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23 Health and safety

23.1 Introduction

This section describes the health and safety of the GFD Project for the workforce and the community.

The GFD Project area is predominantly surrounded by an agricultural landscape. Other land uses include resource industries, various reserves, parks and State forests, as well as some towns also surround the GFD Project area.

Health and safety for the GFD Project will be managed under an existing environment, health and safety management system which complies with relevant Queensland health and safety regulatory requirements. This will be consistent with the health and safety management system already in place for the approved GLNG Project.

This section has been prepared in accordance with section 7.2 of the *Terms of reference for an environmental impact statement* issued March 2013. The index to locate where each ToR requirement is met within this EIS is included in Appendix B: Terms of reference cross-reference.

23.2 Regulatory context

23.2.1 Legislation, policies and guidelines

This EIS has been prepared in accordance with State and Commonwealth regulatory context as described in Appendix C: Regulatory framework. The legislation, policies and guidelines that apply to the health and safety values and potential impacts of the GFD Project are outlined in Table 23–1.

Table 23–1 Regulatory context – health and safety

Legislation, policy or guideline	Relevance to the GFD Project
Petroleum and Gas (Production and Safety) Act 2004 (Qld) (P&G Act) The Act regulates petroleum activities with the aim of developing a safe, efficient and viable petroleum and fuel gas industry in Queensland. Petroleum tenure is granted under the Act. *Petroleum and Gas (Production and Safety) Regulation 2004* (Qld) The regulation provides safety requirements associated with the production, transportation and use of petroleum and fuel gas.	The relevant activities of the GFD Project will comply with the safety and technical requirements set out in the Act and its subordinate regulation. These regulatory requirements apply to gas production activities and are designed to promote the safety of persons. The regulation covers the commissioning, operation, maintenance and decommissioning of operating plants and certain construction work at existing plants.
Environmental Protection Act 1994 (Qld) (EP Act) The EP Act is the principal legislation for the protection and management of environmental values within Queensland. The Act aims to protect the natural environment and associated ecological systems and processes while allowing for ecologically sustainable development.	The EP Act defines an environmental value as a quality or physical characteristic of the environment that is conducive to ecological health or public amenity or safety. Santos GLNG has a general duty to take reasonable and practicable steps to avoid harm to the environment i.e. an adverse effect (whether temporary, or permanent, and of whatever magnitude, duration or frequency) on an environmental value (environmental harm) or unreasonable interference with an environmental value (environmental nuisance).

Legislation, policy or guideline	Relevance to the GFD Project
Environmental Protection (Air) Policy 2008 (Qld) (EPP Air) EPP Air intends to protect the qualities of the air environment that are conducive to the human and ecosystem health, the appearance of natural and developed structures and agricultural use of the environment. The policy provides a framework for making consistent and informed decisions about the air environment, including indicators and objectives.	Santos GLNG has adopted the indicators and objectives provided by the EPP Air to assess the potential impacts of the GFD Project on those characteristics of air quality that are conducive to human and ecosystem health.
Environmental Protection (Noise) Policy 2008 (Qld) (EPP Noise) EPP Noise achieves the objectives of the EP Act in relation to the acoustic environment by stating acoustic quality objectives for enhancing or protecting the environmental values and providing a framework for making consistent, equitable and informed decisions about the acoustic environment.	Santos GLNG has adopted the indicators and objectives provided by the EPP Noise to assess the potential impacts of the GFD Project on those characteristics of acoustic quality that are conducive to human and ecosystem health.
Environmental Protection (Water) Policy 2008 (Qld) (EPP Water) EPP Water aims to protect Queensland's waters while allowing for ecologically sustainable development. It provides a framework for identifying environmental values for aquatic ecosystems and human uses, and determining water quality guidelines and objectives to enhance or protect the environmental values.	The environmental values to be protected by the EPP Water include the suitability of appropriate waters for producing food for human consumption and the suitability of appropriate waters for supply as drinking water. Santos GLNG has adopted the indicators and objectives provided by the EPP Water to assess the potential impacts of the GFD Project on those characteristics of water quality that are conducive to human and ecosystem health.
Building Act 1975 (Qld) This Act provides for the safe design and operational of buildings in order to protect persons, property and the environment. *Building Fire Safety Regulation 2008* (Qld) This regulation provides for the safe design and operation of buildings to ensure that persons and property are protected from fire and hazardous materials emergencies.	The Act and its subordinate regulation are relevant to the GFD Project through the assessment and approval of building design and the requirement to comply with the *Building Code of Australia*. In addition, compliance with fire safety obligations in building design and facilities are also required.
Electrical Safety Act 2002 (Qld) This Act is directed at eliminating the human cost to individuals, families and the community of death, injury and destruction that can be caused by electricity. *Electrical Safety Regulation 2013* (Qld) The regulation prescribes requirements for the use and supply of electricity to eliminate the human costs that can be associated with electrical accidents and faults.	The GFD Project will comply with the framework established by the Electrical Safety Act 2002 and it subordinate regulation in the development and implementation of relevant health and safety management systems to protect and property. In situations where the *Work Health and Safety Act 2011* (Qld) and the Electrical Safety Act 2002 both apply, the Electrical Safety Act 2002 takes precedence.
Fire and Rescue Service Act 1990 (Qld) This Act establishes the Queensland Fire and Rescue Service and provides for the prevention and response to fires and other incidents that endanger persons, property and the environment. *Fire and Rescue Service Regulation 2011* (Qld) This regulation provides for the issuing of notices to control and prevent fires as well as to specify fire levy classes and contributions property owners are charged.	The Act and its subordinate regulation help to ensure the involvement of the Queensland Fire and Rescue Service in emergency planning for the GFD Project.
Radiation Safety Act 1999 (Qld) The Act aims to protect persons and the environment from the risks associated with exposure to radiation. *Radiation Safety Regulation 2010* (Qld) The regulation prescribes the safe utilisation, storage, handling and disposal of radioactive material so as not to endanger persons, property or the environment.	The GFD Project will comply with licensing and safety standards applicable to the use of radiation during construction and operations (e.g. during the inspection of pipeline welds).

