Australia Pacific LNG Project

Appendix N - Waste Management Plan
LNG Facility

Disclaimer

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1. Introduction

1.1 Purpose

Throughout the LNG facility's life cycle (including site preparation, construction, operation and decommissioning) a variety of waste streams and waste products will be generated.

Waste management options identified within this plan will be employed to reduce or avoid impacts due to inappropriate handling of waste. The options examine alternatives that relate to waste minimisation, re-use and recycling of materials instead of disposal. It is intended that the waste products do not adversely impact the environment, human health or the amenity of the area.

The purpose of this waste management plan is to:

- Identify, describe and quantify the various waste products and streams to be generated from the construction, operation, decommissioning and rehabilitation of the LNG facility and associated facilities.
- Assess the potential impacts to the surrounding environment.
- Identify options for waste minimisation and management, with specific reference to the waste hierarchy, as well as other cleaner production techniques.
- Develop mitigation measures to minimise any waste impact.

The following waste management goals will be applied for the LNG facility:

- Consider all waste as a resource to minimise disposal.
- Design to minimise production of waste from all of the LNG facility's activities.
- Minimise the generation of regulated and radioactive wastes.
- Apply the waste management hierarchy of 'avoid, reduce, recycle, recover, treat and dispose'
- Apply sustainable waste management and disposal methods.
- Avoid contamination of land and water.
- Minimise adverse effects to marine, aquatic and terrestrial vegetation and wildlife.
- Minimise potential risks to workers and the public.

1.2 Australia Pacific LNG's corporate standards

Australia Pacific LNG's strategic standards are to prioritise the prevention and minimisation of waste generation and effectively manage wastes in a manner that minimises the impact to the environment, while also being cost effective. A step-by-step approach will be implemented with the following order of preference:

- Prevention and reduction
- Re-use
- Recycle and recovery
- Treatment
- Disposal.

2. Legislation

2.1 Legislative and policy framework

The regulatory requirements in Queensland for waste management are provided within Queensland's *Environmental Protection Act 1994*, the *Environmental Protection Regulation 2008*, the *Environmental Protection (Waste Management) Policy 2000*, and the *Environmental Protection (Waste Management) Regulation 2000*.

2.1.1 Environmental Protection Act

The intention of the *Environmental Protection Act 1994* (EP Act) is to protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes from which life depends (ecologically sustainable development).

The Act defines waste as anything, that is:

1. Left over, or an unwanted by-product, from an industrial, commercial, domestic or other activity.
2. Surplus to the industrial, commercial, domestic or other activity generating the waste.

2.1.2 Environmental Protection Regulation

The *Environmental Protection Regulation 2008* defines general waste as waste other than regulated waste. Regulated waste is defined as waste that is:

1. A commercial or industrial waste, whether or not it has been immobilised or treated.
2. Of a type, or contains a constituent of a type, mentioned in Schedule 7 of the regulation.

2.1.3 Environmental Protection (Waste Management) Policy

The aim of the *Environmental Protection (Waste Management) Policy 2000* is to achieve the goals of the *Environmental Protection Act 1994* in relation to waste management through:

- Identifying the environmental values to be enhanced or protected.
- Providing a framework to:
  - Ensure waste management is consistent with ecologically sustainable development
  - Minimise the impact of waste to the environment
  - Minimise the quantity of waste generated
  - Promote efficient use of resources and maximum use of waste
  - Continuously improve waste management activities.
- Providing for the preparation of waste management programs and industry waste reduction programs.

The policy outlines the waste management hierarchy as an optimal waste management tool, which moves from most preferred to least preferred:

- Waste avoidance
- Waste re-use
- Waste recycling
- Energy recovery
- Waste disposal.

One of the principles highlighted in the policy that applies to the management of wastes associated with the LNG facility is the 'polluter-pays' principle. This principle states that *all costs associated with the management of waste should, if practicable, be borne by the persons who generated the waste*.

The waste management hierarchy and the polluter-pays principle have important ramifications for the design of a waste management program. The waste hierarchy is specifically designed to reduce the amount of waste that a project produces; while the polluter-pays principle encourages cleaner/greener design by the proponent, by ensuring the proponent is held accountable for any wastes that the LNG facility may generate.

The environmental values that have the potential to be impacted by waste are listed in Table 2.1 . The management of waste assists in protecting these values during construction, operation and decommissioning of the LNG facility.

Table 2.1 Environmental values

	Environmental values
Air	• Qualities of the air environment that are suitable for sustaining life, health and well-being of humans • Local amenity (dust, noise, odour) • Aesthetic enjoyment
Water	• Biological integrity of a modified aquatic ecosystem • Suitability for recreational use • Suitability for industrial use • Wildlife habitat • Aquaculture • Human health • Visual amenity
Noise	• Qualities of acoustic environment that are conducive to the well-being of the community or a part of the community, including social and economic amenity
Waste management	• Life, health and well-being of people

	Environmental values
	• Diversity of ecological processes and associated ecosystems • Land use capability, while having regard to economic considerations
Land	• Quality of the land environment to ensure the site is environmentally sustainable for future generations • Flora and fauna habitat protection

2.1.4 Environmental Protection (Waste Management) Regulation

The purpose of the *Environmental Protection (Waste Management) Regulation 2000* is to protect the environment by:

1. Minimising the impact of waste to the environment including, in particular, the impact of waste so far as it directly affects human health.
2. Establishing an integrated framework for minimising and managing waste under the principles of ecologically sustainable development.

The regulation also provides for the reporting and tracking requirements of regulated waste.

2.1.5 Queensland's Waste Strategy 2010-2020 Waste Avoidance and Recycling Consultation Draft

The department of Environment and Resource Management (DERM) is currently reviewing Queensland's waste management systems, and as result, a waste reform is underway consisting of:

- A new waste strategy
- New legislation
- An industry waste levy.

DERM has recently released Queensland's Waste Strategy 2010-2020 Waste Avoidance and Recycling Draft, June 2010, DERM as well as a companion document Proposed Industry Waste Levy Consultation Draft, June 2010, DERM. These documents outline the visions, goals, targets and actions for waste and resource management in Queensland over the next decade to meet State and National policy obligations.

The Strategy's aims are improve management of waste and resources over the next decade, through identifying challenges and priorities as well as setting targets for waste avoidance, resource recovery and disposal. These key areas are based on the waste management hierarchy and, as such, it is expected that this Plan will be in accordance with the Strategy when it is finalised.

2.1.6 Central Queensland Waste and Resource Recovery Strategy

The LNG facility's waste management plan has been developed in general alignment with relevant principles within the Central Queensland Waste and Resource Recovery Strategy, June 2006,

TechSearch Waste and Environment Services. The strategy aims to contribute to the achievement of regional waste management suitability through:

- The preservation and enhancement of community and environmental health values.
- Lower per capita levels of resource consumption.
- Lower waste generation rates.
- Community and business waste minimisation (re-use and recovery for beneficial use).
- The achievement of regional economic and social development while restricting environmental risks to acceptable levels.
- Continuous improvement in environmental performance.

3. Waste generation

There are a variety of sources of waste associated with the development, operation and decommissioning of the LNG facility. LNG facilities are typically very low emission facilities compared to other industries in the Gladstone region, with minimal process wastes associated with the generation of LNG from coal seam gas (CSG). This is attributed to a number of factors, including:

- The use of natural gas to generate energy instead of conventional sources.
- Technological innovations, such as ConocoPhillips' Optimized Cascade® process, which increases the efficiency of processes within the plant.
- The presence of a number of closed-loop processes, which minimise waste streams and products by reusing or recycling outputs as inputs.

3.1 Construction wastes

A number of wastes have been identified which are likely to be generated from general construction activities. These include:

- Vegetation cleared during site preparation works
- Oils and oily wastes from equipment and machinery maintenance and refuelling activities
- Waste paints and solvent
- Waste adhesives
- Aerosol cans
- Waste antifreeze/radiator coolant
- General domestic waste and recyclables from construction workers
- Office wastes
- Paper, cardboard, plastics and wood products from packaging
- Scrap metals (ferrous and non-ferrous)
- Surplus concrete
- Used welding rods
- General inert construction waste
- Greywater and sewage
- Batteries
- Tyres
- Solvents and chemicals
- Medical and first-aid station waste

- Food waste
- Atmospheric emissions
- Waste waters i.e. brine, treated sewage effluent, stormwater.

3.1.1 General waste

details waste streams that will be generated predominantly from the operation of the temporary accommodation facility and construction activity wastes expressed as a quantity per year (based on the forecast total against the expected four-year, nine-month construction period for the first two LNG trains). The waste streams and quantities are based upon a peak construction workforce of 3,300 people.

Section 5 provides more detail about the construction waste streams, the anticipated quantities of each of these streams and associated management options to minimise disposal of wastes and potential environmental or human harm.

Waste generated that cannot be recycled during the construction phase will be collected in mobile garbage bins and suitably-sized roll-on-roll-off bins with proper waste identification and labels in a designated waste segregation area. These wastes will be barged from Curtis Island and disposed of on the mainland at licensed landfill sites.

