Port Expansion Project EIS

Part B

Section B11 – Greenhouse Gas Emissions

AECOM BMT WBM

B.11 Greenhouse Gas Emissions

B.11.1 Relevance of the Project to Greenhouse Gases

A strengthening scientific position, heightened public interest and expectations, and an increasing focus on national and international policy mean that managing greenhouse gas emissions at the corporate and national level is becoming standard practice. The business environment now includes a price cost on greenhouse gas emissions as a direct result of government action, and companies see adapting to climate change as a risk-adverse and cost-effective position long term.

This chapter provides an assessment of the greenhouse gas emissions associated with the construction and operational phases of the PEP.

B.11.2 Assessment Framework and Statutory Policies

B.11.2.1 Defining Scopes – Sources and Responsibilities for Greenhouse Gases

In corporate carbon management and accounting, greenhouse gas emissions are separated into scopes, which are determined by the organisation’s activities. There are three types of emission scopes – Scope 1, 2 and 3.

Scope 1 emissions refer to direct emissions where the point of emission release is owned by the organisation in question, such as company owned equipment. Scope 2 emissions refer to indirect emissions that are from the purchase of electricity, heat or steam consumed by the organisation. Scope 3 emissions refer to all other indirect greenhouse gas emissions that are not Scope 2 emissions. These occur outside the boundary of the organisation’s operations, but are a result of activities of the organisation, such as embodied energy emissions from construction materials, air travel and waste production.

The purpose of differentiating between scopes of emissions is to avoid the potential for double counting. Double counting occurs when two or more organisations assume responsibility for the same emissions in the same scope.

Reporting under the *National Greenhouse and Energy Reporting Act 2007*(NGER Act) requires that organisations report Scope 1 and Scope 2 emissions but not Scope 3 emissions. Scope 3 emissions can be reported voluntarily. The NGER Act states that the following gases must be reported: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFC), perfluorocarbons (PFC) and sulphur hexafluoride (SF_6).

The calculations in this assessment use equivalent carbon dioxide (CO_2-e) as it is the universally accepted measure for calculating the global warming potential of different greenhouse gases to derive a single greenhouse gas emissions unit. Carbon dioxide is used as the reference gas with a global warming potential of one. The global warming potential of a greenhouse gas is the radiative forcing impact contributing to global warming relative to one unit of CO_2. The standard unit of measurement of CO_2-e typically used is tonnes (t).

B.11.2.2 Calculation Approach

This section provides information on the methods used to make the projected annual greenhouse gas emissions estimates.

The greenhouse gas assessment aligns with accounting standards set out by the NGER Act, which are:

- *National Greenhouse and Energy Reporting (Measurement) Determination 2008*
- *National Greenhouse and Energy Reporting (Measurement) Technical Guidelines July 2011.*

The *National Greenhouse and Energy Reporting (Measurement) Determination 2008* outlines the calculation process to determine the quantity of greenhouse gas emissions emitted.

Emissions have been calculated by multiplying activity data with the appropriate emission factor in order to provide the results in tonnes of CO_2-e. The detailed calculation approach and emission factors used are outlined in **Error! Reference source not found.**.

B.11.2.3 Carbon Pricing Mechanism

From 1 July 2012, Australia will join Europe, New Zealand, and other parts of the world in putting a price on greenhouse gas emissions. Under the carbon pricing mechanism businesses that generate at least 25,000 t of CO_2-e a year will be required to buy and surrender to the government a permit for every tonne of pollution they produce. Most of these businesses directly emit greenhouse gases, and include power stations, mines, water utilities and heavy industry. Some will be public authorities responsible for emissions from landfills. The carbon price will not apply to emissions from agriculture or to emissions from fuel used for farm equipment, light commercial or private vehicles.

