

11. Air environment

This section of the EIS covers the potential sources of air pollution during the construction and operation of the Project, and the measures to be undertaken to minimise any potential impacts. The chapter is presented in two sections, the first relating to standard air quality criteria and the second relating to Greenhouse gases.

11.1 Description of environmental values

11.1.1 Regional sources

A review of existing land uses in the Project area has indicated that the existing air quality is likely to be characteristic of a rural environment.

Several industrial sources may affect the quality of the regional airshed. A search of the National Pollution Inventory (NPI) database for 2006–2007 of key industrial sources for the Bowen and Burdekin region found sugar mills, petroleum storage, production of metallurgical coke and the manufacture of polystyrene products from seven industrial sites. These sources are likely to contribute to low background levels of particulate matter and volatile organic compounds. Based on the low number of industrial sources in the Bowen and Burdekin region, the ambient air quality in the regional airshed is not expected to be significantly adversely affected by these sources.

11.1.2 Local sources

A number of industrial and non-industrial sources in the study area have the potential to influence local airsheds. These include:

- vehicular emissions from traffic on the Bruce Highway which runs roughly parallel and within a 3 to 6 km separation distance to most of the proposed channel and pipeline corridor and is crossed by reticulation pipelines
- emissions from trains using the Queensland Rail (QR) North Coast railway line which generally parallels the highway
- coal dust emissions from the coal terminal at Abbot Point
- burning of sugar cane in areas to the south of Burdekin River including near the northern limits of the proposed Project alignment
- dust from agricultural activity (particularly during harvesting and cultivation or major cattle movements)
- particulate and combustion emissions from bushfires, control burns and agricultural burning
- domestic sources associated with residential activities.

Existing local sources are likely to contribute to background levels of particulate matter (PM₁₀ and Total Suspended Particulates (TSP)), oxides of nitrogen, sulphur dioxide, carbon monoxide, volatile organic compounds (VOCs) and heavy metals. With the exception of periodic elevated but localised levels of particulates associated with cane production and other cropping, the ambient air quality in the local context is considered likely to be good.

11.1.3 Adopted background air quality data

Detailed background air quality data were not available (in terms of either TSP or PM₁₀ levels) for the study area. No historical information was available from the local authorities or DERM. No site specific background air quality monitoring has been undertaken for the Project.

In this absence of background data for the study area, for the PM₁₀ evaluation, 24 hour average PM₁₀ data derived from the Gladstone area (Targinie–Stupkin Lane) have been adopted as relevant background data for the purposes of this air quality assessment. The reference data is considered typical of background levels in the study area and at the nearest sensitive receptors to the Project. The five highest 24 hour average background measurements for each month from this reference data are presented in Table 11.1.

Table 11.1 Adopted background 24 hour PM₁₀ concentration data

Rank	Peak value within each month (µg/m ³)												
	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sept	Oct	Nov	Dec	Avg
1st Highest	19.2	27.2	24.3	28.2	23.9	17.3	22.0	28.3	23.0	38.1	78.6	27.1	29.8
2nd Highest	18.4	24.2	22.6	24.0	21.7	14.4	20.4	21.2	22.8	32.1	31.0	26.1	23.2
3rd Highest	18.1	23.8	21.7	21.7	18.1	13.3	16.4	20.8	20.1	29.3	25.6	23.3	21.0
4th Highest	17.3	23.5	21.1	20.3	17.3	12.7	15.3	20.1	19.4	26.8	24.6	21.9	20.0
5th Highest	17.1	23.3	19.7	19.6	16.4	12.4	15.0	17.7	18.9	26.5	24.3	21.8	19.4

