ARROW BOWEN PIPELINE PROJECT

ENVIRONMENTAL MANAGEMENT PLAN

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LIST OF ABBREVIATIONS AND ACRONYMS

Abbreviation / Acronym	Meaning
AADT	Average Annual Daily Traffic
AB	Arrow Bowen
ABP	Arrow Bowen Pipeline
AHD	Australian Height Datum
ANZECC	The Australian and New Zealand Environment and Conservation Council
APIA	Australian Pipeline Industry Association
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
Arrow	Arrow Bowen Pipeline Pty Ltd
Arrow Energy	Arrow Energy Pty Ltd
AS	Australian Standard
ASC	Australian Soil Classification
ASP	Arrow Surat Pipeline
ASS	Acid Sulphate Soil
ASSMP	Acid Sulphate Soil Management Plan
ATSIHP	*Aboriginal and Torres Strait Island Heritage Protection Act 1984*
AVMP	Aquatic Values Management Plan
BBN	Brigalow Belt North
BIM	Block Identification Maps
BMP	Blast Management Plan
BPA	Biodiversity Planning Assessment
CHCU	Cultural Heritage Coordination Unit
CHIMS	Cultural Heritage Information Management System
CHMP	Cultural Heritage Management Plan
CLR	Contaminated Land Register
CO_2-e	Carbon dioxide equivalent
Construction EM Plan	Construction Environmental Management Plan
CSG	Coal Seam Gas
CQC	Central Queensland Coast
DAFF	Queensland Department of Agriculture, Fisheries and Forestry (previously part of DEEDI and DERM)
DATSIMA	Department of Aboriginal and Torres Strait Islander and Multicultural Affairs (previously part of DERM)
dB(A)	Decibel (A-weighted)
DCCEE	Department of Climate Change and Energy Efficiency
DCDB	Digital Cadastral Database
DCVG	Direct Current Voltage Gradient
DEEDI	Queensland Department of Employment, Economic Development and Innovation (now DAFF)
DERM	Department of Environment and Resource Management
DEWR	Commonwealth Department of the Environment and Water Resources (now DSEWPaC)

Abbreviation / Acronym	Meaning
DIWA	Directory of Important Wetlands
DL	Dysart Lateral
DNPRSR	Queensland Department of National Parks, Recreation, Sports and Racing (previously part of DEEDI, DERM and Department of Communities)
DNRM	Department of Natural Resources and Mines
DNRW	Queensland Department of Natural Resources and Water (now part of DNRM)
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
E	Endangered (RE status, threatened flora species status)
EA	Environmental Authority
EA (tenure)	Easement
EEC	Endangered Ecological Communities
EHP	Department of Environment and Heritage Protection
EHSMS	Environmental, Health and Safety Management System
EIS	Environmental Impact Statement
EL	Elphinstone Lateral
ELL	Environmental Line List
EM Plan	Environmental Management Plan
EMR	Environmental Management Register
EVNT	Endangered, Vulnerable, and Near Threatened
EP Act	*Environmental Protection Act 1994*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPC	Exploration Permit for Coal
EPC contractor	Engineering Procurement and Construction contractor
EPP	Environmental Protection Policy
EPP (Noise)	*Environmental Protection (Noise) Policy 2008*
EPP(Air)	*Environmental Protection (Air) Policy 2008*
EPP(Waste)	*Environmental Protection (Waste Management) Policy 2000*
EPP(Water)	*Environmental Protection (Water) Policy 2009*
ERA	Environmentally Relevant Activity
ERP	Emergency Response Plan
ESA	Environmentally Sensitive Area
EV	Environmental Value
EVNT	Endangered Vulnerable and Near-Threatened
FEED	Front-End Engineering Design
FH	Freehold
FIFO	Fly-in, fly-out
GARID	Guidelines for Assessment of Road Impacts of Development
GGH	Gladstone Gas Hub
GIS	Geographic Information System
GQAL	Good Quality Agricultural Land
GSDA	Gladstone State Development Area