Legislation, policy or guideline	Relevance to the GFD Project
Transport Operations (Road Use Management) Act 1995 (Qld) (and associated regulations for dangerous goods and other relevant aspects) The Act provides for the management of vehicles and road use including mass, loading and dimension requirements for heavy vehicle transport. *Heavy Vehicle National Law Amendment Act 2013* (Qld) This Act amends existing Queensland legislation to remove provisions that regulate heavy vehicles that are covered by the Heavy Vehicle National Law and addresses how the National Law will apply in Queensland.	Santos GLNG will comply with requirements of the acts for management of vehicles and road use in planning transport and traffic activity of GFD Project.
Work Health and Safety Act 2011 (Qld) The Act prescribes the health and safety requirements affecting most workplaces, work activities and the use of plant and substances in Queensland. *Work Health and Safety Regulation 2011* (Qld) The regulation prescribes the form of Queensland's statutory insurance scheme to compensate and rehabilitate those injured while at work.	The GFD Project will adopt a systematic health and safety management approach that provides for risk identification and assessment, hazard analysis, management and control, and reporting to protect workers in accordance with regulatory requirements. In this way, Santos GLNG will ensure, so far as is reasonably practicable, the health and safety of workers at the workplace. The Work Health and Safety Regulation 2011 covers workplace hazardous substances and dangerous goods under a single framework for hazardous chemicals and introduces a new hazard classification and hazard communication system based on the United Nations' *Globally Harmonised System of Classification and Labelling of Chemicals*. When in the workplace, dangerous goods must meet the labelling requirements prescribed under the Work Health and Safety Regulation 2011.
Workers' Compensation and Rehabilitation Act 2003 (Qld) The Act provides a statutory insurance scheme to compensate and rehabilitate those injured while at work. *Workers' Compensation and Rehabilitation Regulation 2003* (Qld) The regulation prescribes the form of Queensland's statutory insurance scheme to compensate and rehabilitate those injured while at work.	Santos GLNG must conform to the workers' insurance and compensation requirements set out in this legislation.
State Planning Policy (SPP) The single SPP introduced in December 2013 defines Queensland Government policies about matters of State interest in land use planning and development.	The SPP provides a key framework for the State government's broader commitment to land use planning and development reform. One of the State interests included in the SPP is planning for hazards and safety to ensure that the potential impacts of hazards caused by extreme weather events, natural processes and as the result of human activities are avoided or minimised.

23.2.2 Standards and codes of practice

There are Australian and international standards and codes that provide guidance for the detailed design of the GFD Project. Table 23–2 identifies the standards and codes of practice relevant to the GFD Project.

Table 23–2 Standards and codes of practice relevant to health and safety

Standard or code of practice	Relevance to GFD Project
AS 2885.1: 2012 Australian Standard for pipelines; gas and liquid petroleum, part 1 design and construction	Sets requirements for the design and construction of steel pipelines and associated piping and components used to transmit hydrocarbons.
AS 2885.3: 2012 Australian Standard for pipelines; gas and liquid petroleum, part 3 operation and maintenance	Sets minimum requirements for the operation and maintenance of pipelines, including requirements relating to continued integrity and safe operation.
AS 1940: 2004 Storage and handling of flammable and combustible liquids	Sets requirements for storing flammable and combustible liquids including separation distances and other considerations.
AS 2436:2010 Guide to noise control on construction, maintenance and demolition sites	Details measures to be implemented to manage noise on construction sites, if required. Measures may also be applicable to mobile plant and equipment during operations.
AS/NZS 3000 Wiring Rules: electrical installations	Details measures to be implemented when conducting electrical installations.
National Standard for the Control of Major Hazard Facilities (MHF) (NOHSC:1014(2002)) and *National Code of Practice* (NOHSC: 2016(1996)) (if relevant)	Aims to eliminate the underlying and immediate causes of major accidents at major hazard facilities, by addressing the scale and type of major hazard facilities that are not necessarily covered by current legislation.
Code of Practice for Constructing and Abandoning Coal Seam Gas Wells in Queensland, Second Edition (DNRM, 2013)	Sets minimum standards for the construction, operation and abandonment of wells to ensure long-term well integrity, containment of gas and protection of groundwater resources. Implementation of the code ensures risk to the public and workforce is managed to a level as low as reasonably practicable.
ADG7 The Australian Dangerous Goods Code 7th Edition 2007 (NTC, 2007)	This code lists provisions applicable to the transport of dangerous goods. Santos GLNG will comply with the *Australian Dangerous Goods Code* and relevant transport laws for the transport of dangerous goods by road and rail. When in the workplace, dangerous goods must meet the labelling requirements prescribed under the Work Health and Safety Regulation 2011.
National Fire Protection Association (NFPA) standards and reference documents	NFPA 30: Flammable and Combustible Liquids Code NFPA 58: Storage and Handling of Liquefied Petroleum Gases NFPA 59: Storage and Handling of Liquefied Petroleum Gases at Utility Gas Plants NFPA 70: National Electrical Code NFPA 77: Static Electricity NFPA780: Lightning Protection Code NFPA 307: Construction and Fire Protection at Marine Terminals, Piers and Wharves NFPA 497A: Classification of Class I Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas NFPA 497B: Classification of Class II Hazardous (Classified) Locations for Electrical *Installations in Chemical Process Areas*

Standard or code of practice	Relevance to GFD Project
American Petroleum Institute (API) standards and reference documents	API RP 620: Recommended Rules for Design and Construction of Large, Welded, Low-Pressure Storage Tanks API RP 2003: Protection Against Ignitions Arising Out of Static, Lightning and Stray currents API Std.2510: Design and Construction of Liquefied Petroleum Gas (LPG) Installations. API RP 500: Classification of Locations for Electrical Installations at Petroleum Facilities API RP 520: Sizing, Selection and Installation of Pressure-Relieving Devices in Refineries API RP 521: Guide for Pressure- Relieving and Depressurising Systems API Pub. 2510A: Fire Protection Considerations for the Design and Operation of Liquefied Petroleum Gas (LPG) Storage Facilities.

23.3 Assessment methodology

This assessment describes the health and safety-related environmental values of the community and GFD Project workforce and assesses the GFD Project's potential impact on these values.

Potential health and safety impacts may arise either directly through GFD Project activities or indirectly through potential impacts on environmental values such as those relating to water, land, air or noise, which could affect the health and wellbeing of local populations or the GFD Project workforce.