Notes: PM₁₀ = Particulate matter ≤ 10µm aerodynamic diameter

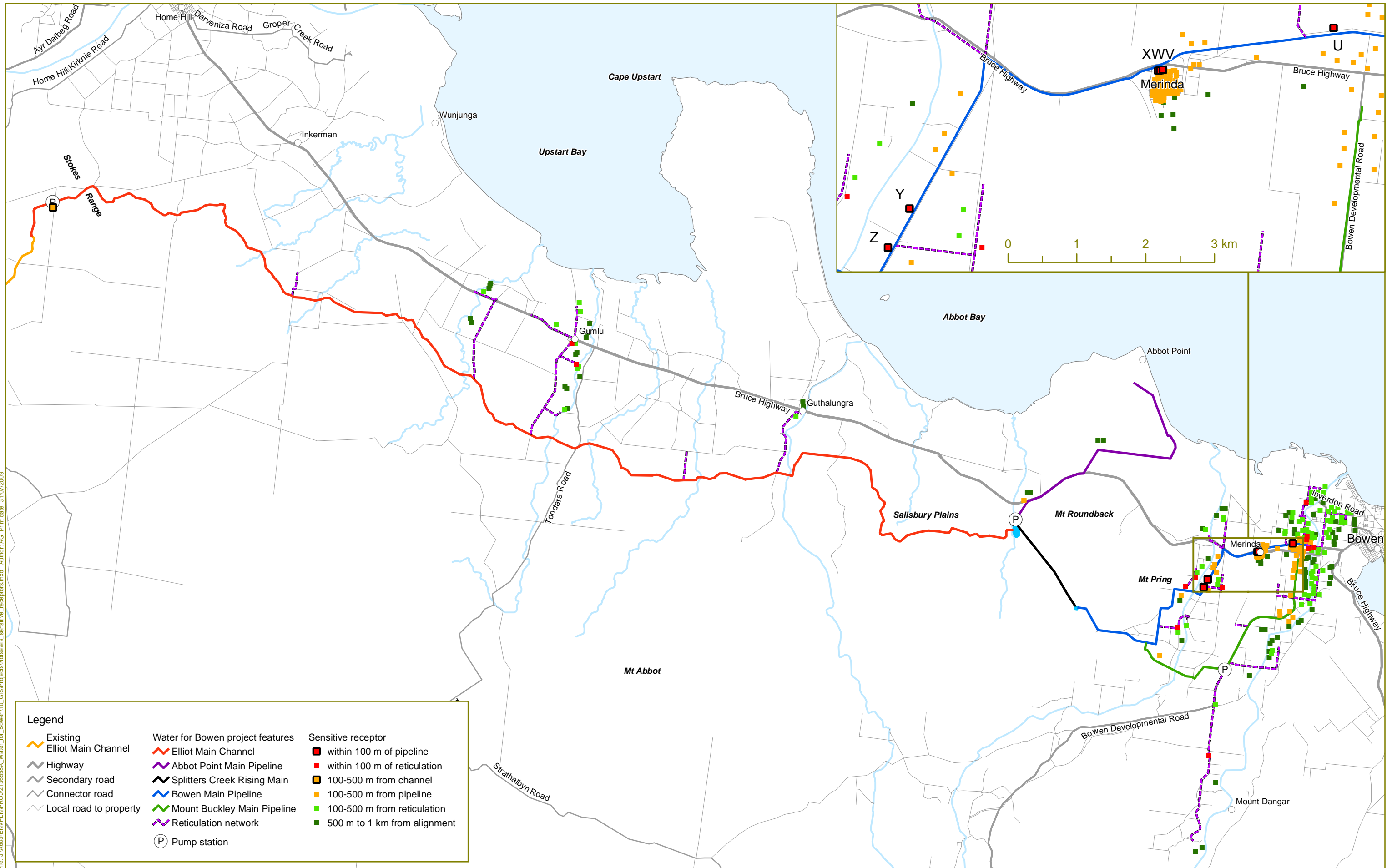
1: Data sourced from QLD EPA for Gladstone (Targinie, Stupkin Lane) 2006.

The DERM goal for 24 hour PM₁₀ is 50 ug/m³. No existing background dust deposition levels were available for the Targinie site. A background dust deposition level of 40 mg/m²/day has been assumed (and is considered typical for a rural environment), a level which is approximately one third of the DERM recommended level of 120 mg/m²/day.

11.1.4 Sensitive receptors in proximity to Project

The majority of the proposed alignments pass through rural properties with predominantly grazing or cropping land uses. Residential receptors are located sporadically within this area. The number of sensitive receptors in proximity to the pipeline reticulation components of the Project increases near Bowen.

An analysis of potential dwellings along the alignment based on topographic mapping has indicated there are 299 sensitive receptors estimated to be within 1 km of the alignment. This includes 17 receptors within 100 m, 199 between 100 m and 500 m and 83 between 500 m and 1,000 m of the alignment. Of the 17 closest receptors, six are adjacent to the Bowen main pipeline, as indicated as U, V, W, X, Y and Z on Figure 11.1. The remaining 11 are located adjacent to the proposed reticulation network. This is to be expected as the network is required to directly assess individual properties. There are no receptor locations within 100 m of the open channel. The closest sensitive receptor to the open channel is located 360 m from the channel centreline.



Legend

Existing Elliot Main Channel	Elliot Main Channel	Sensitive receptor
Highway	Abbot Point Main Pipeline	within 100 m of pipeline
Secondary road	Splitters Creek Rising Main	100-500 m from channel
Connector road	Bowen Main Pipeline	100-500 m from pipeline
Local road to property	Mount Buckley Main Pipeline	100-500 m from reticulation
	Reticulation network	500 m to 1 km from alignment
	Pump station	

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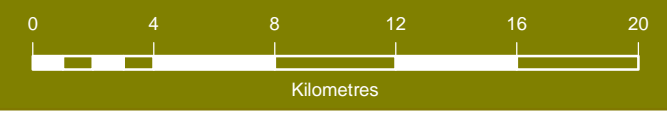


Figure 11.1
Sensitive receptor locations

11.1.5 Air quality compliance criteria

Queensland ambient air quality goals are provided in the Environment Protection (Air) Policy 2008 as administered under the *Environmental Protection Act 1994*. These goals are presented in Table 11.2 and have been adopted as the relevant air quality criteria for assessment of compliance by the Project.

Table 11.2 Adopted ambient air quality goals

Pollutant	Averaging period	Goal
PM ₁₀	24 hour	50 µg/m ³
Dust deposition	Daily	120 mg/m ² /day

11.2 Potential impacts and mitigation measures

11.2.1 Construction phase

11.2.1.1 Mobile vehicular emissions

Emissions are likely to be associated with the combustion of diesel fuel and petrol. The operation of on-site machinery during the construction works and general site operations will generate carbon monoxide (CO), carbon dioxide (CO₂), oxides of nitrogen (NO_x), sulphur dioxide (SO₂) and trace amounts of non-combustible hydrocarbon (C_xH_y) emissions. Emission rates and impact potential depend on the number and power output of the combustion engines, the condition of the engine and the quality of the fuel.

