Appendix J Greenhouse Gasses Assessment



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Final Report

Greenhouse Gas Assessment - Expansion Works at the East Arm Wharf

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Department of Lands and Planning

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Abbreviations

Abbreviation	Description
AGEIS	Australian Greenhouse Emission Information System
AGO	Australian Greenhouse Office
CEMP	Construction Environmental Management Plan
DCCEE	Department of Climate Change and Energy Efficiency
EAW	East Arm Wharf
ECNT	Environment Centre of the Northern Territory
EIS	Environmental Impact Statement
GHG	Greenhouse Gas
NCAS	National Carbon Accounting System
NGA	National Greenhouse Accounts
NT	Northern Territory
NT DLP	Northern Territory Department of Lands and Planning
WBCSD	World Business Council for Sustainable Development
WRI	World Resources Institute



Introduction

1.1 General

URS Australia Pty Ltd (URS) was engaged by the Northern Territory Department of Lands and Planning (DLP) to prepare a Greenhouse Gas (GHG) assessment for inclusion in the Environmental Impact Statement (EIS) being prepared to assess the expansion of the East Arm Wharf (EAW) facility.

The Northern Territory Government (NTG) proposes expanding existing facilities at the East Arm Wharf (EAW) to address increased demands on the wharf to service the oil and gas industry, bulk minerals export, as well as requirements of the Department of Defence (Defence) and other industries (SKM, 2009; AECOM, 2009).

The proposed EAW Expansion (the Project) includes:

- Developing a Marine Supply Base (MSB) adjacent to EAW, primarily to service the existing and developing oil and gas industries in the Timor Sea, Browse Basin and adjacent areas.
- Constructing a barge ramp and hardstand, including berthing for barges and equipment loading and unloading.
- Establishing a rail loop enabling rakes of rail wagons carrying bulk material to be manoeuvred through the port, unloading material through a proposed rail dump facility to the adjacent stockpile areas.
- Extending the EAW quay line, and construction of moorings to accommodate tugs and other smaller vessels.

The greenhouse gas assessment has only quantified Scope 1 emissions from construction phase emissions as activity data associated with Scope 2 and Scope 3 emissions (from construction) hasn't been provided or is unknown. Furthermore activity data for the operational phase currently hasn't been determined hence, only a summary of emissions (rather than a quantitative inventory) has been presented for the operational phase.

Operational areas not included in the GHG assessment are:

- · Emissions from individual proponents occupying areas within the EAW; and
- Emissions from marine vessels as these are directly attributable to the relevant export / import companies.

1.2 Scope of the Greenhouse Gas Assessment

The scope of the assessment incorporates the following items:

- Compilation of a greenhouse gas inventory associated with construction activities, namely:
 - Scope 1 Direct Emissions, including emissions from land clearing and fuel consumption of construction equipment and vehicles;
- Summary of Scope 2, indirect emissions from electricity use and Scope 3, indirect emissions associated with construction activities. However, scope 2 and 3 emissions cannot be confirmed, as quantities of materials and electricity to be used has not been quantified at this stage;
- Summary of Scope 1, 2, and 3 emissions from operational activities as a result of the provision of additional infrastructure. Exact quantities of operational emissions cannot be quantified at this stage.
- Identification of measures to minimise greenhouse gas emissions, and their effects on estimated greenhouse gas inventories;



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• Identification of potential offsets, and their effects on estimated greenhouse gas inventories.

When compiling greenhouse gas inventories it is necessary to clearly define the boundary of the assessment, to ensure that emissions directly associated with the projects and/or proponent are accurately captured.

The boundary of the construction phase of the assessment has been defined as those areas that are to be constructed as summarised within the EIS. Construction projects to be conducted within subdivided land not assessed under the EIS will require assessment under a separate approval.

The boundary of the operation phase of the assessment has been defined as those key areas where operational works involved in maintenance and general wharf upkeep are required (i.e. areas directly attributable to the Port Authority).

Assessment Methodology

2.1 Overview

Greenhouse gases are naturally occurring gases in the earth's atmosphere that absorb and radiate infrared radiation (heat) reflected from the earth's surface. The most abundant of these gases are carbon dioxide (CO_2) and water (H_2O). Other naturally occurring greenhouse gases such as methane (CH_4) and nitrous oxide (N_2O) are present in much smaller amounts in the atmosphere.