Table 3.1 Key waste streams and estimated volumes for construction activities

Waste stream	Waste Type	Estimated quantity
Sewage treatment plant solids	Regulated	140 tonnes/year
Food waste	General	305 tonnes/year
Recyclable waste	General/Recyclable	205 tonnes/year
Plastic	Recyclable	30 tonnes/year
Glass	Recyclable	25 tonnes/year
Metal	Recyclable	20 tonnes/year
Other	General/Recyclable	130 tonnes/year
Paper and cardboard	Recyclable	130 tonnes/year
Wood products/packaging	Recyclable	40 tonnes/year
Scrap metal	Recyclable	275 tonnes/year
Excess concrete	General/Recyclable	2,100 tonnes/year
Oil and oil filters	Regulated/Recyclable	20 tonnes/year
Solvents and chemicals	Regulated	4 tonnes /year
Batteries	Regulated	50 item/year
Tyres	Regulated	45 tonnes/year

Waste stream	Waste Type	Estimated quantity
Medical Waste	Clinical	10 tonnes/year

3.1.2 Atmospheric emissions

Various types of construction equipment will be used from the inception of site work until commissioning of the LNG facility. While the majority of this equipment will use diesel fuel, some equipment will use petrol.

Expected emissions will include oxides of nitrogen (NO_X), carbon dioxide (CO_2), carbon monoxide (CO), oxides of sulphur (SO_X), particulate matter (PM_{10}) and volatile organic compounds (VOCs). Table 3.2 provides an estimate of expected emissions generated by the use of construction equipment for a construction period of four years and nine months, which is the anticipated time for constructing two LNG production trains.

Table 3.2 also shows the further emissions generated through the addition of trains 3 and 4. During the construction period, it is anticipated that diesel consumption will be some 10.2ML and petrol consumption in the order of 1.6ML.

Table 3.2 Estimated site air emissions, during the construction phase

Emission	Total emissions (tonnes) (Trains 1 and 2)	Total emissions (tonnes) (Trains 3 and 4)
PM_{10}	470	470
SO_X	430	430
NO_X	5,620	5,620
CO	1,410	1,410
CO_2	209,880	209,880
VOCs	520	520

Notes:

The estimate is based upon a four-year, nine-month construction period to construct trains 1 and 2 and a similar construction period for trains 3 and 4. As such the emission would be similar

Emissions include site emissions only – no emissions associated with the transport of materials, equipment or personnel to and from the site are included in these estimates.

United States Environmental Protection Agency (USEPA) emission factors have been used to derive emission levels.

3.1.3 Wastewater discharges

Wastewater from construction phase activities will include hydrotest water, flushing water, vehicle and equipment washdown water, brine from the desalination plant, stormwater and sewage treatment plant effluent.

Estimated water quantities are outlined in Table 3.3. However, where appropriate, it is intended that hydrotest water, flushing water and stormwater will be transferred to sedimentation pond(s) for reuse onsite for dust suppression and irrigation, in accordance with regulatory requirements.

Sedimentation pond(s) water will be collected and used to pressure test the storage tanks, pipework and other vessels on-site. This water will be recycled for various testing requirements if the quality is suitable.

Upon completion of all hydrotesting, any remaining hydrotest water will be discharged offshore at a location with adequate flushing to enable rapid dispersal. The test water may contain traces of biocides and oxygen scavengers used to protect the inner surface of the tanks from risks of fouling and corrosion. This water will be monitored and treated, if necessary, prior to any release.

Table 3.3 Waste streams and estimated quantities for construction activities

Waste stream	Estimated quantity[1]
Hydrotest water and flushing water	140,000m^3 (total for construction of trains 1 and 2)
Washdown water	200m^3 per year
Quarantine washdown water	100m^3 per year
Treated sewage effluent	110,000m^3 per year
Stormwater	100,000m^3 per year
Brine	950,000m^3 per year*

[1] Based on an average construction workforce of 1050

It is expected that the discharge of brine from the desalination plant will reach a maximum of 2,300m^3 per day (based on a maximum construction workforce of 3,300). Initially, prior to the completion of the jetty, brine will be discharged near to the end of the materials off-loading facility (MOF) but sufficiently offshore to prevent stagnant hyper-saline areas from forming.

Table 5.1 provides more detail upon the anticipated quantities of each of these waste streams, as well as associated management options to minimise wastewater discharges and associated environmental or human harm.

It is expected treated sewage effluent from the on-site sewage treatment plant will reach a maximum of 860m^3 per day (based on a maximum workforce of 3,300) during the construction period. Effluent surplus to on-site irrigation needs will be discharged to Port Curtis, in accordance with regulatory requirements.

In addition, wastewaters will be generated by the washing down of construction vehicles and plant, including the concrete batching plant.

3.2 Operating wastes

The types of waste generated from the LNG facility's operating activities will include:

- Atmospheric emissions
- Wastewater discharges
- General and regulated solid and semi-solid wastes.

The following sub-sections and Table 5.1 provide information about the anticipated quantities of each of these waste streams, as well as associated management options to minimise disposal of wastes and potential environmental or human harm.

3.2.1 Atmospheric emissions

CSG is processed to produce LNG with primary inputs into the plant being pre-treated (de-watered) CSG from the pipelines, seawater (which is desalinated) and various supplies and chemicals required for normal plant operation and maintenance. A number of these stages are primarily closed-loop cycles, whereby outputs are re-used as inputs.

Wastes associated with LNG processing are primarily generated as atmospheric emissions, primarily from the combustion of hydrocarbons. During normal operation, the majority of these are produced from the following stationary sources:

- Gas turbines to drive refrigerant compressors.
- Gas turbines for power generation.
- Acid gas incinerators.
- Hot oil heaters.
- Nitrogen rejection unit thermal oxidisers.
- Dry gas flare (pilot light operating).
- Wet gas flare (pilot light operating).
- Marine flare (including loading of LNG vessels and unloading LPG vessels, if required).

Non-routine operations are those outside of the general operating parameters for the facility, which occur intermittently for a short duration. Emissions from these events will be variable and intermittent. These emission sources include:

- Dry gas flare (maintenance or upset conditions).
- Wet gas flare (maintenance or upset conditions).
- Marine flare (maintenance or upset conditions).
- Variable emissions (start up and shut down).

Mobile sources and the emissions include vehicle emissions, ferry and barge movements and transit of LNG and LPG vessels.

The main atmospheric pollutants that are generated during operations from these sources include:

- Carbon dioxide (CO_2) emissions vented from the amine pre-treatment process.
- CO_2, NO_X, CO, PM_{10}, sulphur dioxide (SO_2), nitrous oxide (N_2O) and methane (CH_4) emissions from gas turbine stacks, with the primary sources being compressor turbines and power generation turbines.
- CO_2, NO_X, CO, PM_{10}, SO_2, N_2O and CH_4 emissions from flaring (wet, dry and marine flares).

- Volatile organic compounds such as CH_4, ethylene (C_2H_4) and propane (C_3H_8) as fugitive emissions (unintended loss through processing).
- Nitrogen (N_2) via the nitrogen rejection unit during liquefaction.

An expected emissions inventory for primary sources is given in Table 3.4.

Table 3.4 Point source emissions inventory

Parameter	Emission (4 trains) (tonnes/year)[1]
PM_{10}	220
SO_2	750
NO_X	3,550
CO	2,930
CO_2	5,353,000
N_2O	100
CH_4	930
VOCs	180
Tonnes CO_2-e/year	5,403,400

Notes: [1] Emissions from non-routine flaring are included.
[2] CH_4 emissions do not consider oxidiser on the nitrogen removal unit.

The expected level of fugitive emissions has been estimated based upon information from, Australia Pacific LNG's joint venture partner, ConocoPhillips, from its operational experience at the Darwin LNG facility. Fugitive emissions are generated from piping connectors, flange connections, open-ended lines, pumps, valves and other piping equipment. The estimates for each train are:

- Methane – 180 tonnes/year
- Ethylene – 140 tonnes/year
- Propane – 190 tonnes/year.

3.2.2 Wastewater discharges

The LNG facility operations will generate the following wastewater disposal streams:

- Stormwater from the LNG facility site
- Sewage effluent produced by the sewage treatment plant
- Brine from the seawater desalination plant
- Potentially contaminated wastewater from the facility process areas.

Clean stormwater

Stormwater is generally not considered a waste unless it becomes contaminated in a construction or process area. As such, stormwater will be diverted around the LNG facility's footprint to reduce the quantity of stormwater entering the site.

Clean stormwater will be collected from sections of the LNG facility that has limited potential for contaminating this run-off. This stormwater will be directed by surface drains to the hydrotest pond for storage prior to reuse within the LNG facility for irrigation and dust suppression purposes and/or for ocean disposal during wet weather.

Sewage treatment plant effluent

The sewage treatment plant will be an extended aeration, biological treatment plant designed to treat the wastewater to applicable standards for use for site irrigation purposes and/or for discharge to Port Curtis.

