17 WASTE MANAGEMENT

This chapter describes QGC's approach to managing and minimising waste in the construction and operation of the LNG Facility. The major waste streams generated from the construction and operation of the LNG Facility have been identified and summarised in *Sections 17.2.2* and *17.2.3* respectively.

The *Environmental Protection Act 1994 (EP Act)* (Qld), defines "waste" as anything that is:

- left over, or an unwanted by-product, from an industrial commercial, domestic or other activity
- surplus to the industrial commercial, domestic or other activity-generating wastes[1].

Recognising this definition, QGC further defines waste as all materials stored or taken off site for disposal or recycling. Materials include inert site and platform wastes, scrap metals, oils, excavated materials, used fittings and general site and office wastes[2].

17.1 DESCRIPTION OF PROJECT ENVIRONMENTAL OBJECTIVES

The Project environmental objectives for waste management are:

- To minimise waste generation and maximise reuse and recycling of waste products
- To transport, store, handle, and dispose of waste in a manner that does not cause contamination of soil, air or water.

Effective waste management is integral to making the most efficient use of available resources while minimising the odour and visual impacts of litter, preventing short-term pollution and longer-term contamination of soils, air and waterways and safeguarding human and ecological health. Minimisation of waste and cleaner-producing technologies to reduce environmental impacts has been considered throughout the Project development.

The liquefaction of natural gas is a continuous process that incorporates extensive waste minimisation strategies in its design (refer to *Section 17.4* of this chapter). QGC has committed to reducing waste production through recovery, reuse and recycling and through encouraging efficient utilisation of resources. QGC aims to promote best practice disposal of waste products both on site through appropriate maintenance of waste disposal areas and off site through utilising environmentally responsible waste management contractors.

1 Queensland Government (1994) *Queensland Environmental Protection Act* 1994.

2 BG Group (2003) *Waste Management Briefing Note*

17.1.1 Legal Requirements

Under the *EP Act*, waste generators, transporters and receivers must comply with the *Environmental Protection (Waste Management) Policy (EPP Waste) 2000* and the *Environmental Protection (Waste Management) Regulation 2000*. The objective of the policy is to achieve "ecologically sustainable development" in relation to waste management. The waste policy sets a framework for this, which includes:

- adoption of the waste management hierarchy
- assigning responsibility for waste management.

The Queensland Government's waste minimisation hierarchy, as outlined in *EPP Waste*, is (from most preferred to least preferred):

- waste avoidance
- waste reuse
- waste recycling
- energy recovery from waste
- waste disposal.

The waste regulation sets specific requirements for the management of regulated waste, waste disposal facilities, waste management by local government, and litter control.

Requirements within the *Environmental Protection (Water) Policy (EPP Water)* have also been considered in developing mitigation and reuse strategies for stormwater.

17.1.2 QGC Waste Management Standards

QGC has reviewed the current Queensland and Commonwealth waste management legislation to ensure their existing waste management policies and procedures for the LNG Facility are aligned with these legislative requirements. Where QGC standards are more stringent than the local and national legal requirements, the QGC standards will take precedence.

QGC's resource use and waste management objective is to reduce the risk of harm to people and the environment by minimising resource use and waste generation[3]. Unavoidable waste is to be effectively treated and disposed of to minimise the overall impact on the environment through the lifecycle of that material. A summary of the standards include:

Resource Use: Resource use such as freshwater and energy are to be reduced wherever reasonably practicable. Planning measures include the development of a waste inventory and management of wastes in accordance

3 BG Group. *BG Standard: Environment Resource Use and Waste Management Standard*.

with the company's waste hierarchy. Under BG Group policy, new developments, such as the LNG Facility shall optimise process design and constructability and equipment selection and use, to minimise resources and waste generation across the Project lifecycle.

Planning: Opportunities to reduce, reuse and minimise waste associated with particular focus on hazardous and high-volume waste will be continually investigated and implemented where practicable. Planning for waste-related decisions shall take into account local circumstances.

Onsite storage, treatment, handling and disposal: QGC uses a risk assessment-based approach to maintain proper waste storage, labelling, segregation, containment and disposal of wastes. Wherever practicable and within environmental management guidelines, methods to reuse unavoidable wastes into other processes will be undertaken. Underground storage tanks and piping will not be utilised on new developments for hazardous substances.

Waste transfer and offsite treatment and disposal: Third-party contractors will be evaluated prior to works to ensure tasks are carried out in accordance with QGC standards and relevant legislation.

Waste tracking, monitoring and record keeping: Waste volumes will be documented and transport will be traced from point of origin to the final disposal location. Records will be monitored to identify areas for improvement and set performance targets.

Training: Waste management and disposal responsibilities for personnel, including contractors will be clearly established through training.

Audit and Review: Audits of the full waste management process will be undertaken, with the frequency of each audit based on the risks associated with the waste type and quantity. Waste audits will be conducted as a minimum of once every three years.

17.1.3 QGC Waste Management Philosophy

The Project's strategic objective for waste is to prioritise the prevention and minimisation of waste generation, followed by the effective management of wastes in a manner that minimises impact on the environment while also being cost effective. The QGC waste hierarchy depicted below in *Figure 5.17.1* is the foundation of the Project's waste management strategy and is in line with Queensland Government's waste policy framework. It highlights that the key to minimising waste is to reduce resource use, to seek to use waste as inputs into other processes and to ensure that any unavoidable residue remaining is treated and disposed of responsibly.

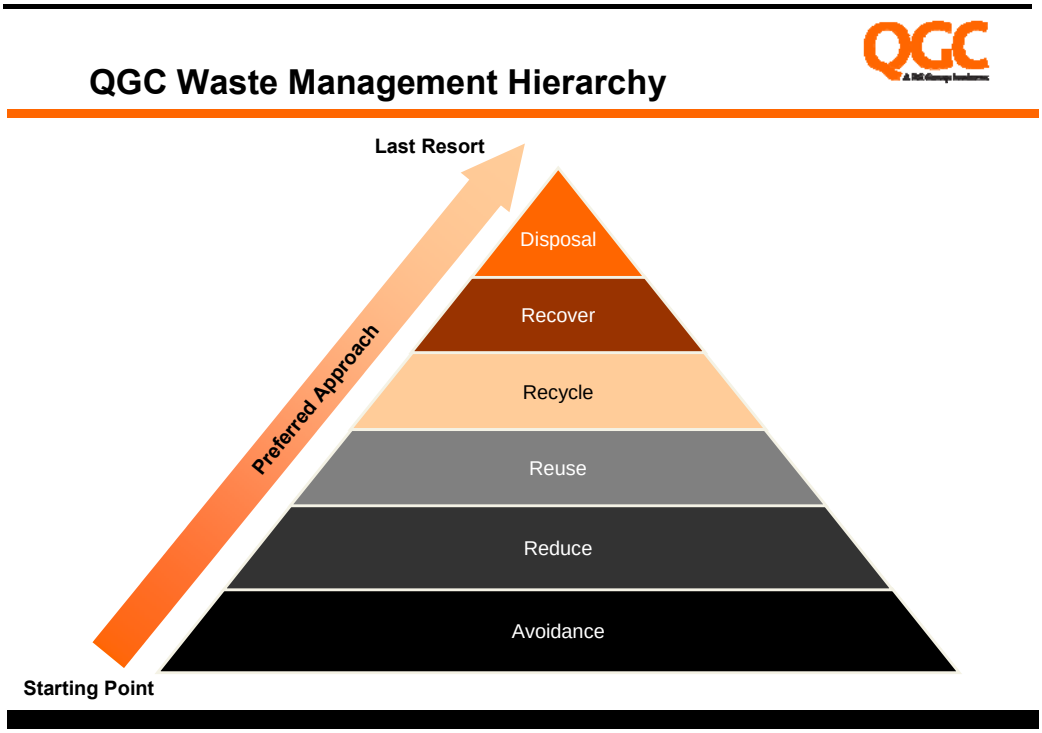
17.1.3.1 QGC Waste Management Hierarchy

- Remove: waste avoidance by eliminating materials
- *Reduce*: generate less waste by inventory control and management,

