane heating fuel, combustion of unleaded petrol, use of jet fuel for aerial surveys, and the burning of non-hazardous wastes (predominantly cardboard). During hook-up and commissioning, the predominant emissions will be the venting of gas for blowdown purposes. This venting will be kept to a minimum.

During operations, there will be emissions from both the burning of diesel fuel by mobile equipment, as well as occasional venting for blowdown purposes. Gas blowdown during operations is expected to be a rare event. Additionally, diesel fuel use in portable generators during operations is expected to be minimal due to the use of solar / battery powered systems at the metering station.

It should be noted that the scope of this emissions assessment was limited to direct emissions from the plant at this stage of the project's development, and that emissions estimates from the clearing of vegetation have not been included. Emissions estimates from the clearing of vegetation have been evaluated by Ecoz and are presented elsewhere in the PER. APT is committed to actively promoting the regrowth of disturbed vegetation to achieve rehabilitation and to significantly offset any emissions from the initial clearing. Future expansion of the pipeline has also been excluded from this assessment.

6.2 Greenhouse Gas Emission Factors

All greenhouse gas emissions calculations performed have used the Australian Greenhouse Office's various workbooks of emission factors, in line with the Northern Territory Environmental Impact Assessment Guide to Greenhouse Gas Emissions. The main references include the AGO Factors and Methods Workbook 2006, and the AGO Australian Methodology for the Estimation of Greenhouse Gas Emissions and Sinks 2005 handbooks for Stationary Sources and Transport Emissions. A full list of references is provided in Section 9.

Table 6-1 below highlights the emission factors used along with the various emission sources predicted to be present during the construction, commissioning, and operations phases. Table 6-2 provides estimates of fuel volumes for the emission sources.

Table 6-1: Emissions Factors for the Emission Sources

Emission Sources	Carbon Dioxide	Units	Methane	Units	Nitrous Oxide	Units
Diesel Generators	69,900	Mg/PJ [1]	4.0	Mg/PJ [3]	0.6	Mg/PJ [3]
Diesel Fuelled Mobile Equipment	69,900	Mg/PJ [4]	5.7	Mg/PJ [5]	2.0	Mg/PJ [5]
Propane Heaters	60,200	Mg/PJ [1]	1.0	Mg/PJ [2]	0.6	Mg/PJ [2]
Helicopters	69,600	Mg/PJ [4]	0.5	Mg/PJ [5]	2.2	Mg/PJ [5]
Unleaded Fuel Use	67,400	Mg/PJ [4, 10]	1.2	Mg/PJ [6,7]	1.2	Mg/PJ [6,7]
Burning of Waste	94,000	Mg/PJ[8,11]	4.2	Mg/PJ [2,11]	4.1	Mg/PJ [2,11]
Gas Blowdown	186	Mg/PJ [9]	17,353	Mg/PJ [9]	0	Mg/PJ [9]

Ref 1 – AGO Stationary Sources 2006 – Table 3
Ref 2 – AGO Stationary Sources 2005 – Table 99
Ref 3 – AGO Stationary Sources 2005 – Table 5
Ref 4 – AGO Transport 2005 – Table A.2
Ref 5 – AGO Transport 2005 – Table A.8
Ref 6 – AGO Transport 2005 – Table 8
Ref 7 – AGO Workbook 2006 – Table 4
Ref 8 – AGO Stationary Sources 2005 – Table 3
Ref 9 – WP Bonaparte Gas Pipeline Design Basis – Appendix B

Table 6-2: Estimated Fuel Volumes for the Emission Sources

Emission Sources	Fuel Volume	Unit	Heating Value	Unit	Energy	Unit
Construction						
Diesel Generators	80	m^3	38.6	MJ/L [3]	3,088	GJ
Diesel Fuelled Mobile Equipment	1,520	m^3	38.6	MJ/L [3]	58,672	GJ
Propane Heaters	20	m^3	25.7	MJ/L [3]	514	GJ
Helicopters	20	m^3	36.8	MJ/L [3]	736	GJ
Unleaded Fuel Use	20	m^3	34.2	MJ/L [3]	684	GJ
Burning of Waste	10	tonnes	10.5	MJ/kg [4]	105	GJ
Commissioning						GJ
Gas Blowdown	4,000	m^3	36.3	MJ/m^3 [1]	145	GJ
Operations						GJ
Gas Blowdown	300	m^3	36.3	MJ/m^3 [1]	10.9	GJ
Diesel Fuelled Mobile Equipment	5	m^3	38.6	MJ/L [3]	193	GJ
Helicopters	5	m^3	36.8	MJ/L [3]	184	GJ