Impacts on the environmental values have been assessed in relevant sections of the EIS, including:

- Section 11: Traffic and transport
- Section 13: Surface water
- Section 14: Groundwater
- Section 15: Air quality
- Section 17: Noise and vibration
- Section 21: Social
- Section 24: Preliminary hazard and risk.

The health and safety risks associated with these impacts are assessed in this section. Impacts were assessed using the risk assessment methodology, which considers the likelihood and consequence of a potential impact to assess its level of risk.

The full description of the risk assessment methodology is described in section 5.6.3 of Section 5: Assessment framework. The standard consequence criteria have been expanded to consider the impacts on people as per Table 23–3.

Table 23–3 Consequence criteria

Consequence category	Description	Impacts to people[1]
Critical Severe, widespread long-term effect	Destruction of sensitive environmental features. Severe impact on ecosystem. Impacts are irreversible and/or widespread. Regulatory and high-level government intervention/action. Community outrage expected. Prosecution likely. Financial loss in excess of $100 million.	Multiple fatalities
Major Wider spread, moderate to long-term effect	Long-term impact of regional significance on sensitive environmental features (e.g. wetlands). Likely to result in regulatory intervention/action. Environmental harm either temporary or permanent, requiring immediate attention. Community outrage possible. Prosecution possible. Financial loss from $50 million to $100 million.	Single fatality
Moderate Localised, short-term to moderate effect	Short term impact on sensitive environmental features. Triggers regulatory investigation. Significant changes that may be rehabilitated with difficulty. Repeated public concern. Financial loss from $5 million to $50 million.	Permanent disabling injury/injuries.
Minor Localised short-term effect	Impact on fauna, flora and/or habitat but no negative effects on ecosystem. Easily rehabilitated. Requires immediate regulator notification. Financial loss from $500,000 to $5 million.	Injury/injuries requiring medical treatment (lost time injury/injuries)
Negligible Minimal impact or no lasting effect	Negligible impact on fauna/flora, habitat, aquatic ecosystem or water resources. Impacts are local, temporary and reversible. Incident reporting according to routine protocols. Financial losses up to $500,000.	First aid treatment, or illness/injury not requirement treatment (no lost time injuries)

[1] Adopted from additional consequence criteria used in Section 24: Hazard and risk.

A summary of the impact assessment is shown in section 23.7.

23.4 Environmental values

This section provides an overview of the health and safety values applicable to the community and GFD Project workforce that could potentially be affected by the construction, operations or decommissioning of the GFD Project. Consistent with the requirements of the EP Act, P&G Act and Work Health and Safety Act, the overarching environmental values derived for the health and safety aspects of the GFD Project are:

- Health, safety, wellbeing and general quality of life of communities, particularly vulnerable members of the community. While there are many values that contribute to health and safety, for the purposes of this EIS, those values with the potential to be impacted by the GFD Project have been considered and include:
  - Air quality that is conducive to human health and agricultural production
  - Acoustic environment that is conducive to human health and agricultural production
  - Water quality that is conducive to human health and agricultural production
  - Transport networks that are well maintained with the capacity for their traffic volume.
- Health, safety and wellbeing of workers associated with the GFD Project.

The baseline condition of these values is discussed further below.

23.4.1 Air quality

Air quality that is conducive to human health, agricultural production and land use amenity is defined through the EPP Air. This policy stipulates air quality guidelines for a number of pollutants including nitrogen dioxide (NO_2), carbon monoxide (CO), particulate matters (PM_{10} and $PM_{2.5}$).

The air environment in the GFD Project area is influenced by emissions such as dust from traffic on unsealed roads, wind erosion of bare soils from agricultural and resources activities and dust storms, and air emissions from industrial activities such as power generation, quarries and resources projects. However, quantifying these emissions is difficult as they are highly variable and seasonally dependent. Monitoring records collected between 2003 and 2010 from the ambient air quality monitoring station at Toowoomba (nearest to the GFD Project area and 330 km east-southeast of Roma) indicate background levels of NO_2 (1 hour average), CO (8 hour average) and PM_{10} (24 hour average) are below the EPP Air objectives.

The EPP Air objectives and baseline characteristics of the air environment in the GFD Project area are further discussed in Section 15: Air quality.

23.4.2 Noise and vibration

The characteristics of the acoustic environment that are conducive to human health and wellbeing and agricultural production are defined in EPP Noise and a number of other regulatory and industry guidelines. As a predominantly rural environment, the existing acoustic environment is influenced primarily by local bird and insect activity, as well as agricultural activities and intermittent noise generated by road traffic. Noise levels are reduced during the evening and night-time periods when bird, insect, agricultural activity and road traffic is generally negligible. The existing background noise levels are below the deemed background noise levels that have been adopted for noise sensitive receptors, with the exception of a monitoring location to the east of Roma.

Existing ambient ground vibrations are not expected to be noticeable at the majority of sensitive receptors in the GFD Project area, with the exception of receptors located close to mines and quarries that conduct blasting.

The objectives and baseline characteristics of the acoustic environment in the GFD Project area are further discussed in Section 17: Noise and vibration.

23.4.3 Surface water and groundwater

Water quality that is conducive to human health, agricultural production and land use is defined through EPP Water. This policy stipulates water quality guidelines and water quality objectives to enhance or protect these values.

Existing human uses of surface water resources throughout the GFD Project area are identified in Section 13: Surface water and Section 14: Groundwater. In general, the following water uses are considered to be the most sensitive within the GFD Project area:

- Livestock water
- Impound water (e.g. farm dams, emergency fire-fighting water supply)
- Domestic supply
- Water harvesting
- Industrial use
- Town water supply.

The primary watercourses of the GFD Project area include the Dawson, Balonne, Comet and Condamine rivers and numerous tributaries. The surface water environment of the GFD Project area is generally slightly to moderately disturbed as a result of existing land use (such as agricultural production and resources extraction).

The groundwater resources of the GFD Project area, which include several aquifers associated with the Great Artesian Basin, includes hydrogeological units that are used for domestic and agricultural purposes and springs/watercourse springs (including spring vents) that provide baseflow to streams.

23.4.4 Traffic and transport values

The safety and efficiency of traffic and transport networks is one of the environmental values identified in Section 11: Traffic and transport, which describes the aspects of the road network relating to the location and provision of physical infrastructure. Physical infrastructure related to safety includes bridges, rail crossings, cattle grids, pavements and road construction standards.