material substitution and process improvements

- *Reuse*: waste materials reusable in their original form become inputs into other processes
- *Recycle*: by reprocessing waste materials back into similar products or secondary raw materials for the production of new products
- *Recover*: extract usable materials or energy from waste (eg. waste-heat recovery system to recover gas turbine driver exhaust heat for process heating requirements)
- Residue: if no other options are available, ensure the proper treatment and disposal of remaining waste residues [4]

Figure 5.17.1 QGC Waste Management Hierarchy



17.2 WASTE GENERATION

Waste will be evaluated for reuse and recycling potential before it is classified as disposable waste. Reusable and recyclable waste materials will be segregated from non-recyclable wastes, which will be disposed of in offsite waste disposal facilities/treatment facilities. Licensed contractors that operate within statutory requirements will be engaged to undertake removal of waste from the site and disposal. Waste will be generated in four major Project phases:

4 BG Group. (2003) Briefing Note: Waste Management. July 2003

- Initial Site Preparation Works
- Construction
- Operation
- Decommissioning.

Decommissioning wastes are not assessed in detail at this stage in the design. Details of waste generated during site preparation, construction and operation are provided below.

17.2.1 Initial Site Preparation Wastes

Initial site preparation involves the clearing of vegetation and bulk earthworks to bench and grade the site.

During initial site preparation activities, the major waste stream is anticipated to be trees/vegetation/organic growth and subsequent root mat and grubbing activities. It is anticipated that approximately 30,000 tonnes to 35,000 tonnes of timber (subject to further detailed survey and assessment) plus approximately 900,000 m^3 of soils and organic material will be generated.

It is proposed to handle the soils wastes on Curtis Island at a designated disposal area within the LNG Facility boundary but outside the LNG Facility footprint. Some soils may have potential for acid sulfate soils (ASS), which is discussed in detail in *Volume 5, Chapter 4*.

17.2.1.1 Management of Cleared Timber

The current proposed strategy for management of vegetation cleared from across the site is outlined in *Volume 2, Chapter 13*. In summary, this includes:

- mulching or chipping of leaves, branches and small timber on site and, where appropriate, for site stabilisation and erosion control. Any excess mulch will be placed in the spoil disposal areas.
- making merchantable timber available to the local Gladstone community where there is a tangible volumetric request, with timber transported to the mainland on truck via Auckland Point. This will only occur on an as-needed or demand basis (*Envirionmentally Relevant Authority (ERA) 47: Timber milling and wood chipping (excluding reconstituted timber products)*).
- Timber unsuitable for milling or which exceeds the local capacity for timber use may be disposed of at the licensed waste disposal facility as green waste for mulching, subject to agreement on volumes and the resulting costs associated with hauling, handling and with any landfill operators; and on capacities being available within the Curtis Island located soils disposal areas where these materials could also be handled.
- While this approach forms the basis of the current assessment as outlined in this EIS, refinement of this approach is ongoing and additional options for management and disposal continue to be assessed. These options are

focused on reducing potential impact on Gladstone municipal infrastructure arising from transport and disposal of timber from the site, and include the following:

- clearing, grubbing and controlled burning of timber on site followed by disposal of the ash mixed in the soils stockpile areas at the site
- clearing, grubbing and shredding of timber and co-disposal with site strip material in the spoil disposal areas
- moving merchantable timber back to the Gladstone community on an as-needed basis, combined with burning, mulching and shredding of the balance of the materials.

These options will be assessed in more detail during the Project Front-End Engineering and Design (FEED) stage based upon understanding of the community interest in available materials, and the associated cost, schedule and risks of large-scale movements over water.

17.2.2 Construction

As outlined in *Section 17.1.3,* the Project's strategic objective is to prioritise the prevention and minimisation of waste generation, followed by the effective management of wastes in a manner that minimises impact on the environment while also being cost effective.

Waste streams generated during construction are to a degree a function of the manpower numbers per month, and the anticipated durations, as well as construction stage and associated activities on site.

The anticipated waste streams generated from general construction activities are summarised below:

17.2.2.1 Solid Waste

- general inert construction debris
- scrap timber
- timber from concrete formwork, boarding and associated waste
- clean office rubbish
- site-generated food waste
- used tyres
- first-aid station waste
- loose packaging material for shipping
- empty aerosol cans
- empty material containers
- scrap metal
- aluminium scrap

- glass
- used batteries
- used oil filters
- used welding rods
- insulation materials
- plastics from conduit and pipework
- grit from blasting operations.

17.2.2.2 Liquid Waste

- sanitary waste (office, jobsite)
- waste oil and oily wastes
- waste adhesives
- waste paint and solvents
- waste antifreeze/radiator coolant.

The following waste streams will be generated from the camp operations supporting construction:

- clean office rubbish
- camp-generated rubbish
- camp generated food waste;
- first-aid station waste
- sanitary waste.

17.2.2.3 Anticipated Construction Waste Stream Volumes

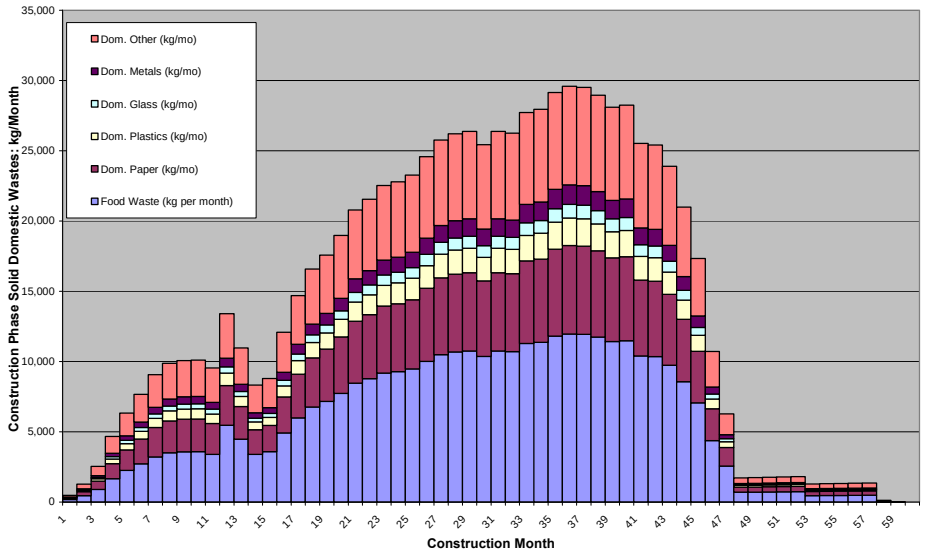
A preliminary analysis of the anticipated waste streams has been undertaken based on construction of LNG Trains 1 and 2 (waste generated during Train 3 construction will be of similar type).