The carbon price is initially fixed at $23/t for 2012/13, rising annually by 2.5% in real terms. From 1 July 2015, an emissions trading scheme will commence whereby the government sets the emissions level cap for Australia and the market determines the price of permits. From 2015 to 2018, there will be a price collar, with minimum and maximum prices. The scheme aims to change company behaviour by encouraging private investment in more efficient practices and technologies, as well as renewable energy. Companies can buy carbon credits generated by eligible projects under the Carbon Farming Initiative to offset their emissions. From 2015 they will be able to obtain up to 50% of their credits from the international market, and from 2021, 100% of credits. Although unlikely to be affected directly by the carbon pricing mechanism, Port of Townsville Limited (POTL) will be exposed to a range of indirect costs associated with the carbon price, including increased costs of energy and other carbon intensive products and services in the supply chain as suppliers pass on their own carbon price liability.

B.11.2.4 National Greenhouse and Energy Reporting Act 2007

The NGER Act established a national system for reporting greenhouse gas emissions, energy consumption and energy production by corporations from 1 July, 2008. The NGER Act requires eligible corporations to publically report their greenhouse emissions, energy consumption and energy production each financial year.

The 2011/12 reporting year has a corporation threshold for reporting of 50,000 t of CO_2-e emitted and 200 terajoules of energy consumed or produced (Figure B.11.1). The 2011/12 reporting year has a facility threshold of 25,000 t of CO_2-e emitted and 100 terajoules of energy consumed or produced. These will be the thresholds for subsequent years.

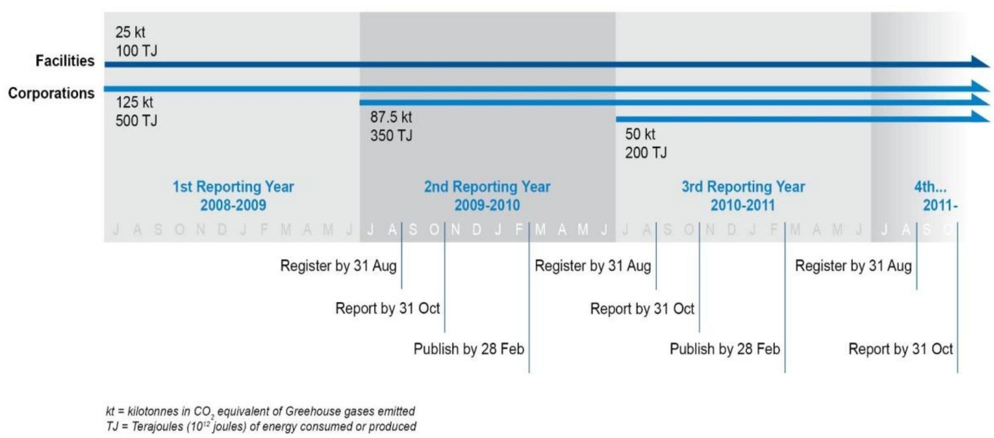

Figure B.11.1 NGER Act Reporting Timeline

Port of Townsville does not trigger the NGER Act and is not required to publically report its annual greenhouse gas emission and energy use. This situation is unlikely to change for subsequent reporting years.

B.11.3 Existing Values, Uses and Characteristics

The existing sources of greenhouse gas emissions for the Port of Townsville are from office facilities (such as refrigerants from air conditioning units, stationary energy fuel use from emergency generators and electricity use), fleet and machinery. The quantity of these emissions does not trigger the NGER Act, and are considered minimal in the context of corporations in Australia.

B.11.4 Assessment of Potential Impacts

B.11.4.1 Background

The main sources of greenhouse gas emissions for the construction phase of the Project include:

- fuel use from the transport of construction materials from the quarry to site
- fuel use from onsite machinery
- fuel use from the capital dredging operations
- stationary energy use from onsite electricity generators (for safety lighting)
- embodied emissions of the construction materials

The main sources of greenhouse gas emissions for the operational phase of the Project include:

- fuel use from fleet, trucks and plant
- fuel use from maintenance dredging
- fuel use from wharf infrastructure, such as cranes
- SF6 use from high voltage switch gear
- refrigerants from office air conditioning units
- stationary energy from office emergency generators
- electricity use from offices and berth lighting
- fuel use from staff use of taxis/buses, air travel and car hire.