The less abundant greenhouse gases (e.g. CH₄ and N₂O) are much more efficient in trapping infrared radiation than CO₂. The measure of how "efficient" a greenhouse gas is in trapping infrared radiation is called the Global Warming Potential, defined as the ratio of infrared radiation trapped by one kilogram of non-CO₂ greenhouse gas compared to one kilogram of CO₂, over a defined time frame. For example, over a 100 year time-frame, methane traps approximately 21 times as much infrared radiation from the earth as CO₂ and nitrous oxide traps approximately 310 times as much infrared radiation as CO₂.¹ When compiling greenhouse gas inventories, this difference in Global Warming Potential is accounted for by converting one tonne of non-CO₂ greenhouse gas into a CO₂ equivalent (CO_{2-e}) amount using the Global Warming Potential for that particular non-CO₂ gas.

Greenhouse gas emissions have been estimated based upon the methodologies outlined in the following documents:

- The World Resources Institute/World Business Council for Sustainable Development (WRI/WBCSD) Greenhouse Gas Protocol (WRI/WBCSD, 2005);
- National Greenhouse and Energy Reporting (Measurement) Determination 2010; and
- The Australian Government National Greenhouse Accounts (NGA) Factors 2010 (DCCEE, 2010a).

2.1.1 The Greenhouse Gas Protocol

The Greenhouse Gas Protocol establishes an international standard for accounting and reporting of greenhouse gas emissions by entities. It defines three "Scopes" of emissions (Scope 1, Scope 2 and Scope 3) for greenhouse gas accounting and reporting purposes. This terminology has been adopted in Australian greenhouse reporting and measurement methodologies and has been employed in this assessment.

Scope 1: Direct greenhouse gas emissions

Direct greenhouse gas emissions are defined as those emissions that occur from sources that are owned or controlled by the entity. Direct greenhouse gas emissions principally result from the following types of activities.

- Generation of electricity, heat or steam i.e. combustion of fuels in stationary sources.
- Physical or chemical processing i.e. manufacture of cement, aluminium, etc.
- Transportation of materials, products, waste and employees i.e. combustion of fuels in mobile combustion sources, e.g. motor vehicles, trains, ships, aeroplanes.
- Fugitive emissions i.e. intentional or unintentional releases from equipment.

¹ Department of Climate Change and Energy Efficiency National Greenhouse Accounts (NGA) Factors, July 2010.



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Scope 2: Energy product use indirect greenhouse gas emissions

Scope 2 emissions are indirect emissions from the use of energy products (e.g. electricity, steam/heat) purchased or otherwise brought into the Project boundary. Scope 2 emissions physically occur at the facility where electricity is generated.

Scope 3: Other indirect greenhouse gas emissions

Scope 3 emissions are defined as those emissions that are a consequence of the Project activities but do not occur from sources owned or controlled by the project initiator.

Some examples of Scope 3 activities provided in the Greenhouse Gas Protocol are:

- Extraction, processing and transport of materials or fuels; or
- Use of sold products and services.

Scope 3 emissions associated with the construction phase of the Project are reportable as Scope 1 emissions from facilities that manufacture or transport the products.

It is usual that for compliance purposes the focus is on direct (Scope 1) emissions from the Project and/or indirect (Scope 2 emissions from energy consumption) rather than Scope 3 emissions. This assessment has therefore predominantly focused on Scope 1 and 2 emissions.

2.1.2 National Greenhouse and Energy Reporting (Measurement) Determination 2008

The National Greenhouse and Energy Reporting Determination 2008 commenced on 1 July 2008 and is made under subsection 10 (3) of the *National Greenhouse and Energy Reporting Act 2007*. It provides for the measurement of the following arising from the operation of facilities:

- Greenhouse gas emissions; and
- The production / consumption of energy.

The determination deals with Scope 1 and Scope 2 emissions. In the determination there are four categories of Scope 1 emissions (in brackets the code for the IPCC classification):

- Fuel combustion (UNFCCC Category 1.A);
- Fugitive emissions from fuels, which deals with emissions released from the extraction, production, flaring of fuel, processing and distribution of fossil fuels (UNFCCC Category 1.B);
- Industrial processes emissions (UNFCCC Category 2); and
- Waste emissions (UNFCCC Category 6).

2.1.3 National Greenhouse Accounts Factors

The NGA Factors (DCCEE, 2010a) provides emission factors which have a general application to a broad range of greenhouse emission inventories.

The default emission factors listed are estimated by the DCCEE using the Australian Greenhouse Emissions Information System (AGEIS) and determined simultaneously with the production of Australia's National Greenhouse Accounts. It includes emission factors for Scope 3 emissions for fuel production and electricity consumption based on Australia's National Greenhouse Accounts.