Estimates have been made on the basis of the assumed workforce breakdown as outlined in *Volume 2, Chapters 6* and *13*, assuming that non-local personnel and some of the subcontractor craft/supervision remain on Curtis Island within the construction camp, while the field non-manual and local labour return home daily to their normal residences. All waste volumes provided are indicative only. Detailed design and construction planning is ongoing, and will not be finalised until the composition of the workforce (local versus non-local personnel) and accommodation strategy are fully developed and implemented.

Waste stream volumes have been based on Engineering, Procurement and Construction (EPC) contractor experience of waste generated on similar sites. Normal allowances have been applied to the personnel that reside on Curtis

Island within the construction camp. A summary of wastes produced by construction per month are presented graphically in *Figure 5.17.2* and *Figure 5.17.3*.

Figure 5.17.2 Indicative Construction Phase Solid Domestic Waste Volumes



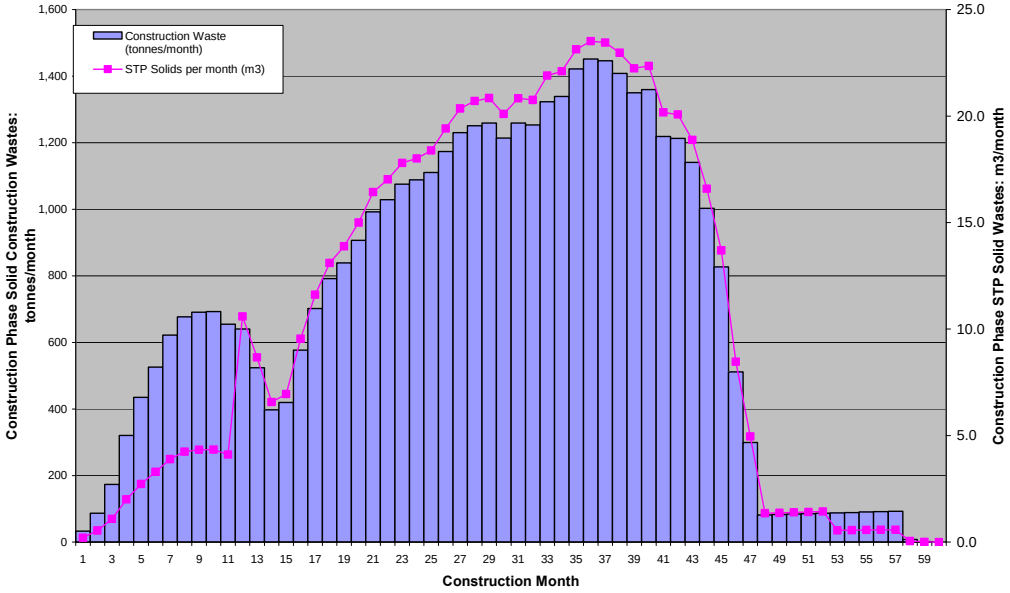
Construction phase solid domestic wastes (generated predominantly from construction camp operations) identified above in *Figure 5.17.2* are outlined in *Table 5.17.1* expressed as forecast total over construction of Train 1 and 2.

Table 5.17.1 Domestic Waste Volumes Generated over Construction of Train 1 and 2

• **Waste Type**	• **Volume**
• Sewerage	• 240,000 m^3
• Sewage Treatment Plant Solids	• 655 m^3
• Food Waste	• 350 tonnes
• Paper	• 183 tonnes
• Plastics	• 60 tonnes
• Glass	• 30 tonnes
• Metals	• 40 tonnes
• Other	• 210 tonnes

In addition to domestic waste volumes outlined in *Table 5.17.1* above, an estimated 42,800 tonnes of construction waste (subject to further detailed design and logistics planning) will be generated from construction over the life of the Project. Construction phase solid construction wastes (non-domestic wastes) generated by construction month are shown in *Figure 5.17.3.* These wastes include general construction wastes as detailed in *Table 5.17.5*, including concrete, steel, aluminium, insulation, soil, rock, copper, carpeting, rubber, floor tiling, etc.

Figure 5.17.3 Indicative Construction Phase Solid Construction Waste, and Sewage Treatment Plant (STP) Waste Volumes



Sewage

A compartmentalised sewage treatment system will be used to deal with variable flows of effluent. For description of proposed sewage treatment plant, refer to *Volume 2, Chapter 13*.

Treated effluent will be disposed of through a combination of irrigation within the LNG Facility boundary, and discharged to Gladstone harbour along with reject (brine) from the desalination plant. Areas for irrigation have not yet been confirmed, but are likely to include construction laydown areas and fire-break around the LNG Facility perimeter. Indicative volume and quality is discussed in *Volume 2, Chapter 13,* and potential impacts on marine water quality and marine fauna associated with marine discharge are described in *Volume 5, Chapter 8*.

17.2.2.4 Dredged Marine Sediments

Refer to *Volume 6* for discussion of the placement of dredged materials.

17.2.2.5 Gaseous Emissions

Refer to *Volume 5, Chapter 12* and *Volume 7* for discussion of the management of gaseous emissions.

17.2.3 Operation

LNG operations will generate a range of atmospheric emissions, wastewater discharges, and solid and semi-liquid wastes for disposal off site. For discussion of air emissions, refer to *Volume 5, Chapter 12* and *Volume 7*.