Abbreviation / Acronym	Meaning
ha	Hectare
HAZOP	Hazard and Operability Study
HDD	Horizontal Directional Drilling
HHMP	Historic Heritage Management Plan
HSEMS	Health, Safety and Environmental Management System
HTWMP	Hydrostatic Test Water Management Plan
HVR	High Value Regrowth
Hz	Hertz
IAS	Initial Advice Statement
ICHD	Indigenous Cultural Heritage Database
ILUA	Indigenous Land Use Agreement
kL	kilolitre
km	Kilometre
km^2	Square kilometre
KP	Kilometre Point
kW	kilowatt
LGA	Local Government Area
LH	Leasehold
LIPP	Local Industry Participation Plan
LNG	Liquefied natural gas
m	Metre
m/s	metre per second
m^2	Square metre
m^3	Cubic metre
MCU	Material Change of Use
MDL	Mineral Development Licence
ML	megalitre
ML	Mining Lease
MLA	Mining Lease Application
mm	millimetre
mm/s	millimetre per second
MSDS	Material Safety Data Sheet
Mt	million tonnes
MUTCD	Manual for Uniform Traffic Control Devices
NATA	National Association of Testing Authorities
NC Act	*Nature Conservation Act 1992*
NES	National Environmental Significance
NNTT	National Native Title Tribunal
NM	Nine Mile
NO_2	Nitrogen dioxide
NT Act	*Commonwealth Native Title Act 1993*
NTDA	Native Title Determination Application

Abbreviation / Acronym	Meaning
NVMP	Noise and Vibration Management Plan
PASS	Possible Acid Sulphate Soil
PetroChina	PetroChina Company Limited
P&G Act	*Petroleum and Gas (Production and Safety) Act 2004*
PIMP	Pipeline Integrity Management Plan
PL	Petroleum Lease
PM_{10}	Particulate matter (up to 10 micrometres in size)
PMP	Pest Management Plan
PPE	Personal Protective Equipment
PPL	Petroleum Pipeline Licence
PSL	Petroleum Survey Licence
PSP	Pipeline Safety Plan
QASSIT	Queensland Acid Sulphate Soils Investigation Team
QH Act	*Queensland Heritage Act 1992*
QHR	Queensland Heritage Register
QPS	Queensland Police Service
QWQG	Queensland Water Quality Guidelines 2009
RE	Regional Ecosystem
RE (tenure)	Reserve
Revision SR	Revision Supplementary Report
RIA	Road Impact Assessment
RMP	Risk Management Plan
ROW	Right of Way
RUMP	Road-use Management Plan
SCADA	Supervisory Control and Data Acquisition
SCL	Strategic cropping land
SCL Act	*Strategic Cropping Land Act 2009*
SCL Regulation	*Strategic Cropping Land Regulation 2009*
SCP	Stakeholder Consultation Plan
SDA	State Development Area
SDPWO Act	*State Development and Public Works Organisation Act 1971*
SGIC	Stanwell-Gladstone Infrastructure Corridor
SGP	Surat to Gladstone Pipeline Pty Ltd (Now named Arrow Surat Pipeline)
Shell	Royal Dutch Shell PLC
SIMP	Social Impact Management Plan
SL	Saraji Lateral
SL (tenure)	State Land
SLA	Statistical Local Area
SMP	Species Management Plan
SMU	Soil Mapping Unit
SOP	Safety and Operating Plan

Abbreviation / Acronym	Meaning
SPP	State Planning Policy
SR	Supplementary Report
SRTM	Shuttle Radar Topographic Mission
TIA	Traffic Impact Assessment
TMP	Traffic Management Plan
TMR	Department of Transport and Main Roads
TOR	Terms of Reference
VM Act	*Vegetation Management Act 1999*
WONS	Weeds of National Significance
WMP	Waste Management Plan