Regional towns in the GFD Project area are connected by a network of highways: the primary north-south highway corridors are the Leichhardt Highway, Carnarvon Highway and Fitzroy Developmental Road. Key east-west highway corridors are the Warrego Highway and Dawson Highway. These State-controlled highways carry the highest traffic volumes in the region, with comparatively high heavy vehicle (freight) traffic volumes. A further network of regional connecting roads provides access between minor townships. These roads are usually sealed, and generally carry fewer than 500 vehicles per day.

Rural roads are present throughout the GFD Project area and enable transport between and within large rural land holdings. These roads may be sealed and/or unsealed and are often maintained by the landholder.

The traffic and transport assessment found a total of 624 traffic accidents along the 4,500 km of roads identified as potentially to be utilised by the GFD Project. This excludes traffic on the Warrego Highway east of Toowoomba where the GFD Project traffic is insignificant. This is based on data available from the Department of Transport and Main Roads, which covers January 2006 to December 2010. The data indicates there were 22 fatal traffic accidents within the GFD Project area.

The traffic and transport assessment calculated the casualty accidents per 100 million vehicle kilometres travelled on the road network likely to be utilised by the GFD Project. Based on current traffic, the majority of the transport network within the GFD Project area has an accident rate below that of the State average. However, there are sections of road that have averages higher than the State, including:

- Carnarvon Highway south of Rolleston and south of Roma
- Dawson Highway each of Bauhinia
- Leichhardt Highway south of Wandoan
- Roma-Taroom Road.

A complete analysis is provided in section 3.5 of Appendix M: Traffic and transport.

23.5 Potential impacts

The risk assessment identified the potential impacts on health and safety values associated with the GFD Project activities. The potential impacts were identified and evaluated following an analysis of the GFD Project activities described in Section 4: Project description.

The potential impacts to health and safety values result directly or indirectly from impacts to environmental values such as those pertaining to air quality, noise and vibration, water resources, and traffic and transport.

The potential impacts are detailed in Table 23–4 below.

Table 23–4 Potential impacts

Project stage	Activity	Potential impact to health and safety
Air quality		
Construction and decommissioning	Clear and grade. Vehicle and mobile equipment movement. Concrete batching. Equipment usage.	Air emissions contribute to an exceedance of one or more of the air quality objectives (for NO2, CO, PM10 or PM2.5) that have the potential to affect human health and wellbeing.
	Operation of sewage treatment plants.	Localised odour emissions that have the potential to affect human health and wellbeing.
Operations	Operation of gas-fired turbine compressors alternators, triethylene glycol (TEG) dehydrator reboilers at gas compression facilities, engines at wellheads, flares. Use of vehicles, trucks and other mobile equipment.	Modelling found that the NO2 and CO emissions would comply with air quality objectives. These air emissions will have a low impact and will not require specific mitigation measures.
Noise and vibration		
Construction and decommissioning	Drilling activities. Construction of facilities, gathering lines, borrow pits, quarries and lay down areas. Vehicle movement on access tracks. Construction of power lines and communication infrastructure. Ground vibration from rock breaking, vibratory rollers and heavy vehicle movements.	Noise and vibration emissions from construction or decommissioning activities could contribute to an exceedance of the prescribed criteria, which may result in annoyance, stress, sleep disturbance and reduced community wellbeing for nearby sensitive receptors. The noise and vibration assessment shows that the highest noise levels are associated with drilling activities.
	Vehicle movement.	Ground vibrations from 12 tonne vibratory rollers may result in annoyance, stress, sleep disturbance and reduced community wellbeing.
Operations	Operation of gas compression facilities, water management facilities, wells and accommodation camps.	Noise emissions from the operation of the facilities could potentially contribute to an exceedance of the noise objectives, which may affect human health and wellbeing for nearby sensitive receptors.
	Light vehicles undertaking maintenance work.	Traffic movements during operations are not expected to exceed the noise criteria.
Traffic and transport		
Construction and decommissioning	Workers travelling from accommodation camps to the GFD Project areas for daily work activities. Heavy vehicle movements for the delivery of plant and equipment, waste removal and personnel transportation purposes.	Increased risk of traffic incidents and road accidents caused by driver factors (e.g. fatigue), vehicle factors (e.g. worn tyres), road environment factors (e.g. deteriorating road conditions), the number of vehicles on the road and the proportion of heavy vehicles present.
Operations	Workers travelling from accommodation camps to the GFD Project infrastructure for routine work activities. Less frequent heavy vehicle movements for delivery of supplies and waste removal.	The intensity of traffic generated during this phase will be considerably lower than that of the construction phase. Further, the proportion of heavy vehicles is greatly reduced. Reduced risk of traffic incidents and road accidents.

Project stage	Activity	Potential impact to health and safety
Water quality		
Construction and decommissioning	Construction of watercourse crossings.	Soil disturbance and stream bank erosion causing increased turbidity and sedimentation.
	Uncontrolled release of chemicals or untreated waste waters.	Potential degradation of surface water or groundwater quality which may impact upon the health and safety of users.
	Construction of areas of stagnant water, such as water storage facilities Open water storages may be present for short periods in the form of oily water sump and drilling fluid sumps at well leases.	Increase in favourable environmental conditions for the presence or distribution of disease vectors (mosquitos, midges or ticks). An increase in disease vectors could increase exposure to and infection from vector-borne diseases.
Operations	Uncontrolled release of chemicals or untreated waste waters and coal seam water.	Potential degradation of surface water or groundwater quality which may impact upon the health and safety of users.
	Operation of water storage devices.	Increase in favourable environmental conditions for the presence or distribution of disease vectors (mosquitos, midges or ticks). An increase in disease vectors could increase exposure to and infection from vector-borne diseases.
Industrial incidents		
Construction	Construction of the gas gathering and transmission pipelines.	Damage to adjacent gas pipelines resulting in impacts to human health.
Operations	Operation of gas compression facilities, water management facilities, wells and accommodation camps.	Loss of containments at various GFD Project facilities which may result in contamination, fires or explosions as well as injuries or fatalities. Catastrophic failure of water storage or water management facilities could result in localised overland flow / flooding.
Decommissioning	Decommissioning and rehabilitation of gas compression facilities, water management facilities, wells and accommodation camps.	Explosions as a result of incorrect preparation for decommissioning.
Workplace health and safety		
Construction and decommissioning	Use of heavy machinery (such as drill rigs and excavators). Movement of heavy and light vehicles Transport and establishment of large infrastructure components	The construction workforce will be exposed to typical construction health and safety risks including noise, dust, heat and physical injury.
Operations	Operation of gas compression facilities, water management facilities, wells and accommodation camps.	The operation workforce will be exposed to typical operational health and safety risks including noise, dust, heat, noise and physical injury.