Greenhouse gas emissions from tenant and shipping operations have not been included in this assessment as POTL has no control over these emissions.

B.11.4.2 Projected Greenhouse Gas Emissions from Construction

B.11.4.2.1 Transportation of Construction Materials to Site

The construction materials transported by trucks from the quarry to the Project Area include the breakwater and revetment core material and armour, rock fill, and rock armour. Table B.11.1 summarises the assumptions that were taken into account when calculating the approximate greenhouse gas emissions from the transport of construction materials to site. Further detail on the calculation process and detailed assumptions is available in **Error! Reference source not found.**. Transportation of construction materials is considered a Scope 1 emission source.

Table B.11.1 Assumptions for Calculating Emissions from the Transport of Construction Materials

Construction Stage	Total Hours	Fuel consumption per truck (L/hr)	Total fuel consumption (kL)
Stage A	647,400	25	16,185
Stage B	1,620		40.5
Stage C	1,620		40.5
Stage D	4,860		121.5

The greenhouse gas emissions produced from the transport of construction materials to site are shown in Table B.11.2.

Table B.11.2 Greenhouse Gas Emissions from Transport of Construction Materials

Stage	t/CO_2-e
A	39,296.2
B	98.3
C	98.3
D	295
Total	39,787.9

B.11.4.2.2 Onsite Machinery

The onsite machinery expected to be used during construction includes excavators, bulldozers, cranes, utility vehicles, transport barges, work boats, survey boats, tugs for barges, off-road dump trucks, on-road dump trucks, stone column or wick drain rig, delivery trucks, bobcats, graders, paving machines, track machines, barge-mounted pile drivers and concrete trucks. Onsite machinery is considered a Scope 1 emission source.

Table B.11.3 summarises the assumptions that were taken into account when calculating the approximate greenhouse gas emissions from the onsite machinery for each construction stage of the PEP. Further detail on the calculation process and detailed assumptions are available in **Error! Reference source not found.**. The machinery associated with the transport of construction materials to site and capital dredging were excluded from this greenhouse gas calculation, and will be calculated elsewhere.

Table B.11.3 Assumptions for Calculating Emissions from Onsite Machinery for Stage A

Onsite Machinery	Stage A			Stage B			Stage C			Stage D		
	Total Hours	Fuel Consumption		Total Hours	Fuel Consumption		Total Hours	Fuel Consumption		Total Hours	Fuel Consumption	
		Machine (L/hr)	Total (kL)		Machine (L/hr)	Total (kL)		Machine (L/hr)	Total (kL)		Machine (L/hr)	Total (kL)
Barge mounted pile driver	2,160	15	32.4	1,350	15	20.3	1,350	15	20.3	2160	15	32.4
Bobcat	2,580	8	20.6	1,720	8	13.8	1,720	8	13.8	2580	8	20.6
Bulldozer	37,900	80	3,032.0	7,806	80	624.5	14,610	80	1,168.8	750	80	60.0
Concrete truck	8,260	25	206.5	5,900	25	147.5	5,900	25	147.5	8260	25	206.5
Crane 1	20,385	30	611.6	1,675	30	50.3	1,515	15	22.7	870	15	13.1
Crane 2	1,703	15	25.5	1,056	15	15.8	1,675	30	50.3	2345	30	70.4
Delivery truck	840	0.4	12.6	840	0.4	12.6	560	15	8.4	840	15	12.6
Excavator	36,520	36	1,314.7	2,190	36	78.8	2,190	36	78.8	2910	36	104.8
Grader	1,080	15	16.2	720	15	25.9	720	36	25.9	1080	36	38.9
Off-road dump truck	16,464	40	658.6	7,056	40	282.2	9,240	40	369.6	8100	20	162.0
On-road dump truck	35,280	20	705.6	8,100	20	162.0	17,820	20	356.4			
Paving machine	216	20	4.3	162	20	3.2	162	20	3.2	162	20	3.2
Stone column or wick drain rig	1,350	20	27.0	1,350	20	27.0	1,350	20	27.0	1350	20	27.0
Survey boat	1,250	40	50.0	-	-	-						
Track machine	216	20	4.3	162	20	3.2	162	20	3.2			
Transport barge	2,500	120	300.0	275	50	13.8						
Tug for barge	440	50	22.0				1,350	15	20.3	440	50	22.0
Utility vehicle	50,880	10	508.8	21,960	10	219.6	30,000	10	300.0	25185	10	251.9
Work boat	2,260	50	45.2	350	50	7.0	350	50	17.5	560	50	28