Ref 1 – WP Bonaparte Gas Pipeline Design Basis – Appendix B
Ref 2 – Information Supplied by APT (APT 2007)
Ref 3 – AGO Transport 2005 – Table A.2
Ref 4 – NPI Boilers - Table 39

6.3 Greenhouse Gas Emissions Data

The greenhouse gas emissions for the BGP project have been calculated using the emission factors and fuel volumes discussed in the previous section. The emissions for the construction, commissioning, and operations phase are shown in Table 6-3. The construction and commissioning phases are short-term, one off events. As such, their emissions have been reported as total emissions for their phase. The operations phase is ongoing and so emissions are shown in tonnes per year of operation. The operational emissions will remain approximately constant until such time, if any, that an expansion of the BGP is proposed, which would require the preparation of a revised inventory, as part of an application for development approval.

Table 6-3: Greenhouse Gas Emissions

Emission Sources	**Carbon Dioxide**	Units	**Methane**	Units	**Nitrous Oxide**	Units	**CO_2-e** [1]	Units
Construction								
Diesel Generators	216	t	$1.2x10^{-2}$	t	$1.8x10^{-3}$	t	217	t
Diesel Fuelled Mobile Equipment	4,101	t	$3.3x10^{-1}$	t	$1.2x10^{-1}$	t	4,145	t
Propane Heaters	30.9	t	$5.1x10^{-4}$	t	$3.1x10^{-4}$	t	31.0	t
Helicopters	51.2	t	$3.7x10^{-4}$	t	$1.6x10^{-3}$	t	51.7	t
Unleaded Fuel Use	46.1	t	$8.3x10^{-4}$	t	$8.5x10^{-4}$	t	46.4	t
Burning of Waste	9.9	t	$4.4x10^{-4}$	t	$4.3x10^{-4}$	t	10.0	t
Commissioning								
Gas Blowdown	$2.7x10^{-2}$	t	2.52	t	0	t	52.9	t
Operations								
Gas Blowdown	$2.0x10^{-3}$	t/y	$1.9x10^{-1}$	t/y	0	t/y	4.0	t/y
Diesel Fuelled Mobile Equipment	13.5	t/y	$1.1x10^{-3}$	t/y	$3.9x10^{-4}$	t/y	13.6	t/y
Helicopters	12.8	t/y	$9.2x10^{-5}$	t/y	$4.0x10^{-4}$	t/y	12.9	t/y