The National Greenhouse Accounts replaces the Australian Greenhouse Office (AGO) Factors and Methods Workbook.

3.1 Overview

The GHG inventory comprises of Scope 1, Scope 2 and Scope 3 emissions for the construction and operational phase of the project and is summarised in the following sections. **Table 3-1** presents a summary of identified emissions sources.

The inventory has been prepared on information supplied at the time by the Project proponent, and necessary assumptions.

Scope	Construction	Operation
Scope 1	Combustion of diesel fuel for	Combustion of fuel for site vehicles.
	construction vehicles;	Combustion of fuel for additional
	Combustion of diesel fuel for trucks delivering construction materials;	dredging through the life of the wharf.
	Land clearing;	
	 Blasting¹ 	
Scope 2	Electricity use ²	Electricity use
Scope 3	Fuel and electricity use	Fuel and electricity use
	 Embodied emissions from concrete use (upstream emissions) 	 Upstream emissions from any material utilised by the Port Authority.
	Embodied emissions from steel use (upstream emissions)	Emissions from generated waste
	Emissions from generated waste	

 Table 3-1
 Summary of Greenhouse Gas Sources - Construction and Operation

Notes: ¹ Blasting maybe associated with dredging, however no details are available at this stage. ² Electricity use during construction is expected to be immaterial.

3.2 Construction Phase

Greenhouse gas emissions associated with the construction phase of the project are predominantly associated with land clearing (loss of vegetation) and the combustion of diesel fuel in construction vehicles. Activity data for Scope 2 and Scope 3 emissions isn't presently available and is expected to be immaterial in comparison to land clearing and fuel use emissions. The construction inventory therefore focuses on Scope 1 emissions.

3.2.1 Land clearing and loss of vegetation

Trees and other vegetation metabolise carbon and store a portion of it as permanent, woody biomass as they grow. When this vegetation is cleared the stored carbon is typically lost to the atmosphere as carbon dioxide (CO_2) along with small amounts of carbon monoxide (CO) and methane (CH_4).

AECOM (2010) indicate that a substantial quantity of mangrove communities would require to be cleared as part of the construction phase. Approximately 15 ha and 205 ha of mangrove forest area to be cleared at the mouth of Hudson Creek and along the southern arm of Bleesers Creek, respectively (AECOM 2010). The land clearing area consists of three mangrove communities:



- Sonneratia alba woodland in the seaward zone;
- Rhiophora stylosa / Campostemon schutzii closed forest (Tidal creek), at the seaward fringe; and
- Ceriops tagal low closed forest (mid tidal flat), at the landward fringe

The National Carbon Accounting System (NCAS) FullCam Modelling Tool, provided by the Department of Climate Change (DCC) was utilised in determining emissions from vegetation losses. The FullCAM software integrates a range of models that simulate carbon cycles on a fine spatial scale to track the greenhouse gas emissions and carbon stock changes (i.e. biomass, litter and soil) associated with land use and management. The modelling methodology adopted was based on methods and guidance presented in ECNT 2009. The model inputs included:

- A single multilayer mixed (forest and agriculture) system plot was utilised, with no accounting of soil and minerals;
- The model supplied data builder was used to provide all necessary inputs into the model. This
 incorporated the use of a single vegetation species (mangroves) for a nominated location within the
 NT;
- Initial plot conditions assumed 100 % forest (i.e. 100% mangroves); and
- Simulation period from 1950 2050, with a single clearing event (clearing 100% of the plot) at the start of 2014. The use of a clearing event is arbitrary as the maximum carbon content of the modelled plot was utilised in determining the carbon mass lost;
- The total carbon mass lost was determined by converting the total mass of carbon within the plot (from the modelled simulation) to a total loss of carbon dioxide equivalent, by assuming all carbon loss was in the form of CO₂.

The results of the model simulation are presented in Table 3-2.

Table 3-2 FullCAM Plot Simulation Output

Maximum Carbon from Simulation	Emission Factor	
(tonnes of Carbon/ha)	(tonnes CO _{2-e} / ha)	
56.27	206.34	

Notes: CO_{2-e} determined by multiplying carbon mass lost by 3.667 (ratio of molecular weight of CO₂ to carbon)

The model simulation outputs are comparable to those emissions presented for other vegetation types. ECNT 2009 presented modelled average greenhouse gas emissions for various vegetation types as follows:

- Open forest (222 tonnes CO_{2-e} / ha);
- Woodland (169 tonnes CO_{2-e} / ha); and
- Open woodland (140 tonnes CO_{2-e} / ha)

The resulting net greenhouse gas emissions from the proposed land clearing are determined from the model simulation. **Table 3-3** outlines the results.