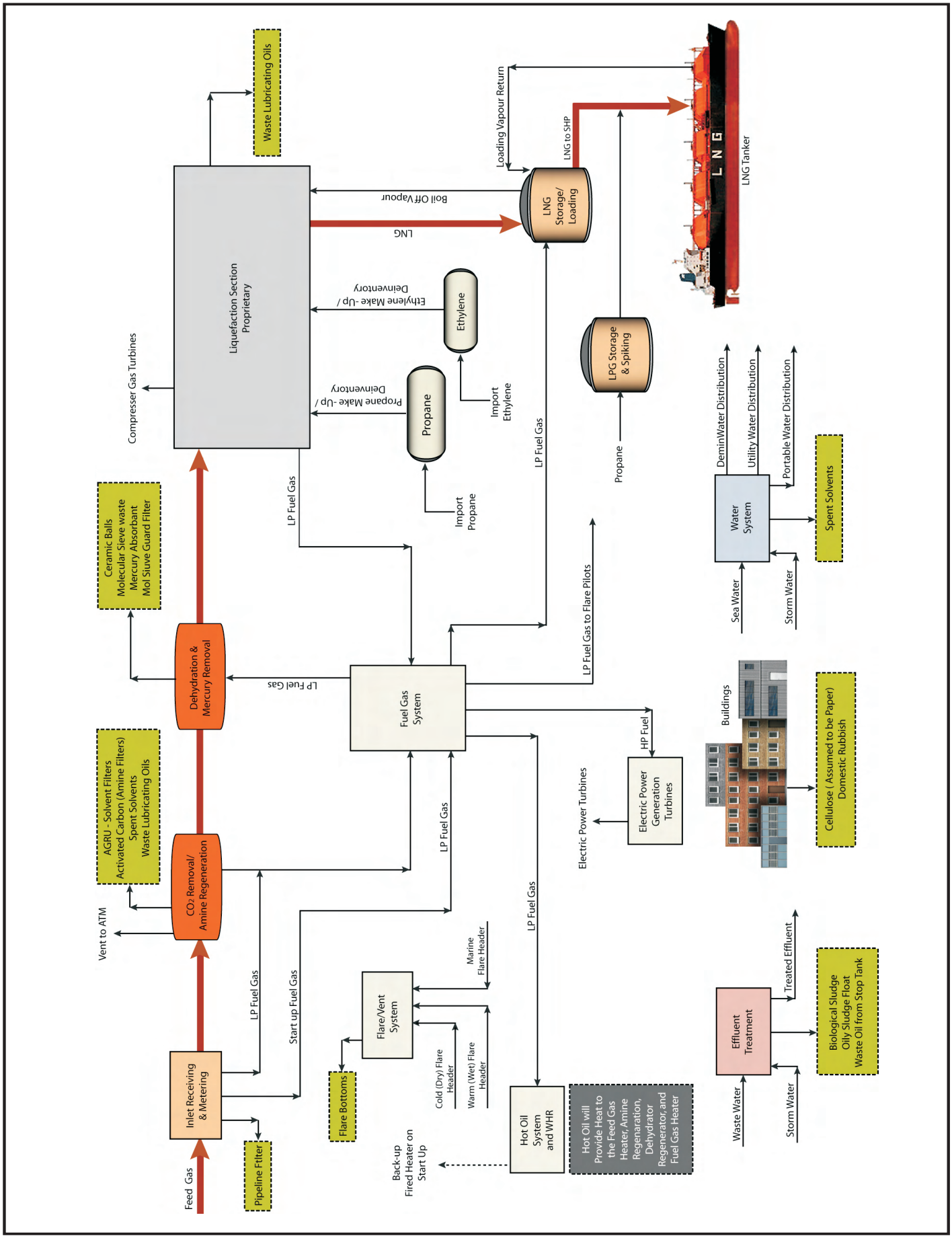
A LNG Facility process flow diagram showing key operational wastes is included on *Figure 5.17.4 .*

17.2.3.1 Solid Waste

Sources of solid wastes in the LNG Facility include: administration and office buildings, plant area, amine and dehydration units, STP, corrugated plate interceptor (CPI separator), dissolved air floatation (DAF) unit, and mercury adsorbent.

Non-hazardous wastes (i.e. general waste defined by Queensland *Environmental Protection Regulation 2008*) will include ceramic balls (generated by the dehydration and mercury removal unit); cellulose (mostly paper and cardboard); and domestic rubbish including food waste.

Hazardous waste (i.e. regulated waste as defined in Queensland *Environmental Protection (Waste Management) Regulation 2000)* will include waste oils and associated wastes; molecular sieve waste (generated by the dehydration and mercury removal unit); used batteries; and spent solvents. It is anticipated that the above wastes can be disposed of safely at registered disposal sites within Queensland, such as the Gladstone Regional Council operated landfill at Benarby, QLD. *Table* 5.17.2 presents an indicative summary of the anticipated solid and semi-liquid wastes generated annually from the LNG Facility (note that these volumes are subject to change with refinement of LNG Facility design).



QUEENSLAND CURTIS LNG A BG Group business	Project	Queensland Curtis LNG Project	Title **Process Flow Diagram with Key Operational Waste**
	Client	QGC - A BG Group business	
ERM Environmental Resources Management Australia Pty Ltd	Drawn JB	Volume 5 Figure 5.17.4	Disclaimer: Maps and Figures contained in this Report may be based on Third Party Data, may not to be to scale and are intended as Guides only. ERM does not warrant the accuracy of any such Maps and Figures.
	Approved DS	File No: 0086165b_EIS_WM_CDR001_F5.17.4	
	Date 18/05/09	Revision 1	

Table 5.17.2 Indicative Annual LNG Facility Solid Waste Generation

Waste product	Quantity (Kg/yr) Unless otherwise stated		
	1-Train	2-Trains	3-Trains
Hazardous Wastes			
Waste Lubricating Oils	8,000	14,000	20,000
Spent Oils	1,000	1,700	2,500
Oily Sludge/Float	7,000	14,000	20,000
Spent Solvents	100	200	250
Waste Oil from Slop Oil Tank	20 m^3/year	35 m^3/year	50 m^3/year
Molecular Sieve Waste 1.	116,400	232,800	349,200
Mercury Adsorbent	3.	3.	3.
Activated Carbon (Amine filter)	33,000**	66,000	99,000**
Non-Hazardous Wastes			
Ceramic Balls*	12,000	24,000	36,000
Biological Sludge	4,000	5,000	6,000
Cellulose	1,000	1,500	2,500
Domestic rubbish	50,000	80,000	120,000

Source: Bechtel Oil, Gas and Chemicals, Inc. 2008. *BG Queensland Curtis LNG Project: Study Report For CTR #42 – Waste Minimization* (unpublished report, Revision 00B issued for Information 10 Feb 09) *pg 16.*

Notes:

1. Kg every 3 years
2. Waste activated carbon quantities are based on reference plant data. These will be verified during the FEED phase.
3. Based on the design feed gas mercury concentration, adsorbent bed life is expected to last for the plant design life.

17.2.3.2 Liquid Waste

Major liquid waste streams anticipated during site operation include the following:

1. stormwater runoff from clean (non-process) parts of the LNG Facility site that will be routed to the sedimentation/evaporation ponds. Excess stormwater (overflow from the ponds) will be discharged as a sheet flow to the harbour.

2. sanitary sewage, which will be gravity-fed to sanitary sumps before being pumped into the STP. The sanitary sewage will be treated in an extended aeration-activated sludge plant. Treated wastewater will be further processed in a tertiary filters and stored before pumped to the irrigation system or discharged to harbour via discharge point at the end of the MOF. Dispersion modelling on effluent discharge has been undertaken on the basis of an assumed 100 per cent of sewage liquid effluent discharged to harbour. Assessment of impacts on marine biota is included in *Volume 5, Chapter 8* and *Chapter 11*;

3. process wastewater and contaminated stormwater runoff from the LNG Facility process areas, which will be routed to the CPI separator via process area spill containment sump and various stormwater lift stations for treatment. CPI effluent will be further treated in a dissolved air floatation unit and a tertiary filter and then routed to the irrigation system. Excess water will be routed to the sedimentation/evaporation ponds and managed as part of the pond water system (i.e., discharge to harbour via sediment pond overflow during periods of high rainfall).

4. brine stream associated with operation of the reverse osmosis treatment plant for potable water supply, which will be discharged to the Port via a discharge point at the end of the MOF. Discussion of brine volumes and quality is included in *Volume 2, Chapter 9*, and assessment of impacts on marine biota is included in *Volume 5, Chapter 8* and *Chapter 11*.

In addition to the above, water will be produced as condensate arising from the use of inlet air chilling. As outlined in *Volume 2, Chapter 9*, this is currently intended to be managed as per clean stormwater (i.e., routed to the sedimentation/evaporation ponds, with overflow from the ponds discharged as a sheet flow to the harbour). However, other options for beneficial use of this water remain under consideration.