It is anticipated that during operation of the LNG facility (four-trains), effluent disposal will be at an average rate of 84m^3/d and up to a maximum rate of 360m^3 per day (based on an average population of 225 and a maximum population of 375). Indicative effluent characteristics from the sewage treatment plant are detailed in Table 3.5.

Treated sewage effluent will be stored in a tank for dechlorination purposes prior to being used for irrigation purposes or discharged to Port Curtis. If it is discharged it is likely that treated sewage effluent will be discharged with the desalination plant brine (refer to below).

Table 3.5 Indicative treated sewage effluent characteristics

Parameter	Concentration
pH	6.5 - 7.5
Five-day biochemical oxygen demand (BOD_5)	10 - 20mg/L
Oil	<10mg/L
Total nitrogen	<4mg/L as N
Total Kjeldahl nitrogen	1 - 4mg/L
Ammonia nitrogen	1 - 4mg/L
Total phosphorus	<1mg/L
Chlorine	<2mg/L
Total dissolved solids (TDS)	250mg/L
E-Coli	<100cfu/100mL

Brine disposal

The brine discharge will be piped and discharged into Port Curtis via an outfall and diffuser arrangement. The diffuser design incorporates the following characteristics:

- Length: 20m
- Number of Ports: Six
- Port diameter: 0.10m with the ports discharging in the offshore direction, horizontal to the bed and perpendicular to the current direction
- Water Depth: 3m below lowest astronomical tide (LAT).

The brine discharge point will be at a location sufficiently far offshore to prevent the formation of stagnant hyper-saline areas in harbour waters and include the following characteristics:

- Sufficient depth for mixing to occur and an adequate distance from the shoreline and from the seawater intake
- Free flowing current conditions that would disperse the brine discharge
- Available access for maintenance purposes
- Free from vessel contact and within the LNG facility's marine lease area.

It is anticipated that during steady state LNG production (four-trains), brine disposal will be at an average rate of 2,300m^3 per day and up to a maximum rate of 3,600m^3/hr.

The indicative characteristics of the brine are detailed in Table 3.6.

Table 3.6 Indicative brine characteristics, desalination plant

Parameter	Concentration
pH	6 – 8
Total dissolved solids	<60,000mg/L
Calcium	<750mg/L
Magnesium	<2,500mg/L
Potassium	<800mg/L
Sodium	<22,000mg/L
Chloride	<33,000mg/L
Fluoride	<3mg/L
Sulfate	<6,000mg/L
Strontium	<25mg/L
Total suspended solids (TSS), average	<30mg/L

Parameter	Concentration
Total suspended solids, maximum	40mg/L
Chlorine	<1mg/L
Anti-scalant	<8mg/L
Flocculent	<5mg/L
Polymer	<1mg/L
Silica dioxide	<2mg/L
Five-day biochemical oxygen demand	<10mg/L

Both near-field and far-field modelling were undertaken to assess dispersion of the brine discharge using an outfall and diffuser arrangement. In the near-field, it was predicted there would be no discernible impact from the discharge of the brine reject to the water quality in the vicinity of the diffuser as dilutions are adequate.

From the far-field modelling it was predicted maximum salinity increases do not exceed 0.11ppt, which is within ambient seawater variation. The potential impact from accumulation of salinity resulting from the LNG facility discharges is considered negligible.

Potentially contaminated wastewater

An integral part of the LNG facility is a dedicated system to collect and treat process and oily wastewater, including oily water from the compressors and various hydrocarbon leaks, and potentially contaminated stormwater, prior to re-use or discharge. Such wastewater will be treated by passage through an oil and water separator (corrugated plate interceptor), a dissolved air flotation unit and an effluent filter.

The oily wastewater will be pre-treated in a hydrocarbon sump drum where vapours and condensate will be separated. The condensate will be pumped to the oil and water separator for retrieval of free oil and the vapours will be sent to the wet gas flare for disposal. The separator produces three waste streams – sludge, treated effluent and waste oil.

The sludge will be temporarily stored in a sludge holding tank, pending periodical transport by a licensed contractor for disposal at a licensed waste management facility. Waste oil will also be stored and transported off-site for recycling. The treated effluent from the oil and water separator will be sent to the dissolved air flotation unit and effluent filter to remove any remaining oil. It will be stored on-site in a tank with treated sewage effluent and is likely to be discharged into Port Curtis with the desalination plant brine if not used for on-site irrigation purposes.

The indicative characteristics of the treated effluent are detailed in Table 3.7. It is anticipated that during steady state LNG production (four trains), this water stream will flow at an average rate of 600m^3 per day and up to a maximum rate of 2,400m^3per day.

Table 3.7 Indicative treated effluent characteristics

Parameter	Concentration
pH	6 - 7
BOD_5	<20mg/L
Oil	<10mg/L
Total Nitrogen	<5mg/L
Total Phosphorous	<2mg/L
TSS	<30mg/L[1]
TDS	<250mg/L[1]

[1] Note: quality characteristics are influenced by the water quality of the process water used

Shipping waste

Management of shipping waste, such as wastewater discharges from shipping ballast, will be regulated by the International Convention of Pollution from Ships (MARPOL), as established by International Maritime Organisation.

Additionally, the Australian Quarantine Inspection Service (AQIS) enforce mandatory ballast water management requirements for vessels engaged in international shipping, which will cover vessels associated with the LNG facility. This is to ensure that exotic species and sediments are not introduced into the Gladstone Port ecosystem from ballast water releases. Ballast water will be exchanged in international waters prior to entering the Great Barrier Reef Marine Park.

Management of shipping waste is undertaken by Gladstone Ports Corporation (GPC) under a certified agreement with the AQIS.

The AQIS deems all saltwater from ports and coastal waters outside Australia's territorial sea to present a high-risk of introducing exotic marine pests into Australia. The discharge of high-risk ballast water from ships is prohibited anywhere inside Australia's territorial sea. Therefore, the ballast water management option for LNG exports is:

- Non-discharge of high-risk ballast water in Australian ports or waters.
- Vessels coming into the Port of Gladstone must make waste available for collection by an authorised collector vessel. Wastes including animal waste, organic refuse and galley scraps of quarantine waste.

Additionally, ConocoPhillips (as the Australia Pacific LNG operator of the LNG facility) will have in place a corporate global marine vetting standard. This is a standard for vessel vetting and marine terminal clearance for vessels that load or unload at a facility operated by ConocoPhillips. This is to ensure prudent management of marine risk.

3.2.3 Solid and semi-solid wastes

The solid and semi-solid wastes generated through the operation of the LNG facility will be:

- General wastes including domestic waste garbage and recyclables from onsite workers, office wastes, paper and cardboard, as well as wood products from packaging.
- Medical and first aid station waste.
- Regulated wastes and/or hazardous wastes including waste lubricating oils, sewage treatment plant sludge, molecular sieve waste, oily sludge from the oil and water separator and dissolved air floatation unit, cellulose and spent solvents.

Table 3.8 outlines the anticipated solid waste generation in tonnes per year for the development of the four-train LNG facility.

Table 3.8 Anticipated LNG facility solid waste generation (4 trains)

Waste product	Waste source	Quantity (Tonnes/year)
General wastes	Plant area	510
Waste lubricating oils	Plant area	220
Spent oils	Plant area	4
Cellulose	Plant area	3
Spent solvents	Plant area	<1
Waste oil from slop oil tank.	Plant area	140
Oily sludge/float	Oil and water separator/dissolved air floatation unit	30
Cartridge filters	Plant area	12
Oil filters/oily rags	Plant area	23
Biological sludge (dry basis)	Sewage treatment plant	15
Molecular sieve ceramic balls[1]	Molecular sieve dehydrators	25
Molecular sieve adsorbent[1]	Molecular sieve dehydrators	270
Activated carbon (amine filter)	Acid gas removal unit	130
Mercury ceramic Balls[2]	Mercury removal unit	90
Mercury adsorbent[2]	Mercury removal unit	150
Amine waste	Amine plant	170
Waste drums and containers	Plant area	2
Waste turbine detergent	Compressor area	170

Waste product	Waste source	Quantity (Tonnes/year)
General recycling	Plant area	350

[1] Tonnes every three years.

[2] Adsorbent bed life is expected to be the LNG facility design life.

Waste materials generated during the operational phase that cannot be re-used on-site will be collected in mobile garbage units and suitably sized roll-on roll-off bins with proper waste identification, colour and labels in a designated staging area and transported by a licensed contractor for re-use, recycling or disposal at licensed waste management facilities on the mainland.

Pre-processing such as compaction on-site will be considered during detailed planning with waste management contractors.

3.3 Decommissioning wastes

It is expected that individual items of equipment and the LNG facility as a whole will be decommissioned when its operation is no longer economically viable.

Facility decommissioning activities will be carried-out in accordance with a decommissioning plan and will comply with regulatory requirements that are in force at the time of decommissioning and good industry practice.