GLOSSARY OF TERMS AND DEFINITIONS

Term	Definition
Ambient	Surrounding or background.
Ambient noise	The sum of the noise from all sources, near and far, in a given environment.
Amenity	A feature that increases attractiveness or value, especially of a piece of real estate or a geographic location.
Anabranch	A stream that branches from a main river then reunites with it.
Annual Return	The sending or receiving of yearly documents, for the purposes of the EP Act.
Anthropogenic	Caused by humans or human activity.
Aquifer	Rock or sediment in a formation, group of formations or part of a formation that is saturated and sufficiently permeable to transmit economic quantities of water to wells and springs.
Aquitard	A bed of low permeability along an aquifer.
Average Minimum Background Noise Level	Assessed as the background noise level per standard time interval that was exceeded for ninety per cent of the interval, defined in AS1055 as the rating background noise level.
A-weighted	Filtering a sound level so that a microphone output approximates the frequency response of a human ear to the sound.
Background noise	The noise ordinarily present and continuous at a given location, excluding extraneous noise and the noise source of interest. Commonly measured using the statistical parameter, LA90, the A-weighted noise level that was exceeded for ninety per cent of the monitoring period.
Biodiversity	The diversity of different species of plants, animals and microorganisms.
Bioregion	Region where the floral or faunal communities are similar.
Blasting	An action using or detonating explosives that may emit a loud, intense sound.
Building and Construction Contracts Structured Training Policy (10 per cent training policy)	The policy requires that a minimum of 10 per cent of the total labour hours on any Queensland Government building or civil construction project (valued over $250,000 for building or $500,000 for civil construction) must be undertaken by Indigenous workers, apprentices, trainees or cadets or used for the upskilling of existing employees (to a maximum of 25 per cent of the deemed hours).
Bund	An embankment constructed around an area to prevent the inflow or outflow of liquids. Also called Bunding.
Catchment	A water intake area or all parts of a drainage basin.
Cathodic Protection	A method used to control the corrosion of a metal surface by making it the cathode of an electrochemical cell.
Carbon Dioxide Equivalent (CO_2eq)	A measure used to compare the emissions from various greenhouse gases based on their global warming potential.
Chromosol	Soils with a strong texture-contrast between the A and B horizons that are not strongly acid or sodic.
Confined Aquifer	An aquifer that is overlain by a confining bed. The confining bed has a significantly lower hydraulic conductivity than the aquifer.
Combustible	Capable of igniting or burning
Community values	Aspects of the social and physical environment in which the members of the community value, including the area's natural assets, community lifestyle, social networks, scenic areas and recreational facilities.
Cultural significance	The aesthetic, historic, scientific, social or spiritual value for past, present or future generations.
dB	Abbreviation for decibel—the unit of sound measurement.

Term	Definition
dB(A)	'A' Weighted overall sound pressure level.
Decibel (weighted) dBA	The measurement of sound pressure level in which the amplitude of the sound signal is negatively weighted in frequencies below 1000 Hz in accordance with a weighing scale known as the 'A' weighing scale. This scale was established to closely simulate human perception of the relative level of pure tone sounds.
Dermosol	Soils with a structured B2 horizon and lacking a strong texture-contrast between the A and B horizons.
Dissolved Oxygen (DO)	The amount of oxygen dissolved in water.
Drainage pattern	The pattern formed by drainage lines, gullies, streams and rivers.
Ecological Sustainable Development (ESD)	Development that improves the quality of life in a way that maintains the ecological processes on which life depends.
Economic Assessment	Provides information on the potential economic impacts of the project at regional, state and national levels. It also indicates strategies for capitalising on economic benefits while at the same time mitigating any possible negative impacts.
Environmental Authority	Licence or Approval issued under the EP Act to conduct specified Chapter 5A activities and Chapter 4 'Environmentally Relevant Activities'.
Environmental impact assessment procedures	Federal or State requirements that must be followed to enable approval to be obtained for a project to proceed.
Environmental Management Register	A land use planning and management register, controlled by Queensland's Department of Environment and Heritage Protection. The EMR provides information on historic and current land use – including whether the land has been or is currently used for a notifiable activity, or has been contaminated by a hazardous containment.
Environmentally Relevant Activities	Activities listed under the EP Act that require an Environmental Authority.
Environmentally Sensitive Area	An area which contains a natural feature, such as the habitat of a rare species, and which is protected by government regulations.
Ephemeral	A stream that flows briefly only in direct response to precipitation in the immediate locality and the channel of which at all times remains above the water table.
Erosion	The wearing away of land surface by wind or water.
Financial Assurance	A security deposit, either cash or a bank guarantee, held by the administering authority to cover the potential costs of rehabilitating areas significantly disturbed by the petroleum activities.
Frequency (Hz)	The human ear responds to sound in the frequency range of 20 Hertz to 20,000 Hz. A combination of sound pressure and frequency determine perceived loudness. The centre frequency of an octave is double the frequency of the lower octave. Sound measurements are usually taken at 16 one third octave bands between 50 and 5000 Hz.
Geotechnical	Studies to investigate subsurface conditions and materials and to determine the relevant physical/mechanical and chemical properties of these materials.
Geographical Information Systems (GIS)	A system designed to capture, store, manipulate, analyse, manage and present all types of geographically referenced data. GIS is the merging of cartography, statistical analysis and database technology.
Geohazard	A geological state that represents or has the potential to develop further into a situation leading to damage or uncontrolled risk.
Geomorphology	The description and interpretation of landforms.
Geotechnical	Studies to investigate subsurface conditions and materials and to determine the relevant physical/mechanical and chemical properties of these materials.