Table 3-3 Scope 1 Emissions - Land Clearing

Area	Area (ha)	Emission Factor (tonnes CO _{2-e} /ha)	Land Clearing Emissions (tonnes CO _{2-e} /ha)
Hudson Creek	15	206.34	3095.1
Bleesers Creek	205	206.34	42,299.7
	45,394.8		

3.2.2 Combustion of Fuel in Construction Vehicles

Combustion of fuel in equipment used during construction activities are considered as Scope 1 emissions. Combustion of fuel in vehicles used to deliver concrete, or other sourced material (i.e. fill) is also considered as a Scope 1 emission, for the purposes of this assessment. Equipment expected to be used during construction includes:

- Small to medium sized Cutter Suction Dredge;
- Bulldozers;
- Rollers;
- Piledrivers;
- Cranes;
- Barge;
- Concrete delivery trucks; and
- Road trains delivering fill and rock.

Expected fuel use during the construction phase has been estimated based on fuel consumption of the above mentioned items and expected construction timeframes. A construction timeframe of 72 months has been adopted, assuming that all construction activities and areas operate serially rather than concurrently. **Table 3-4** summarises the fuel consumptions rates assumed and the subsequent fuel usage estimated for the construction activities.

Table 3-4 Estimations of Fuel Consumption Rates for Construction Activities

Equipment	Fuel Consumption	Activity Data	Fuel Use (kL)
Medium Cutter Suction Dredge	72.5 L/hr ¹	21,600 hours	1,566
Bulldozers	60 L/hr ²	21,600 hours	1,296
Rollers	20 L/hr	21,600 hours	432
Piledrivers	20 L/hr	21,600 hours	432
Cranes	20 L/hr	21,600 hours	432
Barge	120 L/hr ³	21,600 hours	2,592
Concrete Delivery Trucks	0.446 L/km ⁴	1,728,000 km	771
Material Delivery Trucks	0.446 L/km ⁴	1,728,000 km	771
		Total	8,291



Notes: Activity data expressed in hours is based on 30 days per month, 10 hours per day of operation;

Activity data expressed in kilometres is based on 8 deliveries per day, 100 km per delivery, and 30 days per month Fuel consumption rate of 20 L/hr assumed for all equipment, except those outlined below.

¹ Referenced from T. Dinh 1999, fuel usage for 500 – 1000 HP Dredge

² Assumes two bulldozers with fuel consumption rate of 30 L/hr ³ Deformed from T. Dirk 4000, fuel upper for 4500 + UD Dept

³ Referenced from T. Dinh 1999, fuel usage for 1500 + HP Boat

⁴ Referenced from CSIRO 2000

Greenhouse gas emissions from the estimated fuel consumption have been determined from appropriate emission factors and is summarised in **Table 3-5.** A total of 22,371 t CO_{2-e} is determined from the combustion of fuel during construction.

Table 3-5 Greenhouse Gas Emissions from Fuel Combustion - During Construction

Emission Factor (kg CO _{2-e} / kL)			E	missions (t CO ₂ .	e)
CO ₂	CH₄	N ₂ O	CO ₂	CH₄	N 2O
2671.12	7.72	19.3	22,147	64	160

Notes: Emission factors for diesel oil adopted.

3.2.3 Summary of Construction Phase Inventory

A summary of the construction phase inventory is provided in **Table 3-6** below.

Table 3-6 Summary of Construction Phases Greenhouse Gas Emissions

Activity or Source	Emissions (t CO2-e)	
Scope 1		
Combustion of fuel in construction equipment (including transport vehicles)	22,371	
Land Clearing / loss of vegetation	45,395	
Total	67,766	

The total greenhouse gas emissions associated with the construction phase represents less than 1 % of the NT Inventory for 2008 (DCCEE 2010b).

3.3 **Operational Phase**

The operational phase of the project would involve greenhouse gas emissions from the sources outlined in **Section 3.1** from the port authority infrastructure provision. Specific emissions associated with the industrial developments at the wharf are expected to incorporate the following:

- Electricity use and or supply (i.e. equipment, lighting etc);
- Maintenance and equipment supply (i.e. upstream emissions from chemicals and/or drilling muds);
- Waste generation;
- Fuel use (i.e. site vehicles or equipment, vessels associated with each industry); and
- Maintenance.

Activity data for the operational phase has not been supplied, hence no further quantification of operational greenhouse emissions has been compiled.