Ref 1 – Carbon Dioxide Equivalents

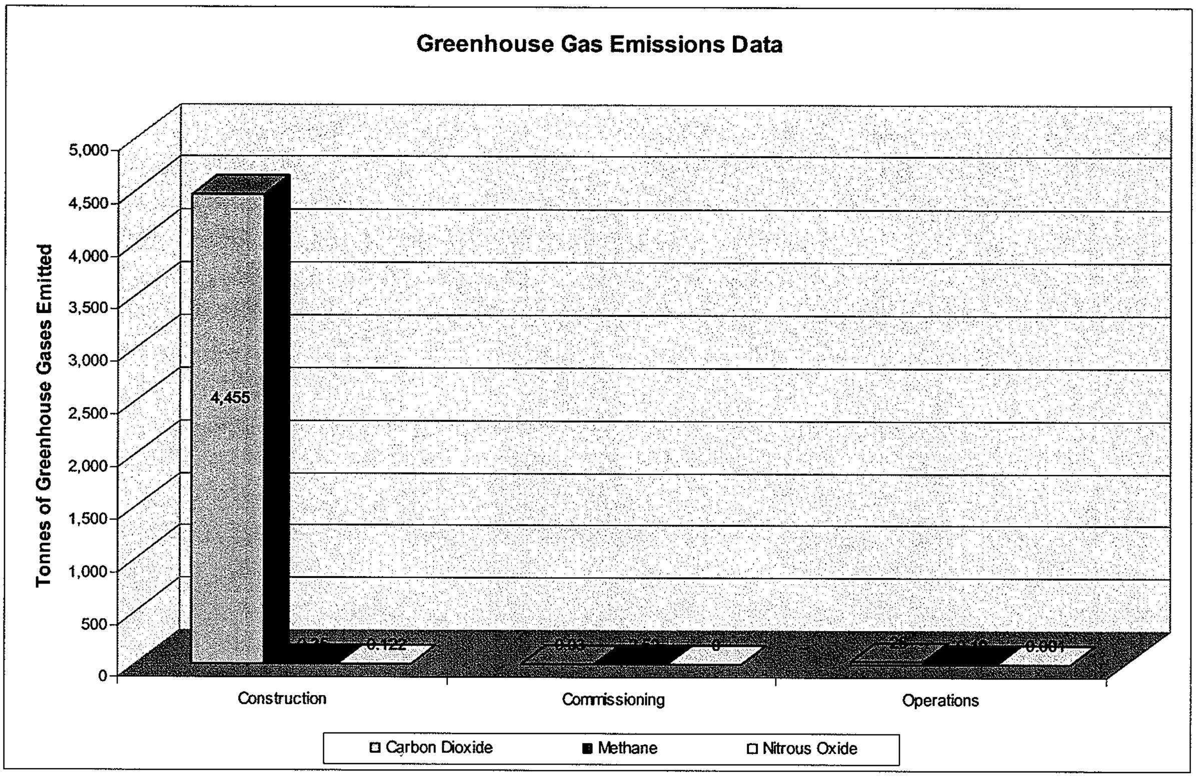

Figure 6-1: Greenhouse Gas Emissions for Construction, Commissioning, and Operations

The total carbon dioxide equivalent emissions for the construction, commissioning, and operational phases are shown below in Table 6-4.

Table 6-4: Carbon Dioxide Equivalent Emissions for Construction, Commissioning, and Operational Phases

Emission Sources	Carbon Dioxide Equivalents CO_2-e	Units
Construction	4,500	t
Commissioning	53	t
Operations	31	t/y

7. EMISSIONS BENCHMARKING

The predicted greenhouse gas emissions for the BGP project have been compared to the greenhouse gas emissions from a number of other Northern Territory sources in order to gain perspective on the project's emissions. The BGP emissions have been compared to the Gove Alumina Refinery (for the expanded 3.5 Mtpa facility), the Darwin 10 Mtpa LNG Facility (URS 2002), and the net emissions from the Northern Territory itself for the year 2004 (AGO 2004). The emissions from the Gove refinery has been separated into two cases – one using the existing fuel oil-fired cogeneration system, the second case using the planned natural-gas fired cogeneration system, as defined in the Environmental Impact Statement for the Expansion of the Gove refinery (URS 2004). It should be noted that the following benchmarking emissions are for operations for the facilities mentioned (including the BGP). The Northern Territory greenhouse gas emissions are the net emissions taking into account both greenhouse gas emissions and offsets for the year 2004 (as more recent data is not yet available from the AGO).