23.6 Mitigation measures

23.6.1 Management standards

Santos GLNG has an established Environment, health and safety management system that is designed to identify, mitigate and manage the environment, and health and safety risks that are associated with Santos GLNG operations. This approach applies the principles of Environment, health and safety management standard 09: Managing environment, health and safety risks, which are:

- Elimination (e.g. by eliminating inventories of dangerous goods)
- Substitution (e.g. by using a less hazardous material in place of a more hazardous material)
- Engineering (e.g. compliance with internal and external standards)
- Isolation (e.g. erection of physical barriers)
- Administrative (e.g. emergency procedures)
- Protective (e.g. use of personal protective equipment (PPE)).

This section outlines two layers of the environment, health and safety management system framework which directly address issues on workforce health and safety.

- Environment, health and safety management standards (EHSMS) — identifies how environment, health and safety risks will be systematically managed across Santos GLNG operations and activities
- Health and safety hazard standards (HSHS) — identifies and provides controls to manage the health and safety risks associated with specific activities.

The environment, health and safety management system has been designed to identify, avoid, mitigate and manage the health and safety risks involved with the GFD Project outlined in this section. This system has been employed for the GLNG Project and been proven as an effective management system and will also be implemented for the GFD Project. Implementing the management system will result in improved health and safety for the environment, surrounding communities and workforce.

The key EHSMS are listed in Table 23–5 and the HSHS standards are described in Table 23–6. The management system enables Santos GLNG's compliance under both the Work Health and Safety Act and the P&G Act and subordinate regulations.

Table 23–5 Environment, health and safety management system – management standards

Management standard	Purpose
EHSMS01 Environment, health and safety policies	The policies outline overall environment, health and safety direction and commit Santos GLNG to improving environment, health and safety performance.
EHSMS02 Legal obligations and other requirements	Understanding legal and other obligations allows Santos GLNG and contractors to comply with environment, health and safety legal requirements.
EHSMS03 Objectives and targets	Objectives and targets are set to measure and drive continuous improvement in environment, health and safety performance.
EHSMS04 Environment, health and safety improvement plans	Improvement plans set out the specific initiatives, actions and milestones for achieving environment, health and safety performance objectives and targets.
EHSMS05 Environment, health and safety responsibility and accountability	Assignment of roles, responsibility and accountability ensures resources, including human, technical and financial are appropriately used to implement, maintain and improve the environment, health and safety management system.

Management standard	Purpose
EHSMS06 Training and competency	Focussed training ensures that everyone with responsibilities allocated under the environment, health and safety management system understands how to fulfil their responsibilities and has the necessary skills. Some of the key requirements include: • Employees and contractors shall only be permitted to perform unsupervised tasks where they have the skills and experience or competency to perform such tasks without harm. • Personnel working at or visiting a Santos GLNG site or facility shall undergo an appropriate environment, health and safety induction. • Employees shall only be appointed to positions where they have the required training, experience and competency requirements defined for that position. • A system shall be developed and maintained to validate that contractors have relevant environment, health and safety competencies, including those required by statute.
EHSMS07 Consultation and communication	Appropriate consultation and communication processes enable employees, contractors and external stakeholders to understand and contribute to environment, health and safety management system requirements and decisions.
EHSMS09 Managing environment, health and safety risks	Risk management processes are necessary to systematically identify hazards, assess their risk and adopt control strategies to reduce risk to as low as reasonably practicable.
EHSMS09.2 Hazard studies	Requirements for the identification and acceptable risk management of environment, health and safety hazards during project development.
EHSMS10 Contractor and supplier environment, health and safety management	Contractors doing work on Santos GLNG's behalf and suppliers of equipment, materials and goods are required to have appropriate environment, health and safety management systems in place so as to prevent harm to Santos GLNG and contractor personnel, the public, the environment and Santos GLNG's business interests.
EHSMS11 Operations integrity	Process safety management deals with the prevention of major hazards or catastrophic events that could lead to fatalities, serious injury, significant property damage or significant environmental harm. Systems and tools are required to manage process safety risks, as a subset of environment, health and safety management. The emphasis is on maintaining effective lines of defence to prevent the occurrence of and mitigate the consequences of major unwanted events. Process safety is addressed across the full lifecycle of assets, from development to operational integrity through to diligence in abandonment.
EHSMS11.1 Design basis – facility and equipment	A detailed description of the facility operating basis, the fluids and chemicals processed within the facility, and the design basis and operating limits of the equipment involved, along with processes to support consistent operation within design limits is required to provide a basis for personnel associated with the operation, maintenance or design of a facility to identify, understand and manage environment, health and safety risks. These supporting processes include alarm management, operating envelopes and control systems.
EHSMS11.2 Facilities design and construction	Facilities need to be designed and constructed (for new and modified facilities) so that they can be commissioned, started up and operated in compliance with applicable legislation and with as low as reasonably practicable risk of safety, health or environmental incidents.
EHSMS11.3 Pre-startup environment, health and safety review	Prior to the startup of new facilities, modified facilities or facilities that have undergone intrusive maintenance, a pre-startup environment, health and safety review is conducted to ensure that the facility can be started up and operated safely and without environmental harm.
EHSMS11.4 Structural integrity	Management processes are required for developing, implementing and maintaining the structural integrity of structures and equipment to ensure that they are structurally safe and meet relevant regulatory requirements.
EHSMS11.5 Mechanical integrity	Management processes are required for developing, implementing and maintaining the mechanical integrity of assets so that the risk of failure is as low as reasonably practicable.