Slight odours may be detected close to the emission source. However, based on the setting of the Project site, the likely ambient air quality characteristics, low population density, and transient nature of odorous emissions, odours are not considered a key issue for this Project. They have, therefore, not been considered further with regard to air impact predictions.

The potential for air quality impacts to occur during the construction phase is expected to be limited to particulate matter emissions.

11.2.1.2 Particulate matter methodology

Assessment of dust impacts (24 hour PM₁₀ and deposition) were assessed quantitatively using the industrial Source Complex — Short Term Version 3 (ISCST3) modelling software package.

Due to the large distance involved during the construction phase of the Project, it was not practical to predict dust levels at all sensitive receptors. For all other locations, a qualitative assessment of potential air quality impacts has been applied. The Air Quality Technical Report presents the outcome of this modelling. This modelling was undertaken on the initial expectation that blasting would be required where the channel was to traverse the Stokes Range. However, subsequent geotechnical investigations have indicated that blasting is unlikely to be necessary. The assessment presented in the technical report thus represents a significant overestimation of the potential particulate emissions and consequent air quality impacts in this area.

11.2.1.3 Modelling characteristics

ISCST3 uses the straight-line steady state Gaussian Plume Equation that predicts ground level dust concentrations as a function of distance from the dust emission source. The model takes into account the source characteristics in terms of relative location, elevation, dust emission rate and the particle size mass distribution of the dust plume from the source.

The ISCST3 modelling program implemented in this assessment uses consecutive meteorological data records to define the conditions for plume rise, transport, diffusion and deposition. The model was used to estimate the concentration and deposition values for each source and receptor combination for each hour of input meteorology and calculated using selected short-term or period average predictions. Atmospheric dispersion curves and surface roughness heights were selected which specifically represented the conditions present.

11.2.1.4 Air emission sources

The following anticipated air (dust) emission sources during the construction phase were included in the modelling assessment:

- aggregate handling on storage piles
- wind erosion
- blasting (as noted above, this potential source is highly unlikely)
- heavy construction operations including bulldozers, scrapers, graders, drill rigs and compactors
- paved and unpaved roads.

Emission factors and rates were applied to all sources considered and two models were constructed to assess 24 hour PM₁₀ and dust deposition (daily) impacts for standard construction activities but also including blasting at Stokes Range. The model outputs provided maximum concentrations at discrete receptors (sensitive locations) and visual representation of contours indicating the extent of plume (dust) dispersion.

11.2.1.5 Impacts on sensitive receptors

The Air Quality Technical report has indicated that, in regard to 24 hour PM₁₀ levels, the highest incremental concentration of 66.4 µg/m³ was predicted at the nearest sensitive receptor i.e. Receptor 1, located in proximity to the Stokes Range crossing. It should be noted that, while this level is in excess of the DERM goal of 50 µg/m³, this outcome is based on the inclusion of blasting within the model. Blasting is by far the largest potential emitter of particulate matter and its exclusion will substantially reduce the potential impacts.

The cumulative impacts at all receptor locations were assessed with the highest concentration (82.5 µg/m³) predicted to occur at Receptor Location 2, again with the effects of blasting included in the modelling. With the exclusion of blasting, it is expected that there will be no adverse incremental or cumulative 24 hour PM₁₀ impacts at the Receptor Locations considered in this assessment.

Compliance with the DERM monthly deposition goal of the 120 mg/m²/day was predicted at each sensitive receptor assessed with the highest cumulative concentration of

28.2 mg/m²/day predicted at Receptor Location 1, again with blasting included in the modelling.

No adverse incremental or cumulative TSP deposition impacts are thus anticipated at any receptors.

Predictive calculations were also used to assess PM_{2.5} impacts during the construction phase. The results indicated that the cumulative 24 hour PM_{2.5} impact marginally exceeded the NEPM intervention level of 25 µg/m³. This is due to a worst-case contemporaneous assessment adopted i.e. maximum predicted 24 hour concentration and a maximum 24 hour measured background level, again with the inclusion of blasting in the modelling. Notwithstanding, based on predicted 24 hour PM₁₀ concentrations and exclusion of the short term effects of blasting, PM_{2.5} levels of this magnitude are not anticipated to occur during the construction phase.

The nature of the construction of the channel and pipelines is that the construction site continually moves along the alignment. Hence, receptors along the route of the proposed channel, (Figure 11.1) are potentially exposed to dust for only a small proportion of the total construction period. As the construction works moves along the corridor and away from the receptor, the dust levels will drop to background levels. It is therefore considered that these receptors will only be potentially exposed to dust above existing background levels for a short period of time.

With regard to the pipeline works, due to the anticipated lower amount of machinery associated with the installation of a pipeline compared to the channel, dust levels at the four most potentially affected receptors along the pipeline in the Bowen area are expected to be lower than dust levels predicted for construction works along the channel.

In areas where construction activities are in close proximity to existing road networks, the potential for dust impacts on road users may arise. However, as discussed above, due to the dynamic nature of the construction phase, only a specific part of the road will be potentially affected at any given time.

During the construction phase, topsoil/soil will be extracted from the alignment area and stockpiled. Dust emissions may arise due the loading of topsoil and clay material onto storage piles, equipment traffic in storage areas, wind erosion of pile surfaces and ground areas around piles, and clay handling and compaction operations. The level of dust emissions will vary with the volume of clay/topsoil handled. Emissions will also depend on the condition of the storage cycle e.g. the stockpile age, moisture content and proportion of fine material.