The overall aim of the decommissioning plan will be to ensure that the site does not pose an on-going risk to public safety or the quality of the environment and fulfils community expectations. The decommissioning plan will be prepared for the facility before decommissioning work starts, in consultation with regulatory authorities and relevant stakeholders.

In preparing the decommissioning plan, Australia Pacific LNG will aim to demonstrate how it will reduce as far as practicable the amount of waste requiring disposal. This will include consideration of re-use and recycling alternatives where feasible, such as:

- Removal for use by another operator.
- Removal for sale to a third party.
- Leaving in place facilities or infrastructure of benefit to the community.

The decommissioning plan will also provide the procedures to be followed for the removal or making safe of the LNG plant, equipment, structures and buildings. Table 3.9 outlines estimated wastes streams and quantities.

Table 3.9 Decommissioning waste and quantities

Waste product	Quantity
Structural steel	33,000t
Concrete	150,000m^3
Jetty trestle	180m equivalent
Piping	213,000m equivalent

Waste product	Quantity
Electrical	1,800,000m equivalent
instrumentation	6,000m equivalent
Pipe and equipment insulation	160,000m equivalent
Buildings	15,000m^2
Mechanical equipment	890 items

The decommissioning contractor will designate waste management areas for segregation of the waste into re-use, recycle and disposal streams. Plant and equipment and components that are in good working order will be re-used, as appropriate. The decommissioning contractor will engage recycling contractors to collect all recyclable material and recycle and re-use as appropriate.

The hydrocarbon product to be processed will be predominantly gaseous, so soil contamination is not expected to be an issue. However, the decommissioning plan will provide for a soil contamination survey to be conducted to determine if there has been any inadvertent contamination (e.g. diesel fuel). If any contamination is discovered, a soil remediation program will be developed and implemented consistent with regulatory requirements and good industry practice at the time of decommissioning.

3.4 Dredging operations

Dredging of the approach channel, swing basins, berth pockets, and the MOF footprint will be required to enable safe shipping access to the LNG facility.

The scope of the Western Basin Dredging and Disposal Project currently under assessment by Government agencies includes capital and maintenance dredging and dredge material disposal requirements for shipping channels, berth pockets and the approach channel to the MOF. This dredging is outside the scope of the Australia Pacific LNG Project EIS.

Additional dredging to that described above, will be required for construction of marine infrastructure, including the causeway, roll-on roll-off dock, ferry dock, MOF, jetty and wharfs. Dredging within the scope of the Australia Pacific LNG Project EIS also includes requirements for vessel access to the causeway, roll-on roll-off dock and ferry dock. This dredging work is located to the north of the dredge footprint and has an estimated volume of 500,000m^3. Australia Pacific LNG is assessing options for minimising the dredging footprint and quantity of dredge material for disposal associated with these marine facilities. Dredging for construction of marine infrastructure and vessel access at Fisherman's Landing is included within the scope of the Australia Pacific LNG Project's EIS.

It is expected that GPC will undertake all of this dredging on behalf of Australia Pacific LNG. The disposal of all dredge material within the scope of the Australia Pacific LNG's EIS will be at location(s) approved under GPC's approved projects, such as the Western Basin Dredging and Disposal Project.

3.5 Potential impacts

The potential impacts associated with non-compliance in waste management could include:

- Land and water contamination from inappropriate storage, handling and disposal of solid and liquid wastes.
- Land and water contamination from spills and releases during handling and transportation.
- Increased populations of vermin from inappropriate storage and handling of waste.
- Odours due to inappropriate storage and handling of waste.
- Water contamination from discharges of contaminated stormwater, sewage treatment effluent, and brine.
- Inefficient use of resources.
- Adverse effects to marine, aquatic and terrestrial flora and fauna.

Given ConocoPhillips' (as the Australia Pacific LNG operator of the LNG facility) track record in effective waste management and proven control measures, construction, operational and decommissioning wastes are considered to present a low risk to the environment and/or public health.

4. Waste management plan

The main purpose of waste management is to minimise impacts to the environmental values as outlined in Table 2.1 . Several strategies will be used for the LNG facility, principally the implementation of the waste management hierarchy and cleaner production principles. These are discussed in further detail in Section 4.5 and Section 4.6 respectively.

The waste management actions proposed for the LNG facility are detailed in Table 5.1.

4.1 Objectives and performance indicators

The objectives of this plan are to:

- Minimise contamination of the site
- Appropriately manage waste generated on-site
- Avoid wastes entering the site
- Minimise waste generated from the site
- Maximise waste recycling and reuse.

The performance indicators for this plan are:

- Zero contaminants or wastes are discharged to land or water on-site
- Zero unauthorised discharges of contaminants or waste to land or water off-site
- Minimise the quantity of wastes disposed to a landfill
- Dispose of all waste appropriately
- Zero complaints relating to waste management.

4.2 Responsibilities

The persons responsible for compliance with this plan during the construction period and operational phase and their responsibilities are summarised below.

4.2.1 Construction phase

During the construction period, the Construction Site Manager will be the Responsible Person and will undertake the following:

- Ensure that the requirements of this plan are satisfied.
- Ensure that contractors and any sub-contractors engaged in the construction of the LNG facility are advised of their responsibilities to undertake their activities required by this plan.
- Ensure that contractors and any sub-contractors engaged in the construction of the LNG facility are advised of their responsibilities regarding waste management.
- Ensure that the auditing/monitoring program is implemented properly.

- Prepare incident reports and implement corrective actions.
- Ensure appropriate records are kept and maintained on-site.
- Retain a copy of this plan on-site for reference by appropriate personnel and provide copy of plan to contractors.
- Recommend additions or changes to this plan based upon experience gained from implementation of the plan.

4.2.2 Operational phase

During the operational phase and subsequent de-commissioning period, the Australia Pacific LNG Environmental Manager will be the Responsible Person and will undertake the following:

- Ensure that the requirements of this plan are satisfied.
- Ensure that the auditing/monitoring program is implemented properly.
- Prepare incident reports and implement corrective actions.
- Ensure appropriate records are kept and maintained on-site.
- Retain a copy of this plan on-site for reference by appropriate personnel.
- Recommend additions or changes to this plan based upon experience gained from implementation of the plan.

4.3 Training and awareness

Environmental management requirements including waste management will be included in an induction and training program for all personnel employed/contracted on the site for the construction and operational phases. Environmental topics will be included in toolbox talks or other on-going worker training and awareness, as required. All project personnel will be made aware of environmental issues relating to waste management and this plan.

A register of training for each employee is to be maintained and reviewed as required.

4.4 Summary of key environmental design features

The following is a summary of the key environmental design features incorporated in the design and operation of the facility to avoid or minimise potential environmental impact.

4.4.1 Liquid waste minimisation

The LNG facility will use a variety of technologies and practices to control and minimise liquid wastes. These measures will include:

- Segregation of wastewater streams and their treatment (contaminated stormwater, treated sewage effluent, brine, clean stormwater).
- Re-use of treated sewage effluent and treated stormwater for potential on-site irrigation.

- Use of air cooling in place of water cooling; this will avoid blowdown water and thermal discharge impacts.
- Use of a waste heat recovery system using heat transfer oil in place of steam to avoid the need to dispose of boiler blowdown and to produce demineralised water.
- Use of dry gas seals rather than water cooling to avoid potential water blowdown and thermal discharges impacts.
- Use of secondary containment structures for diesel tanks.

4.4.2 Solid waste minimisation

The LNG facility will use a variety of technologies and practices to control, minimise, and re-use solid wastes during construction and operation. These measures will include the:

- Implementation of waste management practices through the supply chain that will minimise the generation of solid wastes and recycle as much as practicable at the source.
- Disposal of wastes to an approved landfill on the mainland.
- Re-use of cleared site vegetation as mulch to aid site landscaping following site earthworks.
- Air-drying of solvent-based wastes (waste paint, paint thinner, adhesives, and so on) prior to disposal.

4.4.3 Atmospheric emissions minimisation

The LNG facility will make use of a variety of technologies and practices to control and minimise gaseous wastes. These measures will include the:

- Use of CSG as the fuel source where practicable, in preference to liquid or solid fuels.
- Use of power generators equipped with dry low NO_x technology, and aero-derivative gas turbine drivers equipped with dry low emission (DLE) technology.
- Use of waste heat recovery to supply process heat.
- Capture and re-liquefaction of excess gas generated during ship loading in the LNG process rather than being flared. This will reduce emissions resulting from the burning of this gas stream, whilst preserving CSG resources.
- Use of closed-loop sampling systems to minimise fugitive emissions.

4.5 Waste management hierarchy

The waste management hierarchy will be the primary tool used for sustainable waste management.

4.5.1 Waste avoidance

Waste avoidance will be achieved through the consideration of alternative products, implementation of alternative technology, contracts with companies encouraging sustainable waste management practices and procurement of pre-fabricated materials.

The use of pre-fabricated materials will play an important part in waste avoidance for the LNG facility. Given the remote location and limited access to the site, pre-fabricated/modular components will be brought onto site for use at the LNG facility. This will substantially reduce the quantities of some waste streams associated with the construction phase of the LNG facility, including scrap steel and surplus concrete.