Hydrotest Water

Hydrotest water from the first tank will be reused (as much as practicable) to test the other LNG tank(s) and LPG tank(s). Hydrotest and flushing water when used will be routed to the sedimentation ponds through the site drainage system, and reuse will be maximised for future testing needs.

Water Flush

During the commissioning phase, piping system for specific services will be flushed with fresh water. Sources for flushing water will be clean, impounded stormwater prior to commissioning of the firewater system. Water used during flushing will be collected in the sedimentation/evaporation pond and will be tested prior to reuse for other services.

Chemical Cleaning Washes

Any chemicals used to clean equipment, piping, or tubing systems will be collected and disposed of offsite by a licensed waste-handling contractor to a licensed facility.

Estimated flow volumes and characteristics of liquid effluents to be discharged from the site under normal operating conditions are provided in *Table 5.17.3* below. Discussion of potential impacts on marine water quality and marine biota is included in *Volume 5, Chapters 8 and 11*.

Table 5.17.3 Expected Flows and Water Quality

Stream Description	Flow, m^3/hr						Estimated Characteristics
	Average			Maximum			
No. of Trains	1	2	3	1	2	3	
Treated Process/ contaminated stormwater (1.)	2.5	3.5	5	44	70	100	pH: 6 to 7 BOD_5: 10 to 20 mg/l TSS: 5 to 10 mg/l Oil: 5 to 15 mg/l
Desalination (RO) System Blowdown (2.)	10	15	20	26	40	50	pH: 6.5 to 7.5 units TDS: 55,500-60,000 mg/l $N+^{-}$: 17,000 mg/l Alkalinity: 170 mg/l Cl^{-} 30,650 mg/l Mg++: 2,000 mg/l TSS: 0 mg/l SiO_2: 16 mg/l
Treated sewage (3.)	1	2	2.5	1.5	2.5	3.5	pH: 6.5 to 7.5 BOD_5: 10 to 20 mg/l Oil and grease: 5 to 10 mg/l Total Nitrogen: 30 to 40 mg/l as N Total Kjeldahl Nitrogen: 1 to 5 mg/l Ammonia nitrogen: 1 to 5 mg/l Total Phosphorus: 5 to 10 mg/l TDS; 250 mg/l

Notes:

1. The average flows are based on dry weather flows and includes filter backwash water and reject stream from the RO plant. The maximum flows are based on wet weather flows (i.e. stormwater) and includes dry weather (normal) flows.
2. Based on First Pass RO Reject.
3. Based on an average population of 100 people (includes visitors and transient workers) and a maximum population of 150 people.

17.2.3.3 Stormwater Management

Refer to *Volume 5, Chapter 9* for discussion on stormwater management.

17.2.4 Decommissioning

The storage, handling, treatment and disposal of anticipated wastes generated during the decommissioning phase will be addressed prior to decommissioning through a decommissioning waste management plan which will be negotiated with relevant agencies and parties.

17.3 WASTE MANAGEMENT

The following section details the collection, handling, storage, treatment and transportation of generated wastes to minimise environmental impacts. QGC uses a risk assessment-based approach to maintain proper waste storage, labelling, segregation, containment, tracking and disposal of wastes. Ways to use unavoidable wastes in other processes will be identified.

17.3.1 Collection and Handling

During construction and operation, waste will be collected and separated into streams based on the intended disposal option. Wastes will be stored and handled in accordance with *Environmental Protection Policy (Waste) 2000* governing general and regulated wastes.

Based on experience on other projects currently being executed in Gladstone, and on an assessment of regional infrastructure undertaken for the Project[5], the city and region are understood to be capable of receiving and handling municipal waste streams, including recycling. An assessment of Gladstone infrastructure indicates that the landfill site in the local area has capacity to accept waste material at current predicted levels up to the year 2050.[6]

Waste contractors that are accredited to International Standards Organisation (ISO) 9001, ISO 14001, and Australian Standard (AS)/New Zealand Standard (NZS) 4801 have been identified in the Gladstone region[7]. Such licensed contractors have the capability to transport and dispose the following waste streams to be generated during site construction and operation in accordance with QGC and legislative requirements:

- general waste
- recyclables
- paper and cardboard
- bulk construction and demolition materials
- STP solids
- oil
- oily water
- empty oil drums
- Other oily wastes including vehicle washwater, boiler blowdown, industrial plant washwater
- medical waste.

17.3.2 Storage and Handling

A breakdown of waste streams and management options is provided in *Table 5.17.5.* In general, solid waste streams will be stored in designated areas or skips as they are generated. Storage areas will be clearly marked and skips will be protected against the elements. Once filled, skips will be transported to the appropriate recycling, reuse or disposal facility by an appropriately licensed waste disposal contractor.

5 GHD (2009). Queensland Curtis LNG Project: *Draft Gladstone Infrastructure Audit*. (unpublished report for BG Australia, Rev 42/15574/51470, issued for information February 2009).

6 ibid

7 ibid

17.3.3 Transportation

It is anticipated that ferries used to deliver materials and personnel to site will be employed to transport of vehicles that convey wastes back to the mainland.

Appropriately licensed third-party waste contractors will undertake waste transport and disposal. QGC will evaluate contractors to ensure tasks are carried out in accordance with relevant legislation and QGC standards.

17.3.4 Waste Tracking

Waste-handling and tracking procedures and required forms to track waste will be developed prior to commencement of construction. Separate procedures will be developed by QGC prior to commencement of the LNG Facility operation.

Chain of Custody procedures will be in compliance with the requirements of the *Environmental Protection (Waste Management) Regulation 2000*. As required under this regulation, a waste-tracking system using a computerised data entry system and recording process will be utilised and will include the following[8]:

- name, address, local government area and contact details of generator
- name, address, contact details and environmental authority number of receiver
- name, address, contact details and environmental authority number of transporter
- the day and time the waste is given to the transporter
- the load number
- registration number of the vehicle transporting the load
- if the waste is a dangerous good:
  - the type and number of containers in which the waste is contained
  - its UN number
  - its packing-group designator
  - its dangerous goods class and any subsidiary risk
- the following details of the waste:
  - the type of waste
  - amount expressed in kilograms or litres
  - its physical nature (solid, liquid, paste or gas)
  - its waste code

8 Queensland Government (2000). *Environmental Protection (Waste Management Regulation 2000* Schedule 2.

- the waste origin code for the activity that generated the waste.

17.3.5 Waste Disposal

Wastes that cannot be recycled or reused will be classified and disposed to an appropriately licensed facility in the Gladstone area.

17.3.5.1 Liquid Effluents Discharge Standards

Required waste discharge licenses for liquid effluent (treated stormwater from process areas, desalination brines and sewage liquid effluent) discharges will be sought prior to commencement of construction and operation.

17.3.5.2 Solid Waste Standards

Solid wastes are classified as either general or regulated wastes in accordance with Queensland *Environmental Protection Regulation 2008*[9]. Regulated wastes are further defined in Schedule 1 of the *Environmental Protection (Waste Management) Regulation 2000* and the *Environmental Protection Policy (Waste) 2000.*

Refer to *Table 5.17.5* for a listing of general (non-hazardous) and regulation (hazardous) wastes.

17.3.5.3 Local Recycling Facilities

The Gladstone region is currently serviced by a waste contractor that collects recyclable materials and transports to a Visy recycling facility in Brisbane. A regional Material Recovery Facility (MRF) for the collection and processing of recyclable wastes is anticipated to be developed within 12 months[10]. Wastes considered for recycling include scrap metal, waste oils, activated carbon, and cellulose.