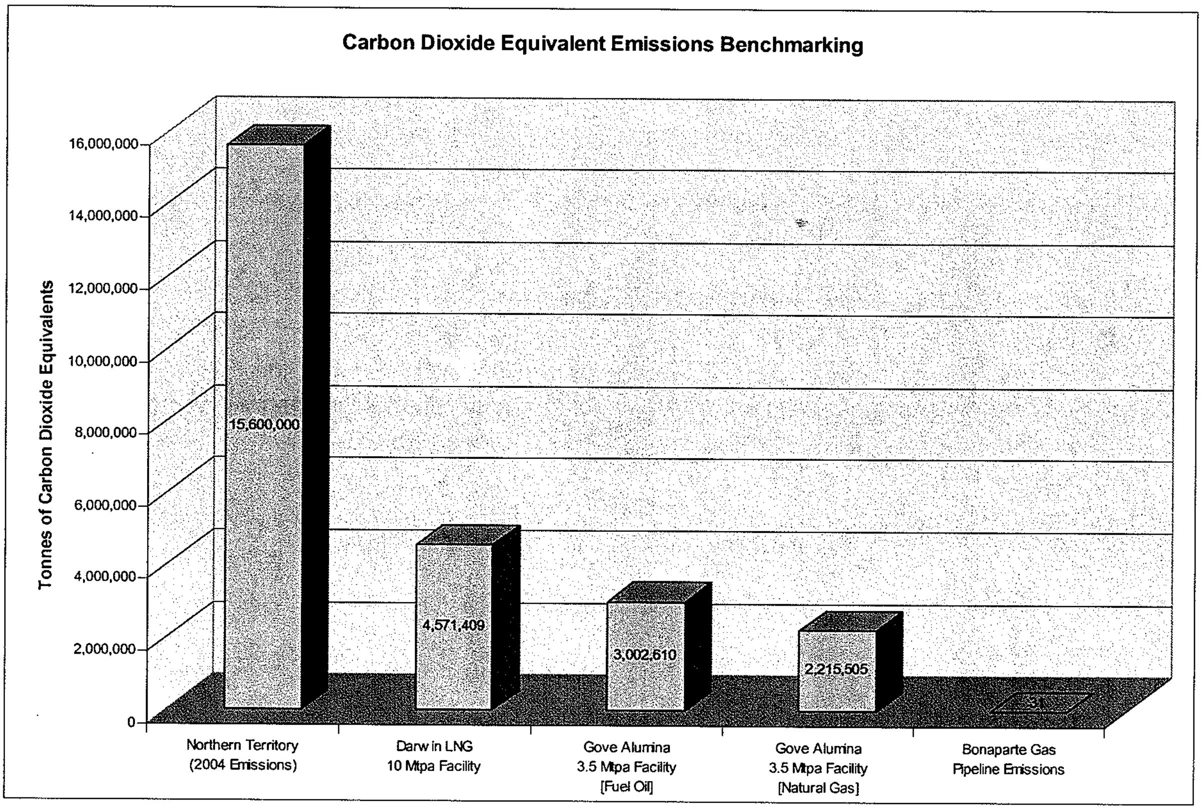

Figure 7-1: Greenhouse Gas Emissions Benchmarking (Operational Emissions)

In order to place the Northern Territory's emissions into a national context, the following figures (Figure 7-2 and Figure 7-3) are taken from the AGO States and Territory Greenhouse Gas Inventories 2004 (AGO 2004). As illustrated in Figure 7-2, the emissions for the Northern Territory (shown above in Figure 7-1 for 2004) made up only around 2.8% of Australia's national emissions for 2004. It should be noted that the proposed BGP will increase the Northern Territory's greenhouse emissions (based on 2004 levels) by approximately 0.0002%. Subsequently Australia's national greenhouse emissions (again based on 2004 levels) would increase by approximately 5.4×10^{-6}%.

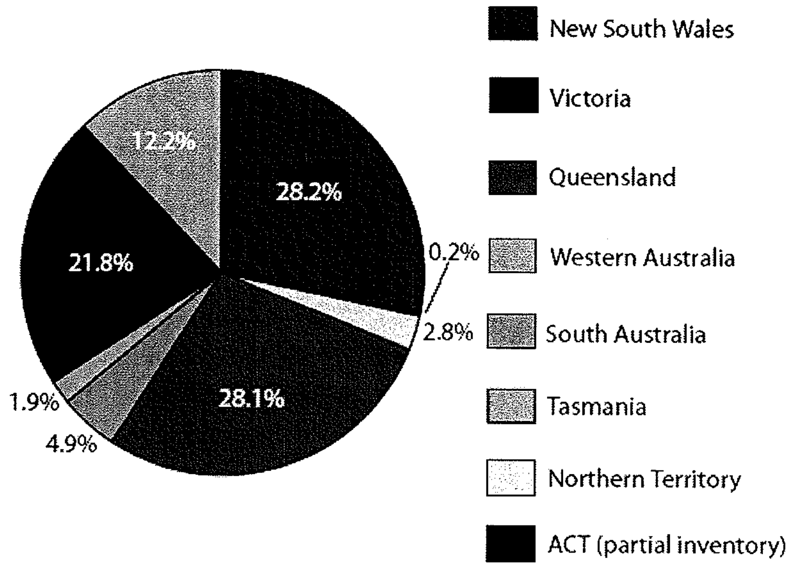

Figure 7-2: State Contributions to the National Greenhouse Emissions by Percentage