4.5.2 Waste re-use

Re-use refers to waste that is re-used without substantially changing its form. Re-use will be achieved initially by identifying re-use opportunities on-site and subsequently through identifying market demands for waste items. To maximise re-use opportunities, wastes will be segregated. Waste items that will be generated by the LNG facility and may be re-used include:

- Wood products from packaging
- Cleared vegetation
- Surplus concrete
- Building materials
- Organic wastes
- Wastewaters.

Future investigations regarding waste re-use will continue. Additionally, the marketability of wastes will be regularly reviewed to ensure potential new and emerging opportunities for waste re-use are maximised.

4.5.3 Waste recycling

Recycling represents an important component of the waste management strategy used onsite. It involves the treatment of a waste that is no longer usable in its current form and using it to create new products. A large percentage of the LNG facility's wastes streams (remaining after re-use opportunities have been exhausted) will be recycled. Table 4.1 provides an outline of the recyclable product, potential end use and a qualitative assessment of the marketability of the product.

Table 4.1 Recyclables and market potential

Recyclable product	Potential end use	Marketability
Scrap ferrous metal	Scrap metal will be managed via a third-party licensed recycling contractor. The product will be removed from the site, shredded and either re-smelted or used in the smelting process. Any grade of steel can be recycled to top quality new metal.	High marketability with continual high demand from local and global market available for scrap metal recycling.
Scrap non-ferrous metal	Scrap metal will be managed via a third-party licensed recycling contractor. The product will be removed from the site, shredded and crushed into bales for resale. It is then smeltered to produce a molten product and forged. There is very little property differences between recycled and virgin	High marketability with continual high demand from local and global market available for scrap metal recycling.

Recyclable product	Potential end use	Marketability
	non-ferrous metal.	
Lead acid batteries	Batteries will be managed via a third-party licensed recycling contractor. The lead acid batteries will be removed from the site and striped with workable components recycled into new batteries.	High marketability with Queensland markets available to recycle this waste.
Scrap/surplus concrete	Crushed and re-used onsite for road base, hardstand areas and erosion and sediment control.	On-site uses
Paper, cardboard, glass, some plastics, tins and cans	These recyclable wastes will be managed via a third- party licensed recycling contractor. The products will be removed from site and taken to a material recovery facility to sort to specifications, baled, shredded, crushed, or otherwise prepared for resale.	Medium marketability as the demand from Australian and global markets for these products are unstable and will fluctuate.
Waste oils	Waste oils will be managed via a third-party licensed recycling contractor. The oils will be taken from the site, filtered and demineralised, propane de-asphalted and distilled to produce re-refined base oil suitable for use as a lubricant, hydraulic or transformer oil.	High marketability with Queensland markets available to recycle this waste.
Activated carbon	Activated carbon will be managed via a third-party licensed recycling contractor. Activated carbon will be taken from the site, impurities removed by either heat (thermal recycling) or steam (steam recycling) and re-used.	Medium marketability with limited Queensland markets available to recycle this waste.
Decommissioning equipment	A decommissioning plan will be developed that will maximise recycling opportunities. Waste concrete, ferrous metals and non-ferrous metals will be managed as above. Working plant and equipment will be sold as appropriate.	Medium to high marketability due to high value recyclable materials generated.

Regulated waste that can be recycled will be transported off-site by a licensed contractor to an appropriate recycling facility.

4.5.4 Energy recovery

Energy recovery is basically reducing the input of energy into a system by using energy from other parts of the overall system.

Energy recovery has been incorporated into design of the LNG facility with the waste heat recovery units to supply process heat into the system and the nitrogen rejection unit with thermal oxidisers.

4.5.5 Waste disposal

Waste disposal to landfill will occur where there is no other practical option available. General waste will be transported to an approved licensed landfill for disposal in accordance with regulatory requirements. Australia Pacific LNG will be involved in the selection of the appropriate waste transporters and landfill(s) for disposal.

One potential option which has been identified is the Benaraby landfill. This landfill is located on the Bruce Highway, Benaraby and is owned and operated by Gladstone Regional Council. It is a licensed facility able to accept general commercial waste, recyclable waste, green waste, construction and demolition waste, sewage sludge and other regulated wastes. The landfill is a single-lined landfill, consisting of 600mm of compact clay, with a leachate collection system. The site is approximately 220ha and has an expected life of 150 years (*Pers. comm.* Scott Prior, Co-ordinator Waste Services, December 2009).

Regulated waste will be transported off-site by a licensed contractor to an appropriate waste facility licensed for regulated waste acceptance. Following discussions with various licensed regulated waste management contractors in the area, it was identified that several waste management contractors were able to remove and have the facilities to dispose and/or recycle regulated waste storage, handling, disposal and spill response for hazardous waste. Combustible and flammable materials will be stored in appropriate bunding in accordance with *Austrailan Standard 1940: The Storage and handling of flammable and combustible liquid*s. Other Australian standards for the storage and handling of dangerous goods will be applied. Spill containment material and spill kits will be strategically located throughout the LNG facility and employees will be trained to use the kits.

In the event of a LNG spill, the temperature differential between the LNG and ambient air will cause the LNG to vaporise, form a cloud and eventually dissipate. Leaks and spills are mitigated though extensive onsite monitoring for leak detection, emergency shut down if gas is detected, exclusion zones around LNG loading and shipping operations and the implementation of safety procedures.

4.6 Waste tracking

A site register will be developed and maintained for all wastes generated onsite. It will include the following details:

- Type of waste
- Volume
- Origin
- Dates of collection
- Storage location
- Any storage particulars
- Date of disposal/recycling
- Name and details of transporter and facility used to dispose the waste.

The tracking of regulated wastes is a legal requirement under *the Environmental Protection (Waste Management) Regulation 2000*. Details including waste type, quantity, waste transporter and disposal location must be recorded and provided to Department of Environment and Resource Management. The treatment, storage and transport of a regulated waste require an environmental authority under the EP Act. Where a contractor carries out these activities, the contractor will be required to hold the appropriate approvals.

4.7 Waste auditing and monitoring

Waste streams and quantities will be monitored through waste management audits during the construction phase initially on a monthly basis and during the operational phase at least on an annual basis. The purpose of auditing the waste management activities onsite includes:

- Ensure and monitor compliance with approval conditions.
- Assessment of the actual wastes compared to predicted waste streams and quantities.
- Monitor potential impacts from wastes.
- Review the waste transportation records.
- Recommend future actions to improve waste management practices.
- Monitor the implementation of the principles of waste management hierarchy.

Prior to engaging any waste contractor to transport, recycling, treat or dispose of any wastes related to the LNG facility, the contractors will be evaluated to ensure compliance with the waste management plan. Subsequent to the evaluation demonstrating compliance with the Plan, an approval will be granted for the contractor and/or waste management facility to manage the waste.

Monitoring of the LNG facility's housekeeping, such as waste storage areas, waste segregation, windblown litter, stockpiles, will be undertaken on a weekly basis and corrective action employed as required.

4.8 Waste reporting

The National Environmental Protection Council has endorsed a national environment protection measure (NEPM) in the form of the national pollutant inventory (NPI). It is a database designed to provide stakeholders and government agencies information about the type and quantity of substances emitted to land, water and air. The purpose of the NPI is to:

- Provide information to industry and government to assist with environmental planning and management.
- Provide the community with up-to-date information about substance emissions and transfers from industrial facilities.
- Promote waste minimisation, cleaner production, and energy and resource efficiency.

Reporting of emissions under the NEPM will be an annual requirement for the LNG facility for both the construction and operational phases.

5. Summary of waste descriptions and management

A summary of waste descriptions and management is provided in Table 5.1.