Management standard	Purpose
EHSMS11.6 Ignition control	Ignition sources are a hazard at locations where explosive atmospheres may occur so processes are required to identify and eliminate or otherwise control such sources in order to reduce the risk of a fire and/or an explosion to as low as reasonably practicable.
EHSMS11.7 Critical protection systems	Critical protection systems are a line of defence to prevent mechanical or electrical integrity being compromised or environment, health and safety incidents escalating so processes are required for the design, assessment, construction, operation, testing, reliability and maintenance of critical protection systems in new and existing facilities.
EHSMS11.8 Operating procedures and safe practices	A controlled system of procedures and safe work practices is required to be developed and maintained to ensure the safety of personnel during operational and maintenance activities, to protect the environment and the safe operation of plant and equipment.
EHSMS11.9 Maintenance	Maintenance specific systems and procedures are required to manage environment, health and safety risks encountered in maintenance operational activities.
EHSMS11.10 Fire risk management	Processes need to be developed and maintained to ensure that fire and fire-related risks in facilities and buildings are managed.
EHSMS11.11 Decommissioning and abandonment	Ensures that environment, health and safety risks associated with the decommissioning and abandonment of plant, equipment and facilities are effectively managed.
EHSMS11.12 Operated by others	Details the Santos requirements for stewarding the environment, health and safety performance of joint venture activities operated by others.
EHSMS12 Management of change	Processes are required to ensure that when changes are made that environment, health and safety risks and other impacts of changes are identified and appropriately managed.
EHSMS12.1 Critical drawings and control systems - change management	Describes the requirement for the control and authorisation of changes to existing piping and instrument diagrams and control systems.
EHSMS12.3 Disablement of protective devices (bridging) - change management	Ensures that the risks associated with temporarily disabling protective devices (bridging) are adequately managed such as the ongoing safety of personnel, environmental impact and the integrity of plant and equipment.
EHSMS12.4 Substitution of materials and equipment components - change management	Ensures the risks associated with the substitution of materials or components in plant and equipment are adequately managed and the changes meet or exceed the performance criteria of the original plant and equipment.
EHSMS12.5 Acquisition and divestment of assets	Ensures that environment, health and safety aspects of proposed acquisitions and divestments are fully understood before making a decision to acquire or divest land or assets, companies or other entities.
EHSMS12.6 Management of personnel change	Identifies and manages potential environment, health and safety risks associated with changes to organisational structure and personnel, and to ensure the adequate transfer of environment, health and safety knowledge during personnel change.
EHSMS13 Emergency preparedness	Ensures that relevant equipment and resources are available and personnel are able to effectively respond to foreseeable emergencies so as to minimise adverse impact on the safety or health of people or the environment.
EHSMS13.1 First-aid and medical facilities	Defines the requirements for first aid, the provision of first–aid facilities and the availability of qualified first–aid personnel to ensure effective treatment of employees, visitors and contractors.
EHSMS14 Monitoring, measurement and reporting	Collection, analysis and reporting of environment, health and safety performance data is necessary to establish whether risks associated with Santos' operations are being managed, minimised and where reasonably practicable, eliminated.
EHSMS15 Incident investigation and response	Reporting, investigation and management of corrective actions associated with incidents is required to identify the underlying system failures and implement appropriate corrective actions to prevent a recurrence.
EHSMS15.1 Injury management	Ensures that there is an effective and equitable injury management system in place for employees who sustain a work related injury or illness.

Management standard	Purpose
EHSMS16 Environment, health and safety audit and inspection	Audit and assessment ensures that environment, health and safety management system have been effectively implemented and are being complied with, and that the system meets legislative requirements and defined environment, health and safety objectives and targets.
EHSMS17 Management review	Periodic reviews of the overall effectiveness of the environment, health and safety management system by senior management ensure continual improvement, suitability and effectiveness.

Hazard standards which define the requirements for managing the specific risks posed by a hazard are listed in Table 23–6.

Table 23–6 Environment, health and safety management system – hazard standards

Hazard standard	Purpose
HSHS01 Hand safety	Details the requirements to reduce the risk of hand injury.
HSHS02 Land transportation	Manages the risks associated with land transportation activities. Key requirements include: • Personnel driving vehicles for, or on behalf of, Santos GLNG must hold an appropriate current drivers licence. • Personnel who drive light vehicles on field roads must have undergone training and hold a current competency certificate. • Santos GLNG contractors will develop and maintain a journey management plan, which will include a search and rescue plan. • When driving, State road rules apply. • Additional rules must be followed when driving on field roads such as lights on when driving, not driving through dust clouds and provision of dune poles and rollover protection. • Detailed controls set out in the standard shall be followed when changing wheels and tyres, in particular when dealing with split rims. • Vehicle recovery procedures will be developed. • Vehicles will be maintained to manufacturers' specifications and pre-start and regular inspections will be carried out. • Detailed controls for heavy vehicles will be followed such as use of log books and observing limitations on carrying liquids in non–baffled tankers. • Quad bikes to be used in limited and approved situations only. • Vehicle incidents to be reported and undergo appropriate investigation.
HSHS03 Air transportation	Manages the risks associated with air transportation activities.
HSHS04 Health and wellbeing	Creates an environment where personnel are motivated to maintain a healthy lifestyle and to manage the risks associated with personnel who are not fit for work. Key requirements include: • Personnel are responsible for maintaining their fitness for work. • Education and awareness programs will be provided to enable personnel to understand and manage their health and fitness for work. • Employees will be provided with access to fitness assessments and fitness programs. • An employee assistance program shall be provided to provide employees access to professional assistance or treatment to maintain or recover their fitness for work. • Health assessments will be provided to encourage employees to achieve or maintain a fit and healthy lifestyle. • Contractors are responsible for ensuring they have programs in place to maintain the health and fitness for work of their employees. • Drug and alcohol testing will be conducted to monitor the effectiveness of the proactive fitness for work measures. • Employees who return a positive drug or alcohol test will, in general, be supported in modifying their behaviour with the aim of returning them to their job.