The greenhouse gas emissions produced from the onsite machinery are shown in Table B.11.4.

Table B.11.4 Greenhouse Gas Emissions from Onsite Machinery

Stage	t/CO_2-e
Stage A	18,447.4
Stage B	4,145.7
Stage C	6,394.4
Stage D	2,557.3
Total	31,544.8

B.11.4.2.3 Capital Dredging

The dredging machinery expected to be used during construction include mechanical dredges, small tug, work boats, survey boats, hopper barges, small trailing suction hopper dredgers (TSHD), medium cutter suction dredgers (CSD) and medium TSHD. Dredging is considered a Scope 1 emission source.

Table B.11.5 summarises the assumptions that were taken into account when calculating the approximate greenhouse gas emissions from the dredging machinery. Further detail on the calculation process and detailed assumptions is available in **Error! Reference source not found.**. Dredging is not required for Stage D.

Table B.11.5 Assumptions for Calculating Emissions from Capital Dredging

Dredging Machinery	Stage A			Stage B			Stage C		
	Total Hours	Fuel Consumption		Total Hours	Fuel Consumption		Total Hours	Fuel Consumption	
		Machine (L/hr)	Total (kL)		Machine (L/hr)	Total (kL)		Machine (L/hr)	Total (kL)
Mechanical dredge	3,978.5	215	855.4	163.5	215.0	35.2	163.5	215.0	35.2
Small tug	1,715.5	50	85.8	70.5	50.0	3.5	70.5	50.0	3.5
Work boat	5,466.5	50	273.3	1,806.5	50.0	90.3	4,162.5	50.0	208.1
Survey boat 1	4,092.0	50	175.9	985.0	50.0	49.3	766.0	50.0	38.3
Survey boat 2	2,450.0	30	73.5	1,400.0	30.0	42.0	2,750.0	30.0	82.5
Hopper barges	8,541.0	250	2,135.3	234.0	250.0	58.5	234.0	250.0	58.5
Small TSHD	4,212.0	225	947.7	292.5	225.0	65.8	351.0	225.0	79.0
Medium CSD	5,341.0	1150	6,142.2	3,052.0	1,150.0	3,509.8	5,995.0	1,150.0	6,894.3
Medium TSHD	1,529.5	3750	5,735.6				1,463.0	3,750.0	5486.3
Medium CSD	3,052.0	1,150.0	3,509.8						

The greenhouse gas emissions produced from capital dredging are shown in Table B.11.6.

Table B.11.6 Greenhouse Gas Emissions from Capital Dredging

Stage	t/CO_2-e
Stage A	39,947.6
Stage B	9,358.2
Stage C	31,285.4
Total	80,591.2

B.11.4.2.4 Stationary Energy

The quantity of greenhouse gas emissions from stationary energy (for example, diesel generators) used for lighting for night works, pumps and booster pumps cannot be estimated due to lack of data. These emissions will be very minor compared to the other sources of greenhouse gas emissions during the construction phase. Stationary energy is considered a Scope 1 emission source.