17.3.5.4 Local Waste Disposal Facilities

Operational and construction solid wastes that cannot be recycled or reused will be disposed of at appropriate waste disposal facilities. A summary of waste facilities located within the Project area, including capacity and wastes accepted is provided below in *Table 5.17.4*[11].

9 Environmental Protection Agency (EPA) (2008). *Environmental Protection Regulation 2008*

10 GHD (2009). Queensland Curtis LNG Project: Draft Gladstone Infrastructure Audit. (an unpublished report for BG Australia, Rev 42/15574/51470, issued for information February 2009).

11 URS (April 2007) Gladstone Nickel Project Environmental Impact Statement. Section 4 Waste Management.

Table 5.17.4 Gladstone Region Waste Disposal Facilities

Shire	Location	Capacity	Facilities
Calliope	Landfill: • Benaraby Transfer Stations: • Yarwun • Mt Larcom • Raglan	Supports Gladstone waste indirectly 40,000 to 50,000 people	• Domestic • Regulated • Recyclable • Green waste
Fitzroy	Landfills: • Gracemere • Alton Downs Transfer Stations: • Bouldercombe • More planned and under development	Gracemere –3 to 4 years Alton Downs –12 months	• Domestic • Light commercial • Some recyclable • Scrap metal • Green waste • Regulated
Gladstone	Gladstone WasteTransfer Station, Joe Joseph Drive	Supports approximately 30,000 people Landfill to Benaraby	• Domestic • Regulated • Green Waste • Recyclable • Inert waste (soil, gravel)

17.3.6 Incineration

The use of waste incinerators on the Curtis Island site was considered as a possible alternative to waste disposal. However, whilst convenient and a safe and effective way of disposing of a range of waste types, this disposal option does not reflect the waste management philosophy and prevents opportunities for reuse to be determined. Additionally, initial discussion with Gladstone Regional Council indicated that they would not support the use of incinerators at the LNG Facility due to the Department of Environment and Resource Management's (formerly Environmental Protection Agency) recent "Clean and Healthy Air for Gladstone" initiative[12].

On this basis, waste incineration was rejected for both construction and operations phases of the Project. Where incineration is the preferred management option for a specified waste stream, an appropriately licensed commercial incinerator will be utilised.

Table 5.17.5 summarises the wastes generated in construction, operation and decommissioning (preliminary only), their classification, and potential management options.

12 GHD (2009). Queensland Curtis LNG Project: Draft Gladstone Infrastructure Audit.

Table 5.17.5 Summary of Waste Streams and Indicative Methods of Management

Source / Activity	Waste Stream	Principle Phase of generation			Hazardous (Y/N/Potential)	Management Options ← Most Preferred to Least Preferred →								Comments
		Construction	Operation	Decommissioning		Avoidance / Source Control	Reuse	Recycle	Compost / land farm	Wastewater Treatment System	Landfill	Pyrolisis/ Incinerate		
Office	White stationery	✓	✓		N	✓	✓	✓	✓		✓	✓		
	Non-white paper	✓	✓		N			✓	✓		✓	✓		
	Plastic packaging	✓	✓		N	✓		✓			✓	✓		
	Misc. metals	✓	✓		N			✓						
	Toner cartridges	✓	✓		N	✓	✓	✓						
	Used office equipment/ furniture	✓		✓	N		✓	✓						
	Used computers	✓		✓	Y		✓	✓						
	Cardboard/corrugated	✓	✓		N	✓		✓	✓		✓	✓		
Canteen	Non-meat food waste	✓	✓		N	✓			✓		✓	✓		
	Meat food waste	✓	✓		N	✓			✓		✓	✓		
	Grease/oils	✓	✓		N	✓	✓	✓				✓		
	Plastic packaging	✓	✓		N	✓		✓			✓	✓		
	Paper	✓	✓		N	✓		✓	✓		✓	✓		
	Recyclable/deposit food and beverage containers	✓	✓		N			✓						
	Plastic utensils/cups	✓	✓		N	✓		✓			✓	✓		

Source / Activity	Waste Stream	Principle Phase of generation			Hazardous (Y/N/Potential)	Management Options ← Most Preferred to Least Preferred →							Comments
	Glass	✓	✓		N			✓	✓			✓		
	Steel containers	✓	✓		N			✓	✓			✓		
	Aluminium	✓	✓		N				✓			✓		
	Wastewater	✓	✓		N	✓		✓			✓			
Hygiene	Sanitary wastewater	✓	✓		N			✓			✓			
	Sanitary biosolids	✓	✓		P					✓		✓	✓	
	Plastic packaging	✓	✓		N	✓			✓			✓	✓	
	Paper packaging	✓	✓		N	✓			✓	✓		✓	✓	
	Laundry washwaters	✓	✓		N	✓		✓			✓			
Health Care	Bandages, gloves, sharps, ampoules, IV bags	✓	✓		Y							✓	✓	
	Packaging	✓	✓		N							✓	✓	
PPE	Ear plugs	✓	✓	✓	N	✓						✓	✓	
	Misc (hardhats, harnesses, etc)	✓	✓	✓	N	✓			✓			✓	✓	
	Dust masks	✓	✓	✓	N	✓						✓	✓	
	Tyvec suits	✓	✓	✓	N	✓			✓			✓	✓	
	Spent respirator cartridges	✓	✓	✓	N	✓						✓	✓	
	Safety shoes & work gloves	✓	✓	✓	N	✓		✓				✓	✓	
	Disposable gloves	✓	✓	✓	N	✓						✓	✓	
Vehicles	Used oil/off-spec fuels/other fluids	✓	✓		Y	✓			✓				✓	
	Rags				N	✓		✓				✓	✓	

Source / Activity	Waste Stream	Principle Phase of generation			Hazardous (Y/N/Potential)	Management Options ← Most Preferred to Least Preferred →						Comments
	Oily adsorbent (clay)	✓	✓		Y	✓			✓		✓		
	Used oil filters	✓	✓		Y	✓		✓				✓	
	Glycol coolant	✓	✓		Y	✓		✓				✓	
	Solvents, degreasers	✓	✓		Y	✓		✓				✓	
	Hydraulic oil	✓	✓		Y			✓				✓	
	Washwater	✓	✓		P	✓	✓			✓			
	Lead acid batteries	✓	✓		Y			✓					
	Tyres	✓	✓		N			✓					
	Spent air filters	✓	✓		N	✓	✓				✓	✓	
	Oil-contaminated soil	✓		✓	Y	✓			✓		✓		
	Worn parts	✓	✓		N			✓			✓		
Warehouse	Packaging paper	✓	✓		N	✓		✓	✓		✓	✓	
	Packaging plastic	✓	✓		N	✓		✓			✓	✓	
	Plastic banding	✓	✓		N	✓		✓			✓	✓	
	Steel banding	✓	✓		N	✓		✓			✓		
	Steel drums/cans	✓	✓		P	✓	✓	✓			✓		
	Plastic drums/cans	✓	✓		P	✓	✓	✓			✓	✓	
	Wood pallets / crating	✓	✓		N	✓	✓	✓	✓		✓	✓	
Construction Materials	Rock / soil	✓			N	✓	✓				✓		
	Metal (steel, copper, aluminium)	✓		✓	N	✓	✓	✓			✓		
	Concrete	✓		✓	N	✓	✓	✓			✓		