Dust generation can occur on both paved and unpaved access roads (haul roads or roads under construction). The mechanism by which dust can be generated from these roads will vary with the volume of traffic, speed, average weight of vehicles travelling along the road and silt loading on the road surface. Dust levels in the immediate area may increase as a result of trucks travelling along haulage routes.

11.2.1.6 Mitigation measures

The following mitigation measures are proposed to ensure that potential air quality impacts are minimised at any existing sensitive receptor location. These measures will be incorporated within the Construction Environmental Management Plan (CEMP) and the Road-use Management Plan (RMP).

These measures may include, although are not necessarily limited to, the following:

- watering of internal unsealed access roadways and work areas. Application rates and frequency will be determined based on atmospheric conditions and the intensity of construction operations. The application of a chemical stabilising agent to unsealed haul roads and stockpile areas may be required where water application rates prove insufficient or there is a limited supply of water. Recycled water (such as that caught in sediment traps or borrow pits) will be used where practicable
- at the joining of unsealed and sealed roads, the sealed area will be swept routinely to remove deposited material that could generate dust
- site rehabilitation will be undertaken as soon as practicable
- disturbed areas will be stabilised as soon as practicable to prevent or minimise wind-blown dust
- on-site low speed limits will be enforced for all construction vehicles operating in the Project area
- vehicle and machinery movements during construction will be restricted to designated areas
- rumble grids and/or wheel wash facilities may be provided at the Project construction exit points onto sealed roads to remove mud and dust from vehicles. Alternatively, roads will be swept to remove dirt and mud
- vehicles transporting spoil and other materials with the potential to generate dust will be covered immediately after loading to prevent wind blown dust emissions and spillages. Tailgates of road trucks will be securely fixed prior to loading and immediately after unloading
- construction plant and equipment will be well maintained and regularly serviced
- all site vehicles and machinery will be switched off or throttled down to a minimum when not in use
- excess or unnecessary revving of engines will not be permitted
- all chemicals and fuels will be stored in sealed containers to avoid fugitive emissions to air
- unloading of diesel will be vented via return hoses that recirculate vapours from delivery to receiver.

Measures to minimise dust will be developed in consultation/agreement with relevant approval bodies prior to the commencement of construction.

A consultation plan with all potentially affected receptors will be put in place which will include discussion of the applied mitigation measures, and a complaints register for the duration of construction and monitoring if required.

11.2.2 Operation phase

The main sources of emissions to air during the operational phase of the Project are not anticipated to be of significance and are likely to comprise mainly dust from employee vehicles traversing the corridor during planned maintenance. As a consequence, specific mitigation measures are not considered necessary.

11.3 Greenhouse gas emissions

This section provides a greenhouse gas (GHG) inventory of direct and indirect emissions resulting from the construction and operation of the Project over an expected lifetime of 82 years (two years for construction and 80 years for operation). All relevant policies and legislation associated with the Project's GHG impact have been addressed, and the loss of carbon sequestration in vegetation carbon stocks caused by the Project will also be discussed.

A number of direct GHG abatement measures committed to by SunWater are presented, in line with national and state abatement policies and guidelines. The potential for emission reduction is described. Further details of the abatement measures are outlined in the draft EMP.

The main types of greenhouse gases expected to be emitted from the Project are carbon dioxide (CO₂) and methane (CH₄). To facilitate the GHG reporting, the standard measurement unit of carbon dioxide equivalents (CO₂-e) has been used.

11.3.1 Legislative framework

11.3.1.1 International climate change policy

Since June 1992, Australia has been a signatory to the United Nations Framework on Climate Change (UNFCCC), which commits Australia to monitor, report, and reduce its overall GHG emissions. It also provides broad overarching principles and institutional arrangements for global greenhouse reporting.

Australia ratified the Kyoto Protocol in December 2007. The ratification commits Australia to meet its emissions targets of reducing 60% of its GHG emissions by 2050 based on 2000 levels. The Protocol requires signatories to meet their targets primarily through domestic action. However, three flexible market mechanisms are also available to complement domestic action in reducing GHG emission levels, and are as follows:

- the Clean Development Mechanism (CDM)
- Joint Implementation (JI)
- International Emissions Trading.

11.3.1.2 Australian climate change policy

The Commonwealth Government released its Policy Framework on Climate Change in July 2007. The Framework supplements the international mechanisms for GHG reductions, by developing a market-based instrument consisting of a domestic emissions trading

scheme known as the Carbon Pollution Reduction Scheme (CPRS), which is due to commence in July 2011.

As an additional policy measure, the National *Greenhouse Energy Reporting (NGER) Act 2007* was implemented in July 2008. Its objective is to provide adequate and rigorous baseline data for the upcoming CPRS and serve as a national framework for the highest emitting Australian corporations to report Scope 1 and Scope 2 GHG emissions, energy consumption and production and the disclosure of energy information, with the ultimate aim of enabling decision makers to make emissions reductions, removals and key investments from a position of improved information. This reporting requirement will ultimately apply to lower emitting corporate groups by 2012.