B.11.4.2.5 Embodied Energy from Construction Materials

The main construction materials used in the construction phase of the Project include primary armour material, core material, filter material, geotextile, concrete and steel (reinforcement and piles). Of these, geotextile, concrete and steel have the highest embodied energy emissions.

Table B.11.7 outlines the assumptions that were taken into account when calculating the approximate greenhouse gas emissions from the embodied energy of geotextile, concrete and steel. The emissions from embodied energy of construction materials will be Scope 3 emissions.

Table B.11.7 Assumptions for Calculating Emissions from Embodied Energy from Construction Materials

Material	Stage A	Stage B	Stage C	Stage D	Density (kg/m³)
Geotextile	116,000 m² (length) 0.001 m² (width)	0	0	0	1,250
Concrete (m³)	20,400	7,000	7,700	16,500	2,400
Steel (reinforcement and piles) (t)	10,600	3,600	4,000	8,600	-

The greenhouse gas emissions produced from the embodied energy from construction materials are shown in Table B.11.8.

Table B.11.8 Greenhouse Gas Emissions from Embodied Energy from Construction Materials

Stage	t/CO_2-e
Stage A	34,164.2
Stage B	11,539.2
Stage C	12,782.3
Stage D	27,454.4
Total	85,940.1

B.11.4.2.6 Summary of Construction Emissions

Table B.11.9 summarises the greenhouse gas emissions produced for each source of emissions in the construction phase of the Project.

Table B.11.9 Summary of Greenhouse Gas Emissions for Construction

Scope	Source of Emissions	t/CO_2-e				
		Stage A	Stage B	Stage C	Stage D	Total
1	Transportation of materials	39,296.2	98.3	98.3	295	39,787.9
1	Onsite machinery	18,447.4	4,145.70	6,394.40	2,557.30	31,554.8
1	Capital dredging	39,947.6	9,358.20	31,285.40	0.00	80,591.2
3	Embodied energy emissions	34,164.2	11,539.20	12,782.30	27,454.40	85,940.1
	Total	**131,855.4**	**25,141.4**	**50,560.4**	**30,306.7**	**237,874.0**

Figure B.11.2 shows a breakdown by source of greenhouse gas emissions from the construction phase for all stages of the construction phase.

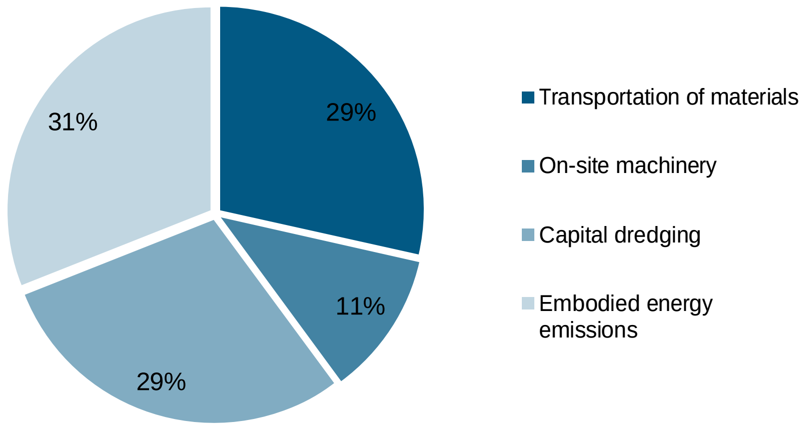

Figure B.11.2 Greenhouse Gas Emissions from the Construction Phase by Source

Table B.11.10 outlines the projected annual greenhouse gas emissions for the construction phase of the Project. Improvements in the performance on greenhouse gas abatement will reduce the amount of greenhouse gas emissions, which will reduce the projected amount of emissions.