Source / Activity	Waste Stream	Principle Phase of generation		Hazardous (Y/N/Potential)	Management Options ← Most Preferred to Least Preferred →							Comments
	Insulation	✓	✓	N	✓					✓		
	Paint & Epoxy coating remnant	✓	✓	Y	✓	✓				✓	✓	
	Solidified cementitious remnants	✓	✓	N	✓					✓		
	Calking (dried)	✓	✓	N	✓					✓	✓	
	Fibre glass, Fibre insulation (e.g. rockwoll, calcium silicate)	✓	✓	N	✓					✓		
	Dried glue products (solvent reactions etc. completed)	✓	✓	N	✓					✓	✓	
	Geomembrane/fabric	✓		N	✓	✓	✓			✓	✓	
	Plastic liner	✓		N	✓		✓			✓	✓	
	Timber	✓		N	✓	✓	✓	✓		✓	✓	
	Timber (treated)	✓		P	✓	✓				✓		
	Styrofoam, PVC piping, HDPE piping	✓		N	✓	✓	✓			✓	✓	
	Blasting abrasive	✓		N	✓	✓	✓			✓		
	Wire	✓		N	✓					✓		
	Refractory	✓		N	✓				✓	✓		
	Carpeting	✓		N	✓					✓	✓	
	Tile	✓		N	✓					✓		
	Rubber	✓		N	✓					✓	✓	
	Glass	✓		N	✓		✓					
	Drywall/plaster	✓		N	✓					✓		

Source / Activity	Waste Stream	Principle Phase of generation			Hazardous (Y/N/Potential)	Management Options ← Most Preferred to Least Preferred →					Comments
Other	Spent solvents	✓	✓		Y	✓		✓		✓	Evaporate
	Cutting oil	✓			Y	✓		✓		✓	
	Flushing/ Chemical cleaning wastes	✓	✓	✓	Y				✓		
	Welding rod	✓			N	✓		✓			
	Empty (punctured upon completion of use) aerosol cans	✓	✓	✓	N	✓		✓			
	Vegetative waste (clearing and grubbing)	✓	✓		N			✓	✓		Use as fertiliser/ mulched/ council landfill
	Cellulose	✓	✓		N			✓	✓		
	Light bulbs	✓	✓	✓	N			✓	✓		
	Fluorescent tubes	✓	✓	✓	Y			✓	✓		
	Spent gas cylinder	✓	✓		N		✓				
	Ballasts (light)	✓	✓		N			✓	✓		
	Batteries (dry cell type)	✓	✓		N			✓	✓		
	Steel cable	✓		✓	N			✓	✓		
	Nylon rigging	✓		✓	N			✓	✓	✓	
	Rope (jute)	✓		✓	N			✓		✓	
	Preservatives/dessicants for equipment shipment	✓			N	✓		✓			
	Acids/caustics	✓	✓	✓	Y	✓			✓		
	Barricade tape	✓	✓	✓	N	✓	✓	✓		✓	✓

Source / Activity	Waste Stream	Principle Phase of generation			Hazardous (Y/N/Potential)	Management Options ← Most Preferred to Least Preferred →			Comments
Wastewater treatment	Biological sludge	✓	✓	✓	N	✓		✓	Potential use as fertilizer/mulch/ council landfill
	Oily sludge/float (scum)	✓	✓		Y			✓	
LNG production	Ceramic balls		✓		N			✓	
	Filter elements	✓	✓		P			✓	
	Molecular sieve waste		✓		Y			✓	
	Mercury contaminated adsorbent (Puraspec)		✓		Y			✓	
	Activated carbon		✓		Y	✓		✓	
	Miscellaneous waste	✓	✓		N			✓	
	Cartridge filters		✓		P			✓	
	Waste oil from waste oil tank		✓		Y	✓		✓	
	Wastewater from T-2912		✓		Y			✓	Evaporate
	Sanitary wastes	✓	✓		N	✓	✓		Treat, test and use for onsite irrigation
	Process/Contaminated stormwater	✓	✓		P	✓	✓		Treat, test and discharge to holding/evaporation ponds
	Brine from desalination unit	✓	✓		N		✓		Test, treat and Discharge to harbour
	Contaminated firewater	✓	✓		P		✓		Treat, test, and discharge to holding/evapor

Source / Activity	Waste Stream	Principle Phase of generation		Hazardous (Y/N/Potential)	Management Options ← Most Preferred to Least Preferred →				Comments
									ation ponds
	Medical waste from clinic	✓	✓	Y				✓	
	Kitchen wastes	✓	✓	N		✓	✓		
	Kitchen grease	✓	✓	N	✓			✓	
	Excavated sediments from stormwater management ponds	✓	✓	P			✓		Treat (as required) and then dispose on-site to aboveground spoil disposal area
	Spill cleaning materials	✓	✓	Y				✓	Incinerate
	Filters (NAG pipeline filter, AGRU-Solvent Filters, Mol. sieve guard filter, C3 product filters) & Flare K.O. drum bottoms		✓	Y				✓	Incinerate

17.4 WASTE MINIMISATION

The goal of the Project is to reduce the generation of hazardous wastes, wastewater discharges, air emissions and solid wastes to the maximum extent achievable.

A waste reduction program will be implemented to reduce the amount of wastes generated during construction and early operation of the LNG Facility. The waste minimisation program will include a systematic assessment of opportunities for reduction at source, reuse, recycling, and recovery of materials or conversion of waste into useable materials, in line with the Queensland Government's objective of waste minimisation outlined in the *EPP Waste Management* and *Section 17.1.1* of this chapter.

Waste materials will be evaluated for reuse and recycling potential before they are classified as disposable waste. Waste material will be segregated to enable recycling or other disposal mechanisms. Non-recyclable wastes generated will be disposed of in offsite waste disposal facilities/treatment facilities using licensed contractors that operate within statutory requirements.

An overview of potential waste minimisation strategies that will be considered for use throughout the Project is provided below.

17.4.1 Waste Avoidance

Source reduction techniques include good operating practices, technology changes, material changes or product changes. Good operating practices are procedural, administrative or institutional procedures that are used to minimise waste. Many of these measures are used as efficiency improvements and good management practices. Good operating practices can often be implemented with little cost and, therefore, have a high return on investment. Good operating practices include:

- waste management programs
- management and personnel practices
- material handling and inventory practices
- loss prevention
- waste segregation
- cost accounting practices
- production scheduling
- equipment maintenance.

Management and personnel practices include employee training and other programs that encourage employees to reduce waste. Material handling and inventory practices include programs to reduce loss of input materials due to mishandling and expired shelf life. Loss prevention minimises waste by identifying and correcting potential problem areas and avoiding releases from equipment and spills. Waste segregation practices reduce the volume of hazardous wastes by preventing the mixing of hazardous wastes with non-hazardous wastes.

Cost-accounting practices include programs to allocate waste treatment and disposal costs directly to the department which generates the waste. This allocation will increase the awareness of operating practices and challenges individuals to develop ways to reduce waste generation. Improved scheduling of batch production runs can reduce the frequency of equipment cleaning and reduce the waste volumes generated.