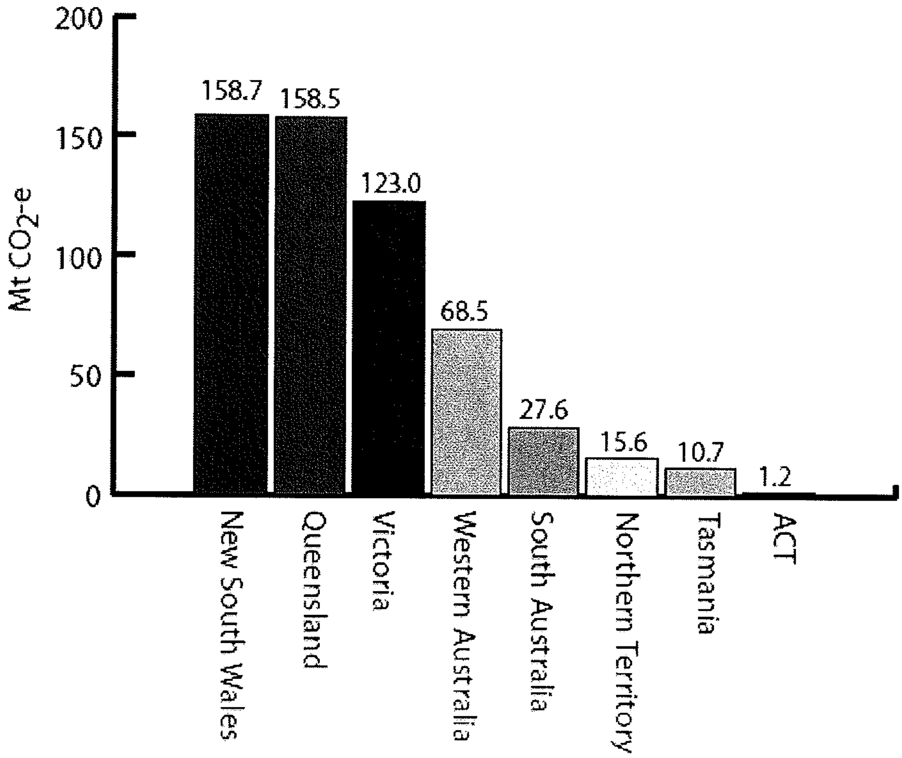

Figure 7-3: State Contributions to the National Greenhouse Emissions by Mt CO_2-e

8. EMISSIONS SUMMARY

The predicted greenhouse gas emissions for the construction, commissioning, and operations phases of the proposed BGP project (excluding emissions from vegetation clearing) have been detailed in the previous sections, and compared to greenhouse emissions from both the Northern Territory and its associated sources as well as National emissions.

The emissions from the BGP are, on a Northern Territory and National approach, very low. Construction emissions represent the largest source of greenhouse gas emissions, with the dominant source diesel fuelled mobile equipment. Emissions from the operations stage have been minimised through the use of solar / battery systems to provide power at the service sites, only relying on diesel generators for backup and external lighting where required.

Additionally the construction of the gas pipeline allows for further utilisation of natural gas as a fuel source, replacing other sources (such as fuel oil at the Gove refinery) which have a higher carbon dioxide equivalent emissions footprint. The greenhouse benefits of this have not been captured in the estimations provided herein.