Table B.11.10 Projected Annual Greenhouse Gas Emissions for Construction Phase

Construction Stage	Duration of Construction (months)	Total Greenhouse Gas Emissions (t/CO_2-e)	Annual Greenhouse Gas Emissions (t/CO_2-e)
Stage A	36	131,855.4	43,951.8
Stage B	18	25,141.4	16,760.9
Stage C	18	50,560.4	33,706.9
Stage D	15	30,306.7	24,245.4
Total	87	277,170.2	38,230.4

B.11.4.3 Projected Greenhouse Gas Emissions from Operations

Where possible, the projected greenhouse gas emissions for the operational phase of the Project have been estimated using a pro rata basis from POTL greenhouse gas inventory data for 2011. Information from 2011 was used as this was deemed to be the most reflective of current and future operations. There is only three years of data available, which is an inadequate length of time to determine trends over time. Greenhouse gas emissions have been estimated based on tonnes of CO_2-e/Mt of trade and tonnes of CO_2-e/ha.

POTL had 11 Mt of trade in 2010/11. The forecast growth in trade is

- 2015 - 21.9 Mt
- 2020 - 29.7 Mt
- 2025 - 33.4 Mt
- 2030 - 41.7 Mt
- 2035 - 45.8 Mt
- 2040 - 48.3 Mt.

The PEP will increase the area of the port by 100 ha, from 404.5 ha to 504.5 ha.

Projected greenhouse gas emissions based on changes in trade tonnage are shown in Table B.11.11 and changes based on size of port area are shown in Table B.11.12 for:

- fuel use from fleet, trucks and plant (Scope 1)
- sf_6 use from high voltage switch gear (Scope 1)
- electricity use from offices and berth lighting (Scope 2)
- fuel use from staff use of taxis/buses, air travel and car hire (Scope 3)

Greenhouse gas emissions from the fuel use associated with maintenance dredging are not included in POTL greenhouse gas inventory because the dredging is done by an external operator. As a result, there is no available data to calculate the projected greenhouse gas emissions from this emission source for the operational phase of the Project.

Greenhouse gas emissions from the fuel use from wharf infrastructure are not included in POTL greenhouse gas inventory. This is due to the minor contribution wharf infrastructure would make to the overall greenhouse gas inventory. As a result, there is no available data to calculate the projected greenhouse gas emissions from this emission source for the operational phase of the Project.

Greenhouse gas emissions from the refrigerants associated with air conditioning units are not included in POTL greenhouse gas inventory. This is due to the minor contribution refrigerants would make to the overall greenhouse gas inventory. As a result, there is no available data to calculate the projected greenhouse gas emissions from this emission source for the operational phase of the Project. Refrigerants would be a Scope 1 emission source.

Greenhouse gas emissions from emergency generators are not included in POTL greenhouse gas inventory. This is likely due to the minor contribution emergency generators would make to the overall greenhouse gas inventory given that they are a back-up source of power. As a result, there is no available data to calculate the projected greenhouse gas emissions from this emission source for the operational phase of the Project. Stationary energy would be a scope 1 emission source.

B.11.4.4 Summary of Operational Emissions

Table B.11.11 summarises the greenhouse gas emissions produced for each source of emissions with available data in the operational phase of the Project using a pro rata basis and based on changes to trade tonnage.

Table B.11.11 Operational Greenhouse Gas Emissions based on Changes to Trade Tonnage

Year	t/CO_2-e								
	Fleet	Trucks	Plant	High Voltage Switch Gear	Electricity Consumption	Taxis/ Buses	Air Travel	Car Hire	Total
2011	167	15.1	292	1.3	947.0	1.7	156	0.3	1,580.4
2015	330.7	30.7	580.4	2.6	1,883.4	3.3	308.8	0.7	3,140.6
2020	448.5	41.6	787.1	3.6	2,554.2	4.5	418.8	0.9	4,259.2
2025	504.3	46.8	885.1	4.0	2,872.4	5.0	470.9	1.0	4,789.5
2030	629.7	58.4	1,105.1	5.0	3,586.2	6.3	588.0	1.3	5,980.0
2035	691.6	64.1	1,213.7	5.5	3,938.8	6.9	645.8	1.4	6,567.8
2040	729.3	67.6	1,280.0	5.8	4,153.8	7.2	681.0	1.4	6,926.1

Table B.11.12 summarises the greenhouse gas emissions produced for each source of emissions with available data in the operational phase of the Project using a pro rata basis and based on changes to size of port area.