Hazard standard	Purpose
HSHS05 Working in hot environments	Manages the risks associated with personnel working in hot environments. Key requirements include: • In hot environments the risk of heat stress shall be considered when conducting Stepback (as defined) and when developing job hazard analysis and operating procedures. • Heat risk control measures shall include heat acclimatisation, work planning, provision of adequate cool drinking water and other control measures as deemed necessary. • Heat risk control measures will, where relevant, be included in job hazard analysis and operating procedures. • The risk of heat stress shall be considered when planning for confined space entry and controls shall be included in the risk assessment and appropriate controls listed on the work permit. • Personnel will undergo competency based heat stress awareness training, where relevant, prior to conducting work in field environments. • Additional awareness training will be provided to personnel during high–risk periods of the year. • Records of heat awareness training will be kept and made available when requested.
HSHS06 Electrical safety	Manages the risks associated with personnel working on or in the vicinity of electrical equipment. Key requirements include: • Personnel will be aware of the relevant standards, regulations, procedures, hazards and safety requirements prior to working on, or in, the immediate vicinity of electrical systems. • A hazardous area management system will be developed to minimise the risk of electrical and related work from igniting potentially explosive atmospheres. • High voltage regulations will be developed to manage the risks associated with work on high voltage equipment.
HSHS07 Working at heights	Manages the risks associated with personnel when working at heights and the risks from objects falling. Key requirements include: • Where work is carried out where a person could fall two or more metres then appropriate controls will be used to prevent people or objects from falling. • Prior to working at heights a job hazard analysis may be required. • Personnel working at heights shall be competent in the use of the fall prevention systems and equipment.
HSHS08 Chemical management and dangerous goods	Manages the risks associated with the handling, use and storage of chemicals.
HSHS09 Radiation	Minimises the risks associated with the handling, use and storage of radioactive substances or use of irradiating equipment.
HSHS10 Food safety	Minimises the risk of detrimental health effects from food supplied by Santos GLNG.
HSHS11 Manual handling and ergonomics	Minimises the risk of injury associated with manual handling tasks and poor ergonomics.
HSHS12 Occupational noise	Minimises the risk of noise–induced hearing loss associated with exposure to excessive occupational noise.
HSHS13 Working alone in remote locations	Minimises the risk to personnel when working alone in remote locations or when working alone in areas for extended periods of time where a significant hazard exists.
HSHS14 Legionella	Minimises the risk of personnel contracting Legionnaires disease.
HSHS15 Security	Manages the security of personnel to ensure their safety, and for the protection of assets.
HSHS16 Lifting equipment	Provides for the safety of personnel during lifting operations.
HSHS17 Personal protective equipment	Minimises the risk of injury or illness by defining requirements for the selection, maintenance and management of PPE.

Hazard standard	Purpose
HSHS18 Confined space entry	Provides for the health and safety of personnel required to enter a confined space.
HSHS19 Excavations	Provides for the safety of personnel involved in the construction or working near the vicinity of excavations.
HSHS20 Plant safety	Details the requirements to support the safe operation of plant in the workplace. The framework used in the standard to systematically manage the risks associated with plant contains five cyclical steps: plant risks/hazards, identify hazards, assess risks, implement controls, and review controls.

23.6.2 Management plans

Santos GLNG is committed to implementation of mitigation measures to manage potential health and safety impacts to the community and GFD Project workforce. Santos GLNG has an established environmental and social management framework, which includes plans and procedures that are applicable to health and safety. These are described in Section 6: Management framework.

The GFD Project Environmental protocol for constraints planning and field development (Constrains protocol) applies the avoidance principle, which provides for adequate separation between sensitive receptors and facilities with the potential to impact community health and wellbeing. Where avoidance is not practicable then activities will be appropriately managed to minimise and mitigate risk to as low as reasonably practicable. In this manner, the Constraints protocol acts to isolate sensitive receptors from those aspects of the GFD Project that have potential health and safety risks.

Those risks that cannot be avoided through isolation will be managed and mitigated as per the management plans outlined in Table 23–7.

Table 23–7 Santos GLNG management plans and strategies

Management plans	Overview
GFD Project environmental protocol for constraints planning and field development (the Constraints protocol)	The Constraints protocol applies to all gas field related activities. The scope of the Constraints protocol is to: • Enable Santos GLNG to comply with all relevant State and Federal statutory approvals and legislation • Support Santos GLNG's environmental policies and the General Environmental Duty (GED) as outlined in the EP Act • Promote the avoidance, minimisation, mitigation and management of direct and indirect adverse environmental impacts associated with land disturbances • Minimise cumulative impacts on environmental values. The Constraints protocol provides a framework to guide placement of infrastructure and adopts the following management principles: • Avoidance — avoiding direct and indirect impacts • Minimisation — minimise potential impacts • Mitigation — implement mitigation and management measures • Remediation and rehabilitation — actively remediate and rehabilitate impacted areas • Offset — offset residual adverse impacts in accordance with regulatory requirements. The Constraints protocol enables the systematic identification and assessment of environmental values and the application of development constraints to effectively avoid and/or manage environmental impacts.
Contingency plan for emergency environmental incidents	The Contingency plan details the management practices in place within Santos GLNG to minimise environmental harm during an emergency environmental incident. The plan identifies potential incidents, and provides response actions, including escalation, communication, reporting and monitoring.

Management plans	Overview
Chemical and fuel management plan (CFMP)	The CFMP details the appropriate storage and handling practices of chemicals and fuels. The objectives of the plan are to: • Facilitate compliance with relevant legislation, regulations and approvals • Provide a framework for Santos GLNG to store and handle bulk chemicals and fuels in a way that minimises risk to the environment and human health • Assess the potential risk of a chemical or fuel prior to its use • Identify and implement appropriate mitigation measures.
Coal seam water management strategy (CWMS)	The CWMS outlines the overarching approach to managing coal seam water. The strategy prioritises the beneficial use of coal seam water where practicable, while avoiding, minimising and mitigating environmental impacts, in accordance with the relevant regulatory framework.
Land release management plan (LRMP)	The LRMP addresses the management of releases of water to land in Santos GLNG's gas fields, including: • Coal seam water use for irrigation, construction and operations purposes • Treated sewage effluent releases to land • Use of treated sewage effluent for construction and operational purposes • Low point drain water releases to land • Hydrostatic test water releases to land. The document includes the principles, methods and controls to effectively manage and minimise the harm caused by release of water to land.
Noise management plan (NMP)	The NMP identifies potential noise impacts from Santos GLNG activities and provides a strategy, methods and controls to: • Avoid — plan the activity and engage with potentially affected stakeholders • Minimise — implement noise mitigation measures to minimise noise impacts • Manage — conduct monitoring, review mitigation methods and ensure compliance with Santos GLNG procedures.
Waste management plan (WMP)	The WMP details the strategy, methods and controls for managing waste generated by Santos GLNG activities. The plan identifies the types of wastes generated by Santos GLNG activities, and describes the waste management framework and how the waste management hierarchy is applied to generated waste.
Social impact management plan (SIMP)	The SIMP established for the GLNG Project will be implemented across the GFD Project. The plan outlines the roles, responsibilities and rights of Santos GLNG, the government, impacted communities and other stakeholders in relation to the GFD Project. In particular, it outlines the framework for community engagement, management strategies to avoid, mitigate or minimise potential impacts and to maximise opportunities and benefits arising throughout the life of the GFD Project, as well as a monitoring and reporting process. The GLNG Project SIMP will be supplemented by issue action plans relating to the GFD Project that focus on the following key areas as agreed with the Coordinated Project Delivery Division of the Coordinator-General's office: • Water and environment • Community safety • Social infrastructure • Community wellbeing and liveability • Local industry participation and training • Aboriginal engagement and participation. The SIMP is an operational document that is updated to reflect the ongoing needs of Santos GLNG and the communities it operates in. It is available on the web at: http://www.santosglng.com/resource-library/community/social-impact-management-plan-community-handbook.aspx
Hydraulic fracturing risk assessment: compendium of assessed fluid systems (Hydraulic fracturing risk assessment)	The Hydraulic fracturing risk assessment report synthesises the hydraulic fracturing risk assessments completed on various hydraulic fracturing fluids and provides a framework for including new fluid systems within the risk assessment document. The body of the report provides generalised information, including the geology and hydrogeology of the area, risk assessment methodologies (qualitative and quantitative) and a high level understanding of current results. The appendices include risk assessments of individual hydraulic fracturing fluid systems.