The Federal Government released its White Paper on the CPRS in December 2008. The paper outlines the emissions trading scheme's design and emissions reduction targets. By 2020, the Government has committed to reducing Australia's carbon pollution by up to 15% below 2000 levels in the context of an international agreement, or to an unconditional 5% reduction if no international agreement of major emitting economies was reached.

The Department of Climate Change (DCC) concurrently released a draft legislation to increase the renewable energy target from 5% to 20% by 2020 on 19 December 2008. The aim for the legislation is to bring the existing mandatory renewable energy target and existing state-based targets into a single national scheme, and is intended to commence in July 2009.

11.3.1.3 State climate change policy and initiatives

In June 2007, the Queensland Government released a policy document entitled 'Climate Smart 2050' (Office of Climate Change 2007), which establishes Queensland's strategy on climate change. The objective of this strategy is to reduce GHG emissions by 60% from 2000 levels by 2050, consistent with the national target. The Climate Smart Adaptation Plan 2007–2012 (Office of Climate Change 2007) outlines the action plan to this end and is further discussed in Section 1.6 of the EIS.

Recently, the Queensland Government has announced it is currently reviewing, updating and consolidating its current strategy and action plan in light of the latest scientific assessments as well as national and international developments in climate change and climate change policy.

11.3.2 Scope and methodology of GHG assessment

11.3.2.1 Scope for reporting the Project's GHG emissions

Current Australian GHG reporting standards require that Scope 1 and 2 emissions are reported. This chapter provides a GHG inventory of Scope 1 and 2 emissions, and considers Scope 3 emissions where possible, such as the extraction, production and transport to end suppliers of greenhouse-intensive raw materials used for construction. However, Scope 3 emissions are considered optional under the GHG Protocol (WRI/WBCSD 2004) and the NGER system, and are generally not reported by companies for the following reasons:

- the level of uncertainty to estimate the emissions is very high due to the number of assumptions required to undertake such estimations
- organisations usually have no effective control over these emissions

- organisations' Scope 3 emissions are most likely to be double counted elsewhere as a Scope 1 or 2 emission by a second company, such as a product supplier or electricity generator.

The Project's water transport infrastructure corridor and balancing storage footprint was used to establish the physical GHG inventory boundary. Sources of GHG emissions controlled or influenced by the Project from this boundary were identified, and categorised under the relevant GHG Protocol (WRI/WBCSD 2004) scopes for direct and indirect emissions, which are as follows:

- Scope 1:
 - ▶ direct emissions related to Project construction and operations activities, including subcontractor and staff transport-related emissions along the water pipeline and open channel route, and vegetation loss due to land clearing to establish the Project
 - ▶ direct emissions from road transport of raw materials (e.g. concrete, steel, and HDPE pipes etc) from end suppliers, such as concrete batching plants, to the construction sites.
- Scope 2:
 - ▶ indirect emissions associated with fossil fuel-based electricity consumption at site during the construction and operations phases.
- Scope 3:
 - ▶ other indirect emissions resulting from sources not owned or influenced by SunWater, such as the extraction, production and transport to end suppliers of greenhouse-intensive raw materials (e.g. to produce the concrete, steel and HDPE pipes)
 - ▶ indirect emissions from electricity consumption, such as the extraction, production and transport of fossil fuel used for electricity generation upstream, and associated network distribution and transmission losses from electricity consumed at site.
 - ▶ other indirect emissions resulting from the transportation and off site treatment and eventual disposal of liquid municipal wastes (after the water from the Project is used).

The following GHG emissions sources and sinks were excluded from the assessment on the basis that the quantities were considered to be insignificant or that accurate data were not available at the time the assessment was prepared:

- energy used in temporary camps for cooking purposes (Scope 1); assumed insignificant
- road transport of borrow and fill material to and from construction site (Scope 1 emissions); because material will be extracted within the water transport corridor and emissions are therefore assumed insignificant
- acid sulphate soils (Scope 1); excluded as it is unlikely that significant quantities of this soil will be encountered during construction
- rock blasting (Scope 1); excluded as it is unlikely to be undertaken during the construction of this Project

- cleared vegetative wastes disposed of in local landfills (Scope 1); excluded as assumed insignificant
- embedded energy (Scope 3) in vehicles/trucks/machinery/equipment used for the Project; excluded due to unavailability of sufficient data and for reasons described earlier
- revegetation within the Project corridor; excluded as not envisaged to be significant from a GHG perspective
- the inventory also excludes indirect downstream (Scope 3) emissions associated with end-users supplied by water from the Project because SunWater has no control or influence on how these emissions will be managed.

The overall GHG emissions have been projected for the life of the Project i.e. 82 years, with the construction phase being carried out in the first two years, and an additional 80 years as the expected operational life.

11.3.2.2 Methodology for reporting the Project's GHG emissions

The aim of this section is to:

- review relevant Project-related data including design specifications of the proposed water transport infrastructure corridor provided by SunWater
- compile and report a GHG inventory from various activities associated with the construction and operation of the Project
- estimate the net loss of carbon sequestration in existing vegetation carbon stocks resulting from land clearing
- describe and assess GHG reductions from direct greenhouse gas abatement measures undertaken for the Project
- recommend direct and indirect mitigation measures to reduce the Project's overall carbon footprint
- assess the Project's GHG impact to Queensland's overall GHG emissions profile.