Table B.11.12 Operational greenhouse gas emissions based on changes to size of port area

Scenario	t/CO_2-e								
	Fleet	Trucks	Plant	High voltage switch gear	Electricity consumption	Taxis/ buses	Air travel	Car hire	Total
Current port	167.0	15.1	292	1.3	947.0	1.7	156	0.3	1,580.4
Current port and PEP	196.8	20.2	348.1	1.5	1,125.0	2.0	185.7	0.5	1,879.8

B.11.5 Mitigation Measures and Residual Impacts

To continually improve performance on greenhouse gas abatement for the construction phase of the Project, it is recommended that POTL follow the carbon management cycle. The carbon management cycle provides a clear framework for organisations to develop a carbon management strategy for the business. At each step of the cycle, specific activities can be undertaken according to priority to realise emission reductions.

The steps in the carbon management cycle are:

- Step 1 Measure: Calculate the quantity and source of onsite and indirect greenhouse gas emissions through a carbon footprint.
- Step 2 Set Objectives: Identify and set greenhouse gas reduction target (e.g. achieve annual carbon neutrality, achieve a 20% reduction on 2004 greenhouse gas emissions by 2015).
- Step 3 Avoid: Reduce greenhouse gas emissions through avoiding unnecessary generation of greenhouse gas emissions (e.g. use of teleconferencing instead of unnecessary flights).
- Step 4 Reduce: Implement energy saving initiatives to reduce energy consumption (e.g. motion sensor lighting, reduced use of fleet, lighting efficiency).
- Step 5 Switch: Switch to cleaner and less energy intensive energy sources (e.g. install solar panels, purchase renewable energy through the Green Power scheme).
- Step 6 Sequester: Identify opportunities to sequester emissions onsite (e.g. plant vegetation on port land to absorb carbon dioxide from the atmosphere and lock it up in a created carbon forest).
- Step 7 Assess: Assess residual greenhouse gas emissions by calculating the quantity of greenhouse gas emission that cannot be avoided or reduced through previous steps.
- Step 8 Offset: Identify opportunities to offset residual emissions by purchasing carbon offsets from accredited carbon abatement providers.

The cycle steers organisations to avoid, reduce and switch to alternatives in the approach to carbon management. The purchase of offsets is only considered when all other possibilities for reducing greenhouse gas emissions have been explored. This helps to ensure that carbon management contributes to improving business and energy efficiency as well as contributing to greenhouse gas emission reductions.

Table B.11.13 suggests abatement measures that would improve greenhouse gas performance during the construction phase. For the operational phase POTL will only be managing common areas, it is recommended that POTL also consider abatement measures for these areas; however, focus has been given to construction emissions as this will be the majority of emissions produced for the Project.