Term	Definition
Good quality agricultural land (GQAL)	Agricultural land is defined as land used for cropping and grazing but does not include land used for intensive animal husbandry such as aquaculture, feedlots, piggeries, poultry farms and plant nurseries. Agricultural land considered to be of good quality would be: Suitable for, and capable of, sustainable agricultural use; Important for agricultural activities of State or regional significance; and Available for agricultural use.
Greenhouse gases	Gases such as carbon dioxide and methane which, when dispersed in the atmosphere, tend to trap heat.
Hazchem	Abbreviation used for the hazardous chemical substances coding system used in the Australian Code for the Transportation of Dangerous Goods by Road and Rail. The system is defined in the Australian Standard AS 1216 and uses a classification and labelling system adopted by the United Nations.
HAZOP	Abbreviation used for a Hazard and Operability study for above ground facilities.
Heavy vehicle	A truck, transport or other vehicle with a gross vehicle weight above a specified level (for example: over 8 t).
Heritage	Places, objects and indigenous languages that have aesthetic, architectural, historical, scientific, technological or social significance of other special value for future generations as well as for the community today.
Horizon	A consistently coloured and textured layer of soil.
Horizontal Directional Drilling (HDD)	Horizontal direction drilling is a trenchless method of installing underground pipes in a shallow arc along a prescribed bore path by using a surface launched drilling rig.
Hydraulic	Of or relating to water or other liquid in motion; operated, moved, or effected by water or liquid.
Hydrostatic pressure testing	Pressure testing of a section of the pipeline with water to establish the strength and leak tightness of the test section and to confirm the strength of the pipeline.
Indigenous Land Use Agreement (ILUA)	An agreement between native title holders or claimants and other interested parties about how land and waters in the area covered by the agreement will be used and managed in the future.
Initial Advice Statement (IAS)	A document used to initiate the environmental impact assessment procedures of the Queensland Government.
Intermittent noise	A noise whose sound pressure level suddenly drops to the background level several times during the period of observation, the time during which the level remains at a constant value different from that of the background level being of the order of 1s or more.
Kandosol	Non-texture contrast soils (with little or gradual increase in clay content with depth) that have weakly to non-structured subsoils (B horizons).
Landslip	A movement of land surface and sub-surface over relatively short distances and possible long timeframes.
Landslide	Where sections of land break away and move large distances in a short time period.
L_{10}	Noise level exceeded for 10% of the measurement period. This represents the upper intrusive noise level and is often used to represent traffic/ music noise.
L_{90}	Noise level exceeded for 90% of the measurement period. This represents the background noise level excluding nearby sources. Also known as LBG.
L_{eq}	Energy averaged noise level over the measurement period. This measure is commonly used when comparing the criterion noise level under the Environmental Noise Regulations and for comparison with relevant standards for air conditioning noise.
L_{max}	Maximum instantaneous noise level during a measured period.
Macroinvertebrate	An invertebrate large enough to be seen without magnification.
Macrophyte	A plant large enough to be seen with the naked eye.

Term	Definition
Maximum Allowable Operating Pressure	Refers to the wall strength of a pressurised cylinder such as a pipeline or storage tank and how much pressure the walls may safely hold in normal operation.
Microchiropteran	Of bats, small or micro bat species.
Mining Leases (MLs)	A lease that permits the lessee to use the land the land or waters covered by the lease solely or primarily for mining.
Offset	An action taken to counter-balance any unavoidable negative environmental impacts that might result from an activity.
Particulate matter	Minute airborne particles.
Perched water table	Water table that is positioned above the normal water table for an area because of the presence of an impermeable rock layer.
Perennial	Lasting for an indefinite amount of time.
Permeability	The capacity of a material to transmit fluid.
Pest	A species: declared under the *Land Protection (Pest and Stock Route Management) Act 2002*; declared under Local Government model local laws; and which may become invasive in the future.
Petajoule (PJ)	A petajoule is equal to one million gigajoules.
Petroleum Leases (PLs)	A PL gives its holder the right to explore for, test for production, and produce *petroleum* within the area of the PL.
Petroleum Pipeline Licences (PPLs)	If petroleum is required to be transported outside the area of a petroleum lease (PL), an application must be made to the Minister for the grant of a pipeline licence (PPL). However, any pipe, or system of pipes, that are within the area of a PL, may be constructed without the requirement for a PPL.
Pigging	A process for internal inspection including cleaning line pipes.
Pipeline	The buried steel gas transmission Arrow Bowen Pipeline.
PM_{10}	Particulate matter with an aerodynamic diameter of 10 micrometers or less.
$PM_{2.5}$	Particulate matter with an aerodynamic diameter of 2.5 micrometers or less
Port Alma	Port Alma is a shipping terminal located in the northern counterpart of the Port of Gladstone. It is managed by the Gladstone Ports Corporation.
Probable Maximum Flood	The largest flood that could conceivably occur at a particular location.
Project	The Arrow Bowen Pipeline project includes the proposed pipeline route, above ground facilities, temporary workers' accommodation camps and temporary support facilities.
Project area	The area that may be impacted on directly or indirectly by the project.
Project site	Right of way during construction which is converted to an operational easement.
Proposed pipeline route	Used when describing the route of the pipeline e.g. the proposed pipeline route described in the Supplementary Report will commence at Red Hill, approximately 90 km north of Moranbah in Central Queensland and terminate at a proposed Arrow Energy gas gathering station near the Bruce Highway west of Gladstone where it will join the Arrow Surat Pipeline. The proposed pipeline route will be approximately 580 km long and consists of • The Arrow Bowen (AB) mainline (477.3 km); • The Elphinstone Lateral (EL) (52 km); • The Saraji Lateral (SL) (25.7 km); and • The Dysart Lateral (DL) (33km).
Putrescibles	Material that is likely to become putrid.