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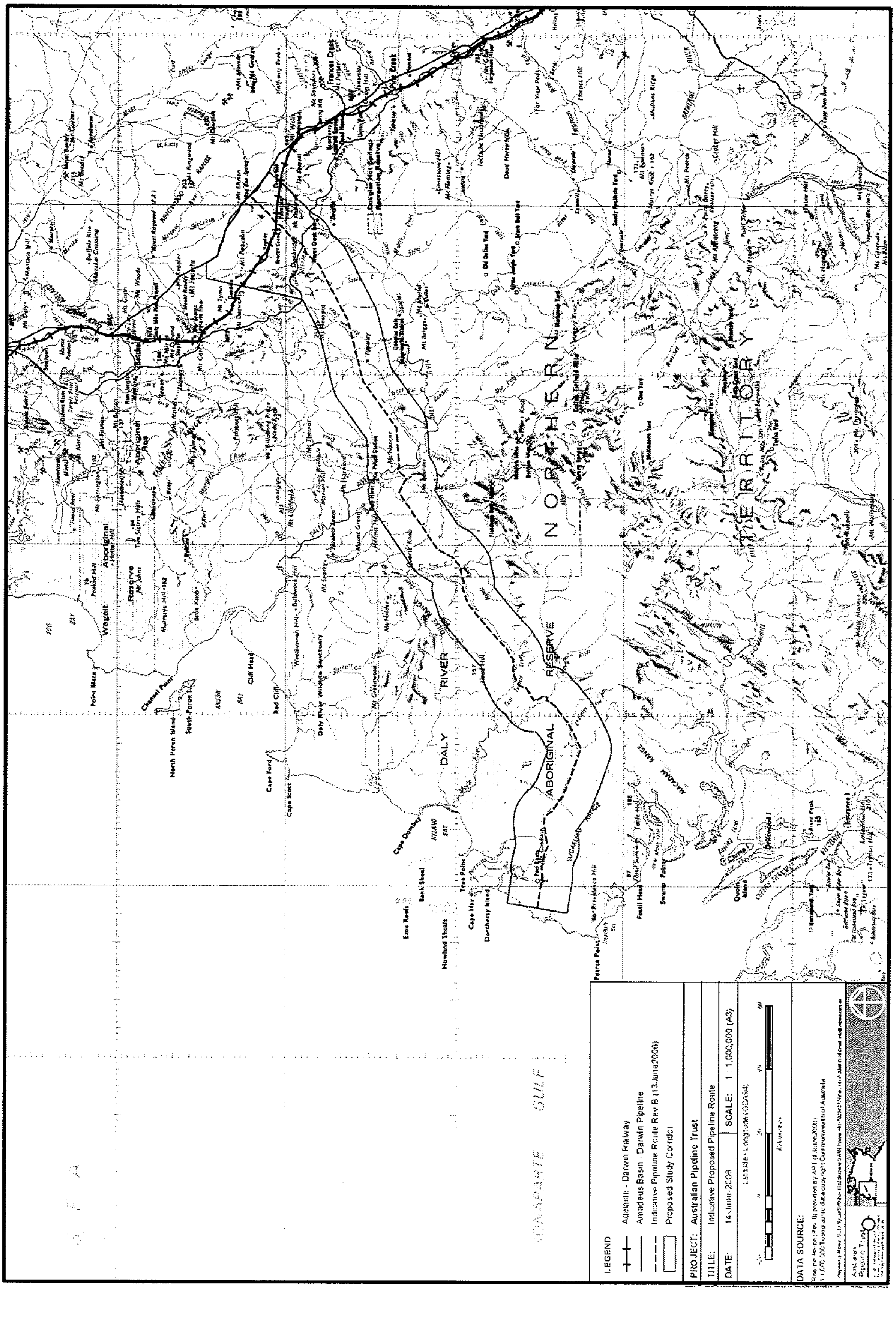
WP 2007. *Bonaparte Gas Pipeline Design Basis.* Rev D. BGP/01/PM/BD/001. WorleyParsons. Brisbane, Australia. February 2007.

Appendix A – Proposed Route of Bonaparte Gas Pipeline


NORTHERN TERRITORY
DALY RIVER
ABORIGINAL RESERVE
BONAPARTE GULF
LEGEND
Adelaide - Darwin Railway
Amadeus Basin - Darwin Pipeline
Indicative Pipeline Route Rev B (13June2006)
Proposed Study Corridor
PROJECT: Australian Pipeline Trust
TITLE: Indicative Proposed Pipeline Route
DATE: 14-June-2006
SCALE: 1:1,000,000 (A3)
DATA SOURCE:

Appendix B – Typical Gas Composition (from Basis of Design Rev D)

Equation of state is from file bwrs.eqs version 2.8000 with title

Starling BWRS with CalVal ISO6976; AGA gas numbers wjt02May27

GAS COMPOSITION # 1 IS

SUBSTANCE	% MASS	% MOLE	INPUT DATA	CALORIFIC VALUE MJ/KG
METHANE	87.01279	92.79153	5315.200	55.54500
ETHANE	2.52111	1.43440	82.16400	51.93000
PROPANE	0.80135	0.31091	17.80900	50.35000
I-BUTANE	0.11695	0.03442	1.971850	49.37000
N-BUTANE	0.22190	0.06531	3.741290	49.53000
I-PENTANE	0.06503	0.01542	0.8832560	48.93000
N-PENTANE	0.04502	0.01068	0.6114850	49.03000
N-HEXANE	0.05602	0.01112	0.6371000	48.70000
N-HEPTANE	0.06503	0.01110	0.6359750	48.45000
N-OCTANE	0.06870	0.01029	0.5893500	48.27000
NITROGEN	8.09429	4.94261	283.1180	0.00000
CARBON DIOXIDE	0.93181	0.36221	20.74780	0.00000

EFFECTIVE MOLECULAR WEIGHT 1.7107390E-02 KG/MOLE
MASS FLOW OF 1 SM3/HR AT THESE CONDITIONS= 2.0140412E-04 KG/S
CALORIFIC VALUE 5.0357435E+01 MJ/KG 3.6511902E+01 MJ/SM3
STANDARD GRAVITY 5.9052087E-01
WOBBE INDEX 6.5530876E+07 J/KG 4.7513479E+01 MJ/SM3