For purposes of the assessment, a number of nationally and internationally accepted methodologies were used such as the National Greenhouse Accounts (NGA) Factors (Department of Climate Change (DCC), November 2008b), The Greenhouse Gas Protocol (World Resources Institute/World Business Council for Sustainable Development (WRI/WBCSD) 2005), and the Australian Methodology for the Estimation of Greenhouse Gas Emissions and Sinks 2006 series (DCC 2006).

A spreadsheet model was developed specifically for the Project incorporating emissions factors and relevant data from the NGA Factors (DCC, November 2008) and other accepted sources, i.e. product suppliers. The data and emission factors were applied to calculate annual projected emissions of the Project's construction and operation phase consistent with the methodology outlined above.

The net loss of carbon sequestration in existing vegetation carbon stocks due to the proposed land clearing for the Project was calculated using the Australian Greenhouse Office's (2005) National Carbon Accounting Toolbox and data viewer (NCAS). Further details of this methodology are presented below.

11.3.2.3 Carbon sequestration potential calculations

The NCAS toolbox and data viewer is a carbon accounting tool for GHG emissions and carbon stock changes from land based sectors. To estimate and predict biomass, litter and soil carbon pools in forest and agricultural systems, the NCAS accounts for land based activities through a highly integrated system combining:

- remotely sensed land cover change (including mapped satellite imagery data)
- land use and management data
- climate and soil data
- greenhouse gas accounting tools
- spatial and temporal ecosystem modelling.

The model was used to estimate the baseline carbon stocks stored in plant biomass and soil pools at the Project site (in t C/ha). The carbon models were calibrated by selecting specific vegetation types corresponding to those present at the site, for which the clearing is proposed, to generate reliable estimates. The proposed vegetation to be cleared (as presented in Chapter 7) has been categorised into the relevant NCAS vegetation types by an experienced botanist.

A total of nine scenarios were used representing the pre-existing (baseline) vegetation on site:

- tidally-influenced communities and wetlands (corresponding to REs 11.1.2, 11.1.4, and 11.3.27)
- eucalyptus woodland (REs 11.2.5, 11.3.4, 11.3.7, 11.3.9, 11.3.10, 11.3.25, 11.3.29, 11.3.30, 11.3.35, 11.12.1 and 11.12.9)
- eucalyptus open woodland (corresponding to RE 11.3.13 and all non remnant vegetation)
- melaleuca forest and woodland (RE 11.3.12)
- tropical eucalyptus woodlands/grasslands (RE 11.3.31)
- casuarina forest and woodland (RE 11.3.32)
- acacia forest and woodlands (RE 11.3.34)
- other forests and woodlands (RE 11.3.33).

The following assumptions were applied to these carbon models:

- GPS coordinates used for the model corresponded to a location where each type of vegetation occurred in the proposed area to be cleared
- implementation of a multilayer mixed scenario (forest and agricultural system) modelled with a 100% thinning (clearing) event followed by a forest percentage change to 0% in order to simulate the vegetation clearing in the Project's corridor
- grazing on non-burnt native grasslands to simulate the expected conditions after the vegetation clearing in the Project corridor during the operations phase (for pipelines only).

The scenarios were run until the carbon content in the plant biomass and soil pools plateaus over time. Each NCAS vegetation type is characterised by a unique carbon content that is influenced by the type of plant community assembly, soil, climate, and other factors selected for the model. The difference in on-site carbon stocks between the baseline and post clearing scenarios shows the net loss of carbon sequestration from existing vegetation, also known as the carbon storing capacity. For estimating the overall net loss of carbon sequestration in existing vegetation carbon stocks caused by the Project due to land clearing, the carbon carrying capacity for each vegetation type was multiplied by its respective proposed cleared area (309.7 ha of REs and 26 ha of non-remnant vegetation, refer Table 7.8, Chapter 7). This GHG assessment was conducted without taking into account the revegetation of parts of the cleared corridor or any vegetation offsets as the carbon storage capacity of regrowth will take a number of years to establish and offsets are yet to be finalised.

Vegetation carbon stock estimates in t C/ha were then converted to carbon dioxide equivalent in t CO₂/ha by multiplying the change in carbon stocks by 44:12, the ratio of the molecular weight of CO₂ to the molecular weight of carbon. Estimates were rounded to the nearest integer.

11.3.2.4 Limitations of GHG assessment

Information availability: The GHG assessment presented below was conducted prior to the Project's final design; therefore, estimates may change slightly once the final design is completed. However, changes are not expected to significantly alter the results of this GHG assessment.

Preliminary information was provided by SunWater and its subcontractors for anticipated construction hours, machinery and vehicle fleet numbers and types. These were used in addition to standard construction practices for estimating the types and volumes of GHG emissions likely to be emitted by the Project's activities during the construction and operation phases.

Overall, the GHG estimates provided in this section are indicative and based on the best available data at the time preparing this EIS, and do not constitute a definite GHG emissions statement for the Project.

NCAS Modelling: The NCAS model is a world-leading tool to account for GHG emissions from land-based sectors. Any site specific data and conditions which may have not been included in the NCAS models are not expected to significantly influence the carbon stock estimates presented.

11.3.2.5 Potential GHG Emissions

Potential emissions — construction phase

The combined direct and indirect GHG emissions associated with the Project's construction are estimated to be 149,599 t CO₂-e. This total does not account for any GHG mitigation measures or offsets that will be implemented during the Project construction, such as utilization of 5% recycled material in HDPE pipes; or recycled paper and cardboard on site. A breakdown of this amount categorised in IPCC economic sectors is shown in Table 11.3.