Table B.11.13 Abatement Measures

Measures	Abatement Measure
Awareness	Include greenhouse gas awareness training as part of site inductions
	Undertake periodic energy audits to monitor energy use and changes to efficiency on site
	Keep informed of best practice industry standards, research into new technology and energy efficiency and trial new approaches where appropriate
Targets and goals	Develop a greenhouse gas inventory to effectively monitor, audit and report on the Project's greenhouse gas emissions
Energy efficiency – construction	Install light sensitive switches on lights so that they do not unnecessarily operate during the day (Site Offices, Construction Lighting)
	Ensure equipment is well maintained
	Install energy saving timers and energy efficient lighting in and around the buildings
	Select appliances based on energy efficiency
Energy efficiency – operations	Require preventative maintenance on equipment and engines to ensure equipment is well maintained
	Ensure lighting and other electrical equipment that is not in use is switched off
	Use variable speed drives with high efficiency linings
	Consider the use of high efficiency electrical motors
	Develop an energy efficiency management plan
	Consider purchasing electricity from renewable sources through Green Power
Renewable energy	Investigate renewable energy options for administration facilities
	Investigate the feasibility of generating electricity from a renewable source onsite
	Consider power generation from wind turbines or solar photovoltaics
	Consider the use of solar panels for road lighting and powering isolated items such as pumps
Fuel use during construction	Source the majority of fill material for the reclamation from capital and maintenance dredging operations in close proximity to the reclamation area
	Reduce haul distances between construction sites and spoil sites by selecting the most direct haulage route possible, provided other aspects of haulage routes are equal (such as safety and available road infrastructure)
	Reduce mobilisation of plant
	Reduce distance to DMPA where possible plus reduce dredge mobilisation distances where possible
	Plan construction works to avoid double handling of materials where possible
	Ensure efficient design of the dredging sequence operations
	Select newer equipment with more efficient engines if possible
	Use fuel efficient vehicles
	Investigate replacing diesel with a less emission intensive fuel, such as biodiesel or use of hybrid vehicles where possible
	Provide information to drivers about smoother driving practices for the trucks transporting the quarried materials to site
	Provide single direction loop roads in and out of the sites that allow trucks to enter and leave without unnecessary manoeuvring, where possible
	Implement procedures to encourage drivers to turn off engines when any significant delays are experienced along the route
	Coordinate staff travel arrangements to reduce trips and maximise passenger loads on each trip
	Choose the most suitable site equipment that can carry out the required tasks with the most efficient fuel consumption rates
	Include energy efficiency clauses in equipment tender specifications
	Incorporate scheduled equipment maintenance procedures
	Implement a regular maintenance program for equipment and construction fleet

Measures	Abatement Measure
	Reduce any unnecessary travel
Procurement	Develop a sustainable purchasing policy for the Construction Contract
	Consider energy efficiency in procurement of equipment
Material use and selection	Use materials with high recycled content or lower embodied construction materials
	Consider the feasibility of sourcing polyester geotextile manufactured from recycled polyethylene terephthalate (PET) for the reclamation area if performs to same level
	Reduce the quantity of imported material required
	Re-use dredge spoil wherever feasible as part of footprint design
Offsets for carbon neutrality	Purchase offsets through a certified offset provider in Australia

B.11.6 Assessment Summary

The total greenhouse gas emissions to be produced during the entire construction phase of the Project are estimated at 237,874.0 t of CO_2-e, which is comprised as shown in Table B.11.14.

Table B.11.14 Construction Greenhouse Gas Emissions

Source	t/CO_2-e	Percentage of Emissions
Transportation of construction materials to site	39,787.9	28.5
Onsite machinery	31,554.8	11.4
Capital dredging	80,591.2	29.1
Embodied energy from construction materials	85,940.1	31.0

The projected annual greenhouse gas emissions from the construction phase are show in Table B.11.15.

Table B.11.15 Projected Annual Greenhouse Gas Emissions (Construction)

Stage	t/CO_2-e	Period
Stage A	43,951.8	36 months
Stage B	16,760.9	18 months
Stage C	33,706.9	18 months
Stage D	24,245.4	15 months
All stages	38,230.4	per annum (assuming a linear construction period)

The operational greenhouse gas emissions were estimated using a pro rata basis from POTL greenhouse gas inventory data for 2011, specifically the tonnes of CO_2-e/Mt of trade and tonnes of CO_2-e/ha. The annual greenhouse gas emissions projected to be produced during the operational phase of the Project are shown in Table B.11.16.

Table B.11.16 Projected Greenhouse Gas Emissions (Operations)

Year	t/CO_2-e	Based on Changes To
2015	3,140.6	trade tonnage
2020	4,259.2	trade tonnage
2025	4,789.5	trade tonnage
2030	5,980.0	trade tonnage
2035	6,567.8	trade tonnage
2040	6,926.1	trade tonnage
annually	1,879.8	size of port area