Discussion

4.1 Measures to Minimise GHG Emissions

Opportunities for minimising greenhouse gas emissions for the construction phase of the project are summarised below. The options incorporate the philosophy of Reduce, Reuse, and Recycle.

Reduce:

- · Reduce the quantity of imported material required;
- Reduce fuel use through equipment fitted with efficient engines;
- Reduce fuel use by utilising imported material from local and not regional areas (i.e. reduce haul distances)
- · Reduce fuel use by minimising idling time of construction equipment;
- Reduce fuel use by using appropriately sized equipment for construction activities;
- Reduce fuel use by minimising vehicle kilometres travelled during constructions;
- Reduce fuel use by incorporating scheduled equipment maintenance procedures;
- Reduce fuel use through efficient planning. Construction activities could potentially be planned to reduce fuel use through transportation of equipment from one area to another. (i.e. conducting all dredging in one area prior to starting another).
- Reduce the amount of cleared land to the extent practicable.

Reuse:

- Reuse of dredge spoil wherever feasible;
- Reuse of second hand products or materials where practical and reasonable;

Recycle:

• Recycling of waste generated where reasonable.

The Construction Environmental Management Plan (CEMP) would incorporate areas where greenhouse gas emissions would be reduced. The use of biodiesel (or other renewable fuel) could potentially reduce the GHG emissions associated with the construction phase, however no commitments to the use of biodiesel has been made at this stage. The recent biodiesel plant at the east arm could present the project an opportunity for the supply of fuel for the project; however it is understood that this facility is no longer in operation or no longer accessible.

Consideration should be given to the purchase of Green power and offsetting greenhouse gas emissions from National Carbon Offset Standard (NCOS) compliant offsets, through the operational phase of the EAW. Furthermore an Operational Environmental Management Plan (OEMP) will be prepared (or an update to existing OEMP), by the Port Authority, that will include requirements for greenhouse gas reductions, including energy efficiency initiatives. In addition the prospect of carbon sequestration through vegetation planting at the site will be fully investigated. The OMP will include consideration to the purchase of Green Power and offsetting greenhouse gas emissions from National Carbon Offset Standard (NCOS) compliant offsets.



URS was engaged by the Northern Territory DLP to prepare a GHG assessment for inclusion in the EIS being prepared to assess the expansion of the EAW facility. The assessment involved the summary of anticipated GHG emissions for the construction and operational phases of the project, in conjunction with the identification of any opportunities for reducing or offsetting any GHG emissions.

The assessment concluded that 67,766 t of CO_{2-e} (Scope 1 emissions) would be associated with the construction phase of the project from combustion of diesel fuel in construction equipment, and loss of vegetation during land clearing. Emission reduction options would be provided within the CEMP for the construction phase and would involve Reduce, Re-use and Recycle initiatives.

GHG emissions from the operational phase of the expansion (i.e. from the port authority) is likely to comprise of emissions from fuel combustion in site vehicles, fuel combustion for additional dredging and maintenance activities through the life of the wharf, generated waste, electricity use (i.e. from lighting), and upstream emissions from any materials utilised by the Port Authority. Due to a lack of information on the details of the above, operational greenhouse gas emissions have not been quantified at this stage.



References

AECOM 2010 - Notice of Intent for the Proposed Expansion Works at East Arm, June 2009

- AECOM 2010 East Arm Wharf Expansion, Concept Dredging and Reclamation Strategy, March 2010
- CSIRO 2000 Life-cycle Emissions Analysis of Alternative Fuels for Heavy Vehicles, Stage 1, CSIRO Atmospheric Research Report C/0411/1.1/F2 to the Australian Greenhouse Office, March 2000
- DCCEE 2010a Department of Climate Change and Energy Efficiency National Greenhouse Accounts (NGA) Factors, July 2010
- DCCEE 2010b Department of Climate Change and Energy Efficiency Australian National Greenhouse Accounts, State and Territory Greenhouse Gas Inventories 2008, May 2010
- ENCT 2009 Estimated Greenhouse Gas Emissions from Land Clearing in the Daly River Catchment Northern Territory, Australia, Environment Centre of the Northern Territory, May 2009
- T. Dinh 1999 Source Inventory Tugs & Towboats, Dredge Vessels and Others, 1999



Limitations

URS Australia Pty Ltd (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Northern Territory Department of Lands and Planning and only those third parties who have been authorised in writing by URS to rely on the report. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the Proposal dated 4 August 2010.

The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

This report was prepared between August and December 2010 and is based on the conditions encountered and information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

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