Technology changes are process and equipment modifications to reduce waste in a production setting. They can range from minor revamps that can be implemented quickly and at low cost, to the replacement of equipment involving large capital costs. Feed material changes support waste management by reducing or eliminating hazardous materials that enter the production run. Product changes or reformulations are performed by a manufacturer of a product to reduce waste from the products used. This also applies to minimising unnecessary packaging from suppliers through contractual agreements and other operating arrangements.

17.4.2 Reuse

Some lumber and green waste generated during construction is proposed to be mulched and reused on site. Mulched timber can be reused for erosion control, to stabilise batters, establish re-vegetated plant stock and as soil conditioning.

Inert material such as concrete, gravel and ceramics may be crushed on site and reused as road base or fill. Appropriate documentation and/or sampling will be undertaken in accordance with *Environmental Protection (Waste Management) Regulation 2000* prior to use as fill material.

Sludge waste from the onsite STP, depending on analytical test results, may be used in green waste mulching.

17.4.3 Recycling

Recycling techniques are characterised as reuse techniques and resource recovery techniques. Recycling via reuse involves the return of a waste to the originating or another process as a substitute for a material from another source.

Reclamation is the recovery of a valuable material from a waste. Reclamation techniques differ from reuse techniques in that the recovered material is not used in the facility; rather it is sold to another company. An example of reclamation is the sale of digested sludge from a STP by a LNG facility to farmers for use as a fertiliser.

17.4.4 *Recover*

Waste recovery options include:

- waste-heat recovery system to recover gas turbine driver exhaust heat for process heating requirements as has been adopted for the Project (refer to *Volume 2, Chapter 9*)
- waste-sorting facility that extracts recyclable materials from combined waste for subsequent reuse.

A waste-sorting facility will be established on site in conjunction with licensed waste disposal contractors selected for site waste management during construction and operation.

17.4.5 *Waste Disposal to Landfill (Residues)*

Remaining wastes that are unable to be avoided, reused or recycled will be disposed to landfill by a licensed contractor as last-resort option.

17.4.6 *Waste Control and Minimisation*

Table 5.17.5 above outlines waste products and potential disposal options. However, a range of alternative waste disposal options are being evaluated including the following:

- Implement waste management practices that will minimise generation of solid wastes and recycle as much waste as practical.
- Provide sanitary wastewater treatment during construction and operation.
- Suitable woody debris, brush, and vegetation will be either mulched and reused on site or sent to local organisations for reuse. If the waste is unsuitable for either of these options, it will be mulched and disposed to municipal landfill.
- Inert wastes (e.g., non-recyclable metal, unsuitable soil, concrete, etc.) may be landfilled off site.
- Used oil, oily wastes, and first-aid station waste will be taken off site and disposed of appropriately at licensed facilities.

Further detail on solid waste control alternatives cannot be provided at present

due to ongoing construction planning and detailed design which may result in variation to waste streams and volumes outlined above, and to investigations for offsite licensed waste disposal sites and options which are ongoing.

17.4.7 Waste Management Plan

QGC is committed to continual improvement in waste management and will develop a waste management plan in accordance with relevant state and commonwealth legislation prior to the commencement of site construction (in conjunction with the EPC contractor) and operations.

This plan will include:

- the scope and objective of the plan
- the environmental values to be protected
- the inputs and outputs of the process, and their impact on the environmental values
- the opportunities and actions to be taken to implement the waste management hierarchy
- lifecycle assessment recommendations
- action plans
- emergency response procedures
- training and management, including outlining the role of the onsite Waste Management Supervisor
- monitoring and reporting program.

Site personnel and contractors will receive training regarding waste management procedures. Trained individuals will implement the following waste management hierarchy when undertaking activities on site:

- eliminate or minimise the waste stream by choice of procedure or technology
- reuse immediately as a material
- reuse immediately as a fuel
- recycle for reuse as a material
- recycle for reuse as a fuel
- landfill (not applicable to liquid wastes) as a last resort for solid wastes
- discharge wastewater (after treatment to acceptable level) to a watercourse
- routine flaring
- minimise venting of hydrocarbons.

During both construction and operational phases, careful consideration will be given to the choice of materials used in the LNG Facility as this can also have an impact on the ultimate volume of waste going to landfill.

17.5 POTENTIAL WASTE IMPACTS AND MITIGATION MEASURES

Solid and liquid wastes will be generated during the construction and operational phases of the Project. Waste classification and management strategy details will be outlined in the site's detailed Construction Waste Management Plan which will be developed in conjunction with the EMP contractor prior to commencement of construction, and Operations Waste Management Plan to be developed prior to operations.

17.5.1 Solid Waste

Only waste for which no other economic use can be identified will go to a landfill, which is the last-resort disposal method. Assuming all wastes are treated, transported and disposed in accordance with waste management legislation, the residual impacts for solid waste are likely to be minor.

Appropriate measures will be implemented to monitor and control the mulch stockpiles on site to prevent spontaneous combustion. Typically, these will include:

- mulch stockpiles shall not be wider than 10 m and higher than 2 m. Typically the stockpiles shall not exceed 200 m in length
- after the establishment of the stockpile they shall be turned every two weeks for the first two months. Following this period an assessment shall be made by the Environmental Representative to determine an appropriate turning regime
- mulch stockpiles shall be monitored on a weekly basis with a temperature gun for the first two months. Following this timeframe the Environmental Representative shall determine an appropriate monitoring frequency
- if the temperature of the stockpile exceeds 60°C the stockpile shall be turned.

17.5.2 Liquid Waste

Wastewater generation will be minimised by efficient use of raw water. Where practicable, segregated and/or treated wastewater will be made available for lower grade use (e.g. for irrigation).

All wastewater, except for uncontaminated rainwater, will be treated before discharge or reuse. All runoff and pump-out from facility construction sites will be inspected and, if needed, directed to settling basins to remove suspended solids (e.g. silt). Therefore, the impacts for liquid waste are likely to be minor.

17.5.3 Hazardous Waste

The need for hazardous materials, including chemicals and petroleum products will be assessed through all phases of the Project in an effort to eliminate, minimise, or substitute with a less hazardous material. All wastes will be treated, transported and disposed in accordance with waste management legislation, and residual impacts for hazardous waste are likely to be minor.

17.5.4 Decommissioning

The storage, handling, treatment, storage and disposal of anticipated wastes generated during the decommissioning phase will be addressed at a later stage of the Project development.

17.6 CONCLUSION

Waste minimisation techniques, cleaner production technologies and legal requirements have been considered in framing QGC's approach to waste management for the Queensland Curtis LNG (QCLNG) Project.

Broadly, waste production will be reduced through avoidance (where possible), recovery, reuse, recycling and the efficient use of resources. Disposal of solid waste is a last resort. Best practice will be applied to the maintenance of onsite waste disposal areas and through the use of environmentally responsible waste contractors for offsite waste disposal. A summary of the impacts outlined in this chapter is provided in *Table 5.17.6* below.

Table 5.17.6 Summary of Impacts from Waste Management

Impact assessment criteria	Assessment outcome
Impact assessment	Negative
Impact type	Direct
Impact duration	Long-term
Impact extent	Local
Impact likelihood	High

Overall assessment of impact significance: minor. This assessment assumes the waste management hierarchy is applied and all solid, liquid and hazardous wastes are treated, transported and disposed of in accordance with applicable waste management legislation.