Management plans	Overview
Road-use management plan	The Road-use management plan was developed to manage the impact associated with the implementation of the Santos GLNG Project. It will be adapted to manage the potential impacts resulting from the GFD Project. The objectives of the plan include: • Manage the efficiency of the road network impacted including State-controlled roads and local government roads • Ensure user safety and safe operation of vehicles • Minimise impacts on road infrastructure condition • Minimise traffic related complaints and incidents to maintain community amenity. This plan will be revised for the GFD Project as appropriate and is not included in this EIS.
Journey management plan	Journey management plans are developed on an as needs basis (normally by contractors) to specify travel issues, including which roads are to be used. They are operational and journey specific are not included in this EIS.
Emergency response plan (ERP)	The ERP forms part of Santos GLNG's overall emergency response. It is supplementary to the Queensland Incident Management Plan and provides the necessary information to deal with emergencies at the asset level. This is an operational document and is not included in this EIS. Santos GLNG will engage with Queensland Ambulance Service, Queensland Fire and Emergency Services (QFES) across the life of the GFD Project concerning joint responsibilities for emergency response.

23.7 Risk assessment

As discussed in section 23.3, impacts were assessed using the risk assessment methodology. As the GFD Project area covers a large geographical area, the general nature of potential impacts to environmental values associated with GFD Project activities are identified and assessed within this section.

Table 23–8 summarises the assessment undertaken for the potential impacts of the GFD Project on health and safety values. For each identified potential impact, the assessment considered:

- The potential pre-mitigated risk, where only the Constraints protocol has been applied and the potential impacts are uncontrolled
- The mitigation measures that will be used to manage the potential impacts on health and safety values. These measures will reduce the likelihood and/or consequence of the potential impacts
- The residual risk of the potential impact after the implementation of mitigation measures. The residual risk takes into account the potential for impact that remains after the mitigation measures are applied.

Table 23–8 Risk assessment – health and safety

Impact	Phase	Pre-mitigated risk			Management and mitigation measures	Residual risk		
		Likelihood	Consequence	Risk		Likelihood	Consequence	Risk
Exceedance of air quality objectives	Construction	Likely	Negligible	Low	In addition to the Constraints protocol, the following management strategies will be applied to reduce the GFD Project's potential risks. • Contingency plan for emergency environmental incidents • CFMP • CWMS • LRMP • NMP • WMP • SIMP • Hydraulic fracturing risk assessment • Road-use management plan • Journey management plan • Emergency response plan • Santos Environment, health and safety management standards (EHSMS) • Santos Health and safety hazard standards (HSHS).	Possible	Negligible	Low
	Operations	Possible		Low		Possible		Low
	Decommissioning	Likely		Low		Possible		Low
Exceedance of noise and vibration criteria	Construction	Likely	Negligible	Low		Possible	Negligible	Low
	Operations	Possible		Low		Possible		Low
	Decommissioning	Likely		Low		Possible		Low
Potential for traffic incidents	Construction	Possible	Critical	High		Possible	Critical	High
	Operations	Possible		High		Possible		High
	Decommissioning	Possible		High		Possible		High
Water quality objective exceedance	Construction	Possible	Minor	Low		Possible	Minor	Low
	Operations	Possible		Low		Unlikely		Low
	Decommissioning	Possible		Low		Possible		Low
Potential for industrial incidents	Construction	Remote	Critical	Medium		Remote	Critical	Medium
	Operations	Remote		Medium		Remote		Medium
	Decommissioning	Remote		Medium		Remote		Medium
Workplace health and safety	Construction	Likely	Major	High		Possible	Major	High
	Operations	Likely	Minor	Medium		Possible	Minor	Low
	Decommissioning	Likely	Moderate	Medium		Possible	Moderate	Medium

23.8 Conclusions

An assessment of GFD Project activities identified a number of potential impacts that may directly affect the health and wellbeing of the community and the workforce. These risks will be managed through Santos GLNG's environment, health and safety management system, which is designed to manage the health, safety and environment risks associated with Santos GLNG's operations.

The residual health and safety impacts that remain after the application of the mitigation and management measures are detailed in Table 23–9.The residual health and safety risks associated with air quality, noise and vibration and water quality impacts are considered low. Residual health and safety risks associated with traffic safety are considered to be high, and for hazardous scenarios the residual risks are considered to be high/medium

Table 23–9 Residual risk – health and safety

Impact	Residual risk		
	Construction	Operations	Decommissioning
Exceedance of air quality objectives	Low	Low	Low
Exceedance of noise and vibration criteria	Low	Low	Low
Potential for traffic incidents	High	High	High
Water quality objective exceedance	Low	Low	Low
Potential for industrial incidents	Medium	Medium	Medium
Workplace health and safety	High	Low	Medium