Table 5.1 Summary of wastes and management

Phase	Waste	Source	Characteristics/nature	Estimated quantity	Potential impact	Management	Responsibility
Site preparation	Overburden, excess on-site material	From earthworks on-site	Inert waste	300,000m^3	Erosion and sedimentation of waterways Surface water quality degradation due to increased sediment loads Contaminates from overburden material contaminating surface water and subsequent release to the environment namely Port Curtis, thus degrading the marine environment	The construction contractor will undertake all stockpiling efficiently and with proper erosion control The construction contractor will ensure appropriate sediment and erosion control measures are in place. Additionally, all site run-off will be captured in sedimentation ponds for treatment as necessary prior to any release into Port Curtis	Construction contractor
	Trees, brush, vegetation	Clearing of vegetation within the lease area	Organic material	Approximately 30,000 to 35,000t	Degradation of marine environment through littering of waterways adjacent to site Hazards to ships and other recreational vessels Fire hazard	Mulching/chipping of leaves, branches and brush for use, where practicable, onsite for erosion control and rehabilitation Due to fire risk of excess mulch stockpiles, discussions will take place regarding alternate disposal/treatment options Milling of larger merchantable timber if viable and where there is demand	Construction contractor
Construction	Machinery/ plant emissions	Construction machinery fuel use. Transportation fuel use. Stationary energy through electricity use. NO_x and SO_x emissions from, ferries, vehicles, machinery and plant All moving parts of machinery and plant for the clearing, earthworks, power generation, pumping, etc	Greenhouse gas emissions Fugitive emissions NO_x, CO_2, CO, SO_x and VOCs	Variable (for trains 1 and 2 only as it is the worst case) NO_x 5,620t CO_2 209,880t CO 1,410t SO_x 430t VOC 520t Approximately 85,000 tonnes CO2-e	Contributions to lifecycle greenhouse gas emissions Fugitive emissions released to the Gladstone air shed Reduced air quality for Gladstone	Use of larger trucks fully loaded whenever practicable Use of fully loaded ferries, barges and ships whenever practicable Maintenance of major energy users to ensure efficient operation Use of competitive local sources of supply, when it is possible, to minimise transport Use of recycled office paper products where the quality is adequate for its usage Switching off or using standby mode for electrical devices (including lights) when not in use during work hours and all off after hours or using motion sensors Use of energy efficient lighting, whenever practicable Consider other initiatives to reduce emissions such as energy efficiency, use of biofuels, use of fuels incorporating off-set programs and use of energy efficient materials Ensure all machinery/plant is appropriately maintained and in good working order	Construction contractor
	Surplus concrete	Surplus concrete, over orders and from the wash-out of the	Inert with components such as cement (limestone and gypsum), water, fly ash, slag cement,	2,100t/yr	Minor contamination to land Loss of amenity due to poor	The construction contractor will designate a site/area for concrete wash-outs and surplus concrete	Construction contractor

Phase	Waste	Source	Characteristics/nature	Estimated quantity	Potential impact	Management	Responsibility
		concrete trucks	aggregate		housekeeping	Concrete will be crushed or broken for use as hard stand or sediment and erosion control or transported off-site for recycling to the extent practical	
	Scrap metals	Metals from packaging, machinery parts, food containers, drums and tins, cabling, etc	Inert waste Ferrous metals such as iron, steel and tin Non-ferrous metals such as aluminium, copper, brass and lead	275t/yr	Minor contaminated land Loss of amenity due to poor housekeeping	The construction contractor will segregate scrap metal from all other waste and designate a storage area The construction contractor will engage a scrap steel contractor to supply a roll–on-roll-off bin for the accumulation of scrap metals. The scrap metal contractor will regularly remove the scrap from the site	Construction contractor
	Oil, oily rags and oil filters (maintenance)	Oily rags from maintenance of machinery and plant Cleaning rags/cloths from cleaning various components of facilities and structures	Regulated waste Contaminated with hydrocarbons and chemicals	20t/yr	Release of oily rags to the environment causing minor contamination to land and surface waters and subsequent release to the environment (namely Port Curtis) Loss of amenity due to poor housekeeping	The construction contractor will utilise mobile bins for the segregation and storage of oily rags, cleaning rags and cloths, and oil filters The construction contractor will engage a licensed waste contractor	Construction contractor
	General waste / Recyclable waste (garbage)	Waste from the construction workforce, including packaging, food wastes, paper and cardboard, tins and cans, bottles and jars, etc	General waste including food wastes, packaging, plastics, glass, metals	510t/yr	Release of waste causing contamination of land and surface water and subsequent release to the environment namely Port Curtis, thus degrading the marine environment Loss of amenity due to poor housekeeping Increase in vermin	The construction contractor will designate several areas throughout the site for waste storage. Areas such as offices, lunch rooms, work shops, etc. will be serviced with mobile garbage bins. Several bins will be required for general waste as well as additional bins for co-mingled recycling, such as glass bottles and jars, metal tins and cans, paper and cardboard and plastic bottles. A licensed waste management contractor will be contracted to supply bins, transport waste, recycle recyclable waste and dispose of non-recyclable waste most likely at the Benaraby landfill	Construction contractor
	Paper and cardboard	Paper and cardboard from packaging, office paper, cardboard boxes, newspapers	Inert waste Made from a fibre called cellulose that comes from trees harvested from plantations and forests	130t/yr	Release of waste causing minor contamination of land and surface water and subsequent release to the environment Fire hazard Loss of amenity due to poor housekeeping Increase in vermin	The construction contractor will segregate all recyclable paper and cardboard waste and designate an area for storage until pick-up The construction contractor will engage a paper and cardboard contractor to supply roll-on-roll-off bins for the storage of accumulated paper and cardboard. The paper and cardboard contractor will regularly remove the paper and cardboard from the site	Construction contractor
	Wood products	Wood products from packaging and very limited vegetation	Inert waste Organic material	40t/yr	Release of waste causing minor contamination of land and surface water and subsequent	The construction contractor will designate an area for the storage of wood products. The construction contractor will engage a licensed contractor to remove and transport the wood products off-site for	Construction contractor

Phase	Waste	Source	Characteristics/nature	Estimated quantity	Potential impact	Management	Responsibility
		clearing			release to the environment Fire hazard Loss of amenity due to poor housekeeping Increase in vermin	recycling or re-use	
	Batteries	Batteries from machinery/ plant	Regulated waste, recyclable waste Chemicals, heavy metals, etc	50/yr	Release of waste causing minor contamination of land and surface water and subsequent release to the environment Loss of amenity due to poor housekeeping	The construction contractor will store batteries in a bunded area sized to 110% of the capacity. The waste contractor will regularly remove batteries and dispose or recycle depending on the quality of the waste	Construction contractor
	Tyres	Tyres from machinery/ plant	Regulated waste, recyclable waste	45t/yr	Release of waste causing minor contamination of land and surface water and subsequent release to the environment Loss of amenity due to poor housekeeping	The construction contractor will designate an area for the storage of tyres The waste contractor will regularly remove batteries and dispose or recycle depending on the quality of the waste	Construction contractor
	Waste paints, solvents and chemicals	Oils, solvents and chemical from maintenance and water treatment. The oils, solvents and chemicals will be stored in a bunded area in close proximity to the workshop	Regulated waste Liquid waste, chemicals hydrocarbons	4t/yr	Spills and overflows causing contamination of land, surface water and groundwater Spillage and subsequent release to the environment (namely Port Curtis), thus degrading the marine environment	The construction contractor will designate an area for the storage of waste oils and solvents The construction contractor will engage a waste oil and solvents contractor to supply a bulk container for the storage of oils and solvents. This container will be sited in a bunded area sized to 110% of the capacity. The waste oils and solvents contractor will regularly remove the waste oils and solvents and dispose or recycle depending on the quality of the waste	Construction contractor
	Medical waste	Medical waste from the first aid station	Clinical waste	10t/yr	Infectious and biohazard potential impact to employees on site	The medical officer will label and store the medical waste appropriately The construction contractor will engage a clinical waste contractor to remove and dispose/destroy the waste. The clinical waste contractor will regularly remove and dispose of the waste	Construction contractor
	Greywater and sewage	Greywater and sewage from portable amenities throughout the site, kitchen sinks, showers, etc	Regulated waste Liquid waste, contaminated with pathogens, such as bacteria, viruses, prions and parasitic worms; Non-pathogenic bacteria; Organic particles such as faeces, hairs, food, vomit, paper fibres, plant	110,000m^3/yr	Spills and overflows causing contamination of land, surface water and groundwater Spillage and subsequent release to the environment (namely Port Curtis), thus degrading the marine environment	The construction contractor will implement the management requirements outlined in the Wastewater Management Plan The construction contractor will develop a sewage treatment plant for the construction phase of the LNG facility. Until the sewage treatment plant is constructed the site will be supplied with portable amenities as required The construction contractor will be responsible for the maintenance of	Construction contractor