Table 11.3 Emissions inventory for Project construction

Fuels/ process	Scope emissions	Units of measurement	Assumptions used	GHG emission factors (t CO _{2e})	Project GHG profile (t CO _{2e}) ¹
Land use and land use change and forestry					
Vegetation clearing (remnant and non-remnant)	1	335.7 ha	Non-remnant vegetation consists of eucalyptus open woodland	NCAS toolbox, DCC 2005	89,792
Fuels used for transport and construction					
Diesel oil — General	1	17,710 kL	40 hours/week over 105 weeks	0.06992	47,785
Diesel oil – materials delivery	3	612 kL	Average road distance used from end suppliers to Guthalungra	0.06992	1,651
Non-transport fuels (stationary)					
Diesel oil	1	272 kL	Four generators operating 40 hours/week over 100 weeks Two generators operating 40 hours/week over 105 weeks	0.06953	728
Wastes (from camp sites)					
Food	3	19 t	Default DOC proportion used was 0.15 (Table 40, NGA Factors, 2008)	0.94	17
Municipal liquid wastes	3	11 t	240 people over 105 weeks	refer to default values in Table 43 (NGA factors, 2008)	127
Industrial processes (Scope 3)					
Cement	3	4,096 t	From 12,800 m ³ of construction concrete	0.7055	2,888
Steel	3	1 t	–	2.26	2
HDPE pipes	3	5,726 t	HDPE pipe density indexes obtained from standard for HDPE pipes DIN 8074/75 : PE 100 (TGG, 2009)	1.67	9,162
Total					152,153

1. Rounded to whole numbers. Rounding may result in information in the table not summing to exact total.
2. NGA Factors, DCC 2008, Table 4, emission factor based on t CO_{2e}/GJ
3. NGA Factors, DCC 2008, Table 3, emission factor based on t CO_{2e}/GJ
4. NGA Factors, DCC 2008, Table 40 and 41
5. Review of the Technology Pathway for the Australian cement industry 2005-2030, Australian Cement Industry 6. Federation 2007
7. Bluescope Steel Health Safety Environment Report 2007
8. Borealis report on climate change: Addressing climate change, 2008

Approximately 137,815 t CO₂-e of direct GHG emissions (Scope 1) will be emitted by the Project construction activities, mainly from vegetation loss. Fuels used for transport and construction have also been identified as another major source, with 47,785 t CO₂-e direct emissions and 1,651 t CO₂-e as indirect emissions. These include transport-related emissions from utility buses that will shuttle up to 60% of construction workers from the temporary accommodation camps to various construction sites.

No indirect GHG emissions from electricity consumption (Scope 2) are expected, as electricity is not planned to be used on site during the Project's construction phase. The Gumlu temporary camp will be powered by diesel generators which have been incorporated into the above estimates. while the existing Merinda camp is on mains power.

Other indirect emissions (Scope 3) associated with industrial processes such as the extraction, production and transport of raw construction materials will also be significant but have been included in the above estimates. These include greenhouse-intensive materials such as aluminium and steel on emissions resulting from the cement content in concrete.

However, these sources occur off site and are outside the control and influence of SunWater. Further, these emissions are considered to be a one-off event emitted by the Project, and several mitigation measures will be implemented to minimise their impacts. Further details of these measures are discussed in Section 11.4.

A package sewage treatment plant will be used for construction camps. However, methane (CH₄) emitted from this will not be a significant contributor to the overall GHG emissions of the construction phase.

According to DCC's State and Territory Greenhouse Gas Inventories 2006 (2008a), the total GHG emissions for Queensland in 2006 were estimated to be 170.9 MtCO₂-e. The Project's construction activities will contribute approximately 0.09% to Queensland's overall annual GHG emissions profile.

GHG emissions associated with vegetation clearing

The proposed clearing of 335.7 ha of vegetation will cause a loss of approximately 89,792 t CO₂-e in carbon sequestration potential of the vegetation carbon stocks.

Table 11.4 presents the resulting net loss according to the area of different vegetation types to be cleared.

Table 11.4 Estimated net loss of carbon sequestration potential from the Project

Vegetation type based on NCAS modelling	Total cleared area (ha)	Carbon sequestration potential of vegetation type (t CO ₂ /ha) ¹	Net loss of carbon sequestration potential from Project (t CO ₂ /ha) ²
Acacia forest and woodlands	19.7	259	5,102
Casuarina forest and woodland	27.1	338	9,160
Eucalyptus woodland	246.3	258	63,545
Tidally-influenced communities and wetlands	5	460	2,300
Melaleuca forest and woodland	3.5	340	1,190
Other forests and woodlands	5.8	232	1,346
Tropical eucalyptus woodlands and grasslands	0.5	332	166

Vegetation type based on NCAS modelling	Total cleared area (ha)	Carbon sequestration potential of vegetation type (t CO ₂ /ha) ¹	Net loss of carbon sequestration potential from Project (t CO ₂ /ha) ²
Eucalyptus open woodland (including non remnant vegetation)	27.6	253	6,983
Total	335.7	—	89,792

1. Calculated using the NCAS toolbox kit, DCC, 2005

2. All values were rounded up to whole numbers. Rounding errors may result in information in the table not summing to exact total.