Phase	Waste	Source	Characteristics/nature	Estimated quantity	Potential impact	Management	Responsibility
			material, humus, etc Soluble organic material such as urea, fruit sugars, soluble proteins, drugs, pharmaceuticals, etc. Inorganic particles such as sand, grit, metal particles, ceramics etc Soluble inorganic material such as ammonia, road-salt, sea-salt, cyanide, hydrogen sulphide, thiocyanates, thiosulfates etc Gases such as hydrogen sulphide, carbon dioxide, methane etc			the portable amenities including the regular pump outs and inspections. The pump outs will be undertaken by a licensed liquid waste contractor to remove, transport and dispose of all treated sewage wastes The construction contractor will hire portable amenities, to include shower facilities, for the duration required. The portable amenity vendor will supply and ensure continual maintenance, cleaning and pump outs are being carried out. The construction contractor will also be responsible to ensure that the vendor is fulfilling their obligations A regulated liquid waste licensed contractor required for sewage waste transport and disposal until the sewage treatment plant is operational	
	Sewage treatment plant solid waste	Semi-solid waste product of the sewage treatment plant	Regulated waste Coarse primary solids and secondary sludge accumulated in the treatment process Toxic organic and inorganic compounds (e.g. heavy metals)	140t/yr	Releases causing contamination of land, and surface water	The sewage treatment plant will include contained storage for sewage treatment plant solids and waste A regulated waste licensed contractor will transport waste from the site for disposal	Construction contractor
	Cleaning/wash down water.	Water from washdown.	Liquid waste, potential regulated waste. Water with potential contaminates of hydrocarbons, silts and cleaning chemicals	200m^3/yr	Spills and overflows causing contamination of land, surface water and groundwater Spillage and subsequent release to the environment (i.e. Port Curtis), thus degrading the marine environment	The construction contractor will designate an area for wash down with a minimum distance of 20m from any drainage line. A trench will be constructed to capture and contain all wash down water. The wash down water will be pumped through the interceptor and through the stormwater system subsequent to visual inspection/monitoring for indications of sediments loads and/or hydrocarbon contamination The construction contractor will engage a waste oil and solvents contractor to supply a bulk container for the storage of waste oils and solvents. The waste oils and solvents contractor will regularly remove the waste oils and solvents and dispose or recycle depending on the quality of the waste	Construction contractor
	Wash down water.	AQIS facility at the LNG facility.	Liquid waste, potential regulated waste Water with potential contaminates of hydrocarbons, silts and cleaning chemicals	100m^3/yr	Spills and overflows causing contamination of land, surface water and groundwater Spillage and subsequent release to the environment (i.e. Port Curtis), thus degrading the marine environment	The construction contractor will construct a waste down facility with a closed loop system to capture and store the wastewater in accordance with AQIS requirements The construction contractor will engage a wastewater contractor approved by AQIS to remove and dispose of the waste	Construction contractor
	Hydrotest water	Water used during construction activities for integrity testing of	Liquid waste, potential regulated waste. Water with potential contaminates	140,000m^3 (based on the LNG tank volume and re-	Spills and overflows causing contamination of land, surface water and groundwater	After hydrostatic testing, the hydrotest water will be re-used where practicable and treated if necessary for release	Construction contractor

Phase	Waste	Source	Characteristics/nature	Estimated quantity	Potential impact	Management	Responsibility
		the LNG tanks, other vessels and piping.	of silts, cleaning chemicals, traces of biocides and oxygen scavengers used to protect the inner surface of the tanks from risks of fouling and corrosion.	use of hydrotest water for first two LNG tanks and the LPG tank).	Spillage and subsequent release to the environment namely Port Curtis, potentially degrading the marine environment		
	Brine	Reject water from the desalination process	Liquid waste with a high saline concentration.	950,000m^3/yr	The release of hyper-saline water into Port Curtis has the potential to degrade the marine environment Loss of biodiversity due to degradation of native flora and fauna	Discharge of brine will be sufficiently far offshore to prevent stagnant hyper-saline areas close inshore. The design of the outfall will include measures for diffusion dispersion Water quality parameters will be sufficient to be released into the marine environment so as to not cause harm to or degrade the marine environment	Designer / construction contractor
Operation	General waste (garbage)	Waste from the operational workforce, packaging, food wastes, paper and cardboard, tins and cans, bottles and jars etc	General waste including food wastes, packaging, plastics, glass, metals	510t/yr	Release of waste causing contamination of land and surface water and subsequent release to the environment namely Port Curtis, thus degrading the marine environment Loss of amenity due to poor housekeeping Increase in vermin	The operator will designate several areas throughout the site for waste storage. Areas such as offices, lunch rooms, work shops, etc. will be serviced with mobile garbage bins. Several bins will be required for general waste as well as additional bins for co-mingled recycling, such as glass bottles and jars, metal tins and cans, paper and cardboard and plastic bottles. A licensed waste management contractor will be contracted to supply bins, transport waste, recycle recyclable waste and dispose of non-recyclable waste most likely at the Benaraby landfill	Operator
	Oily rags,- oil filters, (maintenance)	Oily rags and filters from maintenance of machinery and plant Cleaning rags/cloths from cleaning various components of plant and structures	Regulated waste Contaminated with hydrocarbons and chemicals	23t/year	Release of oily rags to the environment causing minor contamination to land and surface waters and subsequent release to the environment (namely Port Curtis) Loss of amenity due to poor housekeeping	The operator will utilise mobile bins for the segregation and storage of oily rags and cleaning rags and cloths The operator will engage a licensed waste contractor	Operator
	Paper and cardboard	Paper and cardboard from packaging, office paper, cardboard boxes, newspapers	Inert waste Made from a fibre called cellulose that comes from trees harvested from plantations and forests	2t/yr	Release of waste causing minor contamination of land and surface water and subsequent release to the environment Fire hazard Loss of amenity due to poor housekeeping Increase in vermin	The operator will segregate all recyclable paper and cardboard waste and designate an area for storage The operator will engage a paper and cardboard contractor to supply roll-on-roll-off bins for the storage of accumulated paper and cardboard. The paper and cardboard contractor will regularly remove the paper and cardboard from the site	Operator

Phase	Waste	Source	Characteristics/nature	Estimated quantity	Potential impact	Management	Responsibility
	Wood products	Wood products from packaging and very limited landscape maintenance	Inert waste Organic material	0.5t/yr	Release of waste causing minor contamination of land and surface water and subsequent release to the environment Fire hazard Loss of amenity due to poor housekeeping Increase in vermin	The operator will designate an area for the storage of wood products. The operator will engage a licensed contractor to remove and transport the wood products off-site for recycling or re-use	Operator
	Molecular sieve ceramic balls	Dehydration process	Inert waste Ceramic is an inorganic, non-metallic solid	25t/yr	Release of waste causing minor contamination of land and surface water and subsequent release to the environment (i.e. Port Curtis) Loss of amenity due to poor housekeeping	Wastes which cannot be recycled will be collected in mobile garbage bins or roll-on-roll-off bins with proper waste identification and labels in a designated staging area. These wastes will be barged from the island and disposed of on the mainland in licensed landfill sites	Operator
	Molecular sieve adsorbent	Dehydration process	Regulated waste	270t/yr	Release of waste causing severe contamination of land and surface water and subsequent release to the environment (i.e. Port Curtis) Loss of amenity due to poor housekeeping	Wastes which cannot be recycled will be collected in mobile garbage bins or roll-on-roll-off bins with proper waste identification and labels in a designated staging area. This waste will be transported and disposed of by a licensed regulated waste management contactor	Operator
	Activated carbon	Acid gas removal unit Mercury removal units	Regulated waste It is a form of carbon that has been processed to make it extremely porous and thus to have a very large surface area available for adsorption or chemical reactions	130t/yr	Release of waste causing contamination of land and surface water and subsequent release to the environment (namely Port Curtis), thus degrading the marine environment	Options to recycle the activated carbon will be further investigated Wastes which cannot be recycled will be collected in mobile garbage bins or roll-on-roll-off bins with proper waste identification and labels in a designated storage area. This waste will be transported and disposed of by a licensed regulated waste management contactor	Operator
	Mercury ceramic balls	Mercury removal unit	Regulated waste	90t/yr	Release of waste causing contamination of land and surface water and subsequent release to the environment (namely Port Curtis), thus degrading the marine environment	Wastes which cannot be recycled will be collected in mobile garbage bins or roll-on-roll-off bins with proper waste identification and labels in a designated staging area. This waste will be transported and disposed of by a licensed regulated waste management contactor	Operator
	Mercury adsorbent	Mercury removal unit	Regulated waste	2150t/yr	Release of waste causing contamination of land and surface water and subsequent	Wastes which cannot be recycled will be collected in mobile garbage bins or roll-on-roll-off bins with proper waste identification and labels in a designated staging area. This waste will be transported and disposed	