The majority of cleared vegetation is expected to be comprised of non-millable timber, with suitable material (non weed) planned to be mulched, chipped or pushed to the side of the easement. Mulch and wood chips will be reused for rehabilitation and stabilisation in exposed areas during construction, and in erosion control around the channel embankments. Additionally, recycling and chipping for beneficial re-use will be considered where possible, such as sale of wood chips to the local landscaping industry.

As part of the weed management plan outlined in the construction EMP (Chapter 20), any plant material containing declared weeds will be disposed of in local landfills. A proportion of cleared vegetation is expected to end up in this category, although the resulting emissions are expected to be negligible in comparison to other GHG sources related to the Project.

Potential emissions — operation and maintenance phase

Table 11.5 presents a breakdown of the estimated annual and life of Project GHG emissions during the operation and maintenance phase, calculated according to IPCC economic sectors and scopes.

Overall, an estimated 1,136,419 t CO₂-e will be generated from the Project's operation and maintenance activities over a lifespan of 80 years. The largest source will be from indirect GHG emissions (Scope 2) associated with electricity consumption of the pump stations. This source represents over 87% of the Project's overall operations phase GHG emissions, with approximately 987,780 t CO₂-e, or 12,347 t CO₂-e per annum (inclusive of other indirect emissions attributable to electricity consumption from grid).

Other indirect emissions (Scope 3) relating to electricity consumption correspond to emissions attributable to the extraction, production and transport of stationary fuels consumed, and to the electricity lost to the transmission and distribution networks. This represents just over 12% of the overall annual GHG emissions from the Project.

Direct GHG emissions (Scope 1) are projected to be very low, with only 7,528 t CO₂-e emitted over the life of the Project by maintenance vehicles. Weed control activities along the water transport corridor may also contribute to these emissions. However, this impact will be negligible and was thus not assessed.

It is expected that the Project's annual operation activities will contribute approximately 0.008% to Queensland's overall annual GHG emissions based on 2006 emission levels.

Abatement measures in regard to GHG emissions to be implemented for the Project are described later in Section 11.4.

Table 11.5 Breakdown of estimated annual and life of Project GHG emissions during operation and maintenance phases

Fuels/process	Scope emissions	Energy profile	Assumptions used	GHG emission factors (t CO ₂ -e)	Annual GHG emissions (t CO ₂ -e)	Life of Project GHG emissions (t CO ₂ -e) ¹
Fuels used for transport and construction						
Diesel oil — general	1	35 kL/yr	Vehicles operating 350 to 365 days per annum	0.06992	94	7,528
Stationary energy (electricity used from grid)						
Electricity consumption	2	13,568,400 kWh/yr	Based on pump stations electricity usage.	0.000913	12,347	987,780
Other indirect emissions attributable to electricity consumption from grid	3	13,568,400 kWh/yr	—	0.000134	1,764	141,111
Total					14,205	1,136,419

1. Rounded to whole numbers. Rounding may result in information in the table not summing to exact totals.

2. NGA Factors, DCC 2008, Table 4, emission factor based on t CO₂-e/GJ

3. NGA Factors, DCC 2008, Table 39

4. NGA Factors, DCC 2008, Table 39

11.4 Greenhouse gas abatement

SunWater has committed to a number of direct GHG abatement measures during construction and operation of the Project. As discussed in Section 11.3.2.5, transport-related emissions are reduced by using utility buses to shuttle up to 60% of construction workers from the temporary accommodation camps to various construction sites.

A preliminary assessment of embodied measures that will reduce the Project's carbon footprint has been conducted to quantify, where possible, the changes to GHG emissions.

Using standard industry emissions factors, a reduction of 539 t CO₂-e from the calculations in Section 11.3.2.5 is expected by incorporating the following GHG abatement measures during the construction of the Project:

- 413 t CO₂-e by using up to 5% of recycled HDPE material in the pipes
- 126 t CO₂-e by recycling cardboard and paper used on site.

The following commitments will be undertaken as part of SunWater's aim to reduce the Project's overall carbon footprint during the construction phase:

- minimise the clearing footprint (for example in riparian zones the general easement width of the open channel can be reduced from 50 m to about 20 m)
- local sourcing of material such as concrete, crushed material/aggregates and water for the temporary camp sites
- any millable timber will be made available for commercial extraction
- re-use of cleared vegetation waste at site in the form of mulch or wood chips for soil erosion control around channel embankments or for revegetation, or consider the sale of wood chips to the local landscaping industry
- vegetation protection and rehabilitation in conformance with the requirements of the VM Act and necessary offsets
- regular energy audits and management to ensure energy is being used efficiently.

The following commitments will be undertaken as part of SunWater's aim to reduce the Project's overall carbon footprint during the operation phase:

- regular energy audits and management to ensure energy is being used efficiently (such as using solar power for the overshot control gates)
- annual auditing and reporting on GHG emissions from all relevant activities (based on the CPRS requirements).

The above measures are expected to contribute substantially to reducing the Project's carbon footprint. As more cost-effective and viable alternatives become available in the future to reduce GHG emissions and enhance energy efficiency, for example related to the power supply for the pump stations, SunWater will seek to investigate and implement these options when practical and feasible.

In addition to the specific carbon reduction measures presented above, the EMP further details activities to reduce GHG emissions and these will move forward into the CEMP and OEMP.