Phase	Waste	Source	Characteristics/nature	Estimated quantity	Potential impact	Management	Responsibility
					release to the environment (namely Port Curtis), thus degrading the marine environment	of by a licensed regulated waste management contactor	
	Amine waste	Amine plant	Regulated waste Amine is related to a nitrogen compound-containing organic compounds that is derived, either in principle or in practice, from ammonia	170t/yr	Release of waste causing contamination of land and surface water and subsequent release to the environment (namely Port Curtis), thus degrading the marine environment	Wastes which cannot be recycled will be collected in mobile garbage bins or roll-on-roll-off bins with proper waste identification and labels in a designated storage area. This waste will be transported and disposed of by a licensed regulated waste management contactor	Operator
	Process water containing oils and solvents.	Oils and solvents from minor maintenance onsite. The oils and solvents will be stored in a bunded area in close proximity to the workshop. Oily water drains from the compressors. Hydrocarbon drains from regeneration gas compressor and regenerator reflux pumps.	Regulated waste Liquid waste, hydrocarbons: (waste lubricating oils, spent oils, oily sludge/float, spent solvents, waste oil from slop oil tank)	Waste lubricating oils 220t/yr Spent oils 4t/yr Oily sludge/float 30t/yr Spent solvents 0.4t/yr Waste oil from slop oil tank 140t/yr	Spills and overflows causing contamination of land, surface water and groundwater Loss of biodiversity due to degradation of native flora and fauna Spillage and subsequent release to the environment (namely Port Curtis), thus degrading the marine environment.	Process wastewater will be treated by CPI oil/water separator, a dissolved air flotation unit (DAF) and an effluent sand filter The sludge will be temporarily stored in a sludge holding tank, pending periodical transport by a licensed contract or for disposal at a licensed waste management facility. Waste oil will also be stored and transported off-site for recycling The treated water from the CPI will be sent to the DAF unit and effluent filter to remove any remaining oil. The treated effluent will be used as irrigation water and/or will be discharged into Port Curtis via an outfall Potential recycling or re-use options for waste oils will be investigated in conjunction with the waste management contractor	Designer / operator
	Treated sewage treatment plant effluent.	Greywater and sewage from bathrooms, toilets, showers and sink kitchens throughout the site	Regulated waste Liquid waste, contaminated with pathogens, such as bacteria, viruses, prions and parasitic worms Non-pathogenic bacteria; Organic particles such as faeces, hairs, food, vomit, paper fibres, plant material, humus etc Soluble organic material such as urea, fruit sugars, soluble proteins, drugs, pharmaceuticals etc Inorganic particles such as sand, grit, metal particles, ceramics etc Soluble inorganic material such as	$31,000m^3$/yr (based upon an average population of 225 people)	Spills and overflows causing contamination of land, surface water and groundwater Spillage and subsequent release to the environment (namely Port Curtis), thus degrading the marine environment	The operator will implement the management requirements outlined in the Wastewater Management Plan Sewage produced from the various buildings is fed by gravity in underground lines to sanitary sumps before being pumped into the onsite sewage treatment plant. The sewage will be treated in an extended aeration type activated sludge plant. Treated wastewater is further processed through tertiary treatment and stored before being re-used, where practicable and/or discharged to Port Curtis via the diffuser	Designer / operator

Phase	Waste	Source	Characteristics/nature	Estimated quantity	Potential impact	Management	Responsibility
			ammonia, road-salt, sea-salt, cyanide, hydrogen sulphide, thiocyanates, thiosulfates etc Gases such as hydrogen sulphide, carbon dioxide, methane etc				
	Sewage treatment plant biological sludge	Semi-solid waste product of the sewage treatment plant	Regulated waste Coarse primary solids and secondary sludge accumulated in the treatment process must be treated and disposed of in a safe and effective manner. This material is potentially contaminated with toxic organic and inorganic compounds (e.g. heavy metals)	15t/yr	Releases causing contamination of land, and surface water	The sewage treatment plant will include contained storage for sewage treatment plant solids and waste A regulated waste licensed contractor will transport waste from the site for disposal	Operator
	Brine	Reject water from the desalination process.	Liquid waste with a high saline concentration.	840,960m^3/yr	The release of hyper-saline water into Port Curtis has the potential to degrade the marine environment Loss of biodiversity due to degradation of native flora and fauna	The operator will implement the management requirements outlined in the Wastewater Management Plan Brine from the desalination process is to discharge into the marine environment via the diffuser, ensuring good mixing and dilution with ambient marine waters. Desalination process options have minimised the discharge quantity of the brine	Designer / operator
Process	Heaters	Gas from hot oil heaters, pilots, acid gas incinerators, thermal oxidisors	GHG emission and hot exhaust gases	PM_{10} 15t/yr NOx 200 t/yr CO 160t/yr CO_2 1,090,340t/yr N_2O 1t/yr CH_4 5t/yr	Contributes to lifecycle greenhouse gas emissions	Implement greenhouse abatement measures, including: • The use of ConocoPhillips' Optimized Cascade® process • GE LM2500+G4 gas turbines were selected as they are efficient (efficiency approximately 40%) and will use less fuel gas • Both aero-derivative gas turbine drivers and generators are equipped with DLE technology • Waste heat recovery is planned for some of the Refrigeration Gas turbines to supply heat to the hot oil system and the Dehydration system regeneration gas	Designer / operator
	Gas turbines	Refrigeration compressor/turbines, power generation turbines, emergency generator		PM_{10} 205t/yr NOx 3,290t/yr CO 2,420t/yr CO_2 4,153,120t/yr N_2O 100t/yr CH_4 920t/yr			
	Flaring	Ground flares (wet, dry and marine)	GHG emissions and hot exhaust gases	SO_2 1t/yr	Contributes to lifecycle GHG emissions	Implement greenhouse abatement measures	Designer / operator

Phase	Waste	Source	Characteristics/nature	Estimated quantity	Potential impact	Management	Responsibility
				NOx 63t/yr CO 340t/yr CO_2 109,120t/yr N_2O 2/yr CH_4 2t/yr		There will not be any routine flaring. Flaring will only occur during commissioning, process upsets, maintenance and emergency situations but not during normal operations The ground flare proposed for the LNG facility burns more cleanly than a conventional elevated pipe (stack) flare and this results in fewer emission by-products and less GHG emissions overall In order to minimise emissions, excess gas generated during ship loading will be recovered rather than flaring	
	Fugitive emissions	Losses from LNG facility processing	GHG emissions. Propane, Ethylene, Methane	Methane 180t/yr Ethylene 140t/yr Propane 190t/yr	Contributes to lifecycle GHG emissions	Implement greenhouse abatement measures The key measures implemented in the design to reduce fugitive emissions are as follows: • Routine maintenance • Vapour recovery for the LNG storage • Vapour return-line for the LNG loading arms	Designer / operator
	Treated process and contaminated stormwater.	LNG facility	Liquid waste with the following quality: pH = 6 to 7 BOD_5 = <20mg/L TN = <5mg/L TP = <2mg/L TSS = <30mg/L TDS = <350mg/L Oil = <10mg/L	228,000m^3/yr (based upon dry weather (average) flows and wet weather (stormwater) flows	Excess water to treat Spills and overflows causing contamination of land, surface water and groundwater Spillage and subsequent release to the environment (namely Port Curtis), thus degrading the marine environment Loss of biodiversity due to degradation of native flora and fauna	Process water and contaminated stormwater will be directed to the CPI separator for treatment. CPI effluent will be further treated in a dissolved air flotation unit and an effluent filter and then routed to the irrigation system, where it will be of sufficient quality for irrigation purposes onsite	Designer / operator
	Spills/ washdown	LNG facility	Liquid waste Regulated waste (worst case)	Variable 50,000m^3/yr	Spills and overflows causing contamination of land, surface water and groundwater Social amenity degradation Spillage and subsequent release to the environment namely Port Curtis, thus degrading the marine environment	Process water and contaminated stormwater will be directed to the CPI separator for treatment. CPI effluent will be further treated in a dissolved air flotation unit and an effluent filter and then can be distributed by an irrigation system, as it will be of sufficient quality for irrigation purposes onsite	Designer / operator
Ship waste (GPC, AQIS)	Solid, liquid, contaminated, bilge water wastes.	From the LNG vessels loading	Regulated wastes Wastewaters Solid wastes	Variable 80,000t/yr	Contamination of receiving waters (namely Port Curtis), thus degrading the marine environment	Management of harbour traffic is undertaken by GPC under an agreement with the AQIS Non-discharge of AQIS defined high-risk ballast water in Australian	Designer /operator

Phase	Waste	Source	Characteristics/nature	Estimated quantity	Potential impact	Management	Responsibility
			General wastes Food wastes Recycling wastes		Introduction of marine pests through ballast water, hull fouling, and fouling of seawater intake pipes	ports or waters Vessels coming into Port of Gladstone must make waste available for collection by an authorised collector vessel. Wastes including organic refuse and galley scraps of quarantine waste	
Decommissioning and rehabilitation	Contaminated fill	LNG facility	Land contaminated with hydrocarbons	None expected	Restricting the land use of the site for future users. Contamination of land, surface water and groundwater. Social amenity degradation Release to the environment namely Port Curtis, thus degrading the marine environment.	The site will be listed on the Environmental Management Register but it is not expected to be listed on the Contaminated Land Register due to the operational activities onsite. In summary, a decommissioning plan will detail rehabilitation process and will be developed in accordance with regulatory requirements and the land owner contractual agreements	Operator/ decommissioning manager
	Machinery/ plant Scrap steel Cabling Pipework	Four LNG trains consisting of: Gas feed station Amine package Dehydration plant Liquefaction module Vessel loading arms Flares Storage tank Septic systems Buildings	Mostly inert waste Recycling wastes Machinery Ferrous and non ferrous metals Plastics Concrete	Structural steel 33,000t Concrete 150,000m^3 Jetty trestle 180m equivalent (e) Piping 213,000m e Electrical 1,800,000m e Instrumentation 6,000m e insulation 10,940m^2 e Pipe and equipment insulation 160,000m e Buildings 15,000m^2 Mechanical equipment 890 items	Contaminated land Release to the environment (namely Port Curtis), thus degrading the marine environment Social amenity degradation due to poor housekeeping	The operator will develop a decommissioning plan prior to any decommissioning works commence The decommissioning contractor will designate areas for segregation of the waste/recycle/re-use streams. Equipment/plant/components that are in good working order will be sold as appropriate The decommissioning contractor will engage recycling contractors to collect all recyclable material for recycling and re-use	Operator/ decommissioning manager