Term	Definition
Qualitative	An assessment based on descriptions or distinctions and quality or characteristic rather than on some quantity or measured
Quantitative	An assessment based on the amount or number of something.
Ramsar	An international treaty for the conservation and sustainable use of wetlands. The treaty was adopted in the Iranian city of Ramsar in 1971.
receptor	A land-use, human being, flora/fauna species, building, residence, community, watercourse or water feature which can be impacted by the development.
Recharge	Water flowing into an aquifer.
Recharge Area	An area in which there are downward components of hydraulic head in the aquifer. Infiltration moves downward into the deeper parts of an aquifer in a recharge area.
Remnant vegetation	Patches of vegetation amongst a clearing.
Revision D pipeline route	The pipeline route studied in the EIS.
Revision SR pipeline route	The pipeline route studied in the Supplementary Report.
Right Of Way (ROW)	The area cleared for the construction of the pipeline.
Riparian	Pertaining to, or situated on the bank of, a body of water, especially a watercourse such as a river.
Rudosol	A soil type with rudimentary pedologic organization, apart from a minimal A horizon.
Salinity	The total content of dissolved solids in groundwater, commonly expressed as parts of dissolved solids per million parts of solution (ppm), or milligrams of dissolved solids per litre of solution (mg/L). The significance of salinity depends on its nature as well as the amount of the dissolved solids.
Saturation	The extent or degree to which the voids in rock contain water; usually expressed as a percent related to total void or pore space.
Seismic	Relating to an earthquake or to other tremors of the Earth, such as those caused by large explosions.
Social Impact Assessment	Includes the processes of analysing, monitoring and managing the intended and unintended social consequences, both positive and negative, of planning interventions (policies, programs, plans, projects) and any social change processes invoked by those interventions. Its primary purpose is to bring about a more sustainable and equitable biophysical and human environment.
Sodic	Having a high sodium content.
Sodicity	The level of exchangeable sodium cations in the soil, typically expressed as a percentage (ESP). It relates to likely dispersion on wetting and hence ability to be eroded and transported in stormwater. An ESP of greater than 6% is sodic and greater than 15% is strongly sodic. ESP levels can be lower in soils that are more saline.
Sodosol	Soils with a strong texture-contrast between the A horizons and sodic B horizons that are not strongly acid.
Solvents	A substance in which another substance is dissolved, forming a solution.
Sound Attenuation	The reduction in the intensity or in the sound pressure level of sound which is transmitted from one point to another.
Sound Power Level	The total sound energy radiated from a source per unit of time. Ten times the logarithm to the base 10 of the ratio of a given power to a reference power.
Stakeholders	Groups, companies or individuals who may be potentially affected, or have a particular interest in a proposal/development. Stakeholders may include local residents, government agencies, Aboriginal groups, relevant business and industry groups, community groups, and elected representatives.

Term	Definition
State Development Area	Created under Section 77 of the *State Development and Public Works Organisation Act 1971*. Their creation promotes economic development and addresses areas of market failure in the development of industrial land and multi-user infrastructure corridors in Queensland.
Statistical Local Area (SLA)	The smallest level of geography/general purpose spatial unit contained in the Australia Standard Geographical Classification (ASGC) in non-census years.
Strategic Cropping Land (SCL)	Defined by the Queensland Government as the best cropping land and as a finite resource subject to a range of competing land-use activities, including agriculture, mining and urban development.
Steady-state noise	A noise having negligibly small fluctuations of sound pressure level within the period of observation.
Subcatchment	An area within a catchment drained by one or more tributaries of the main water body.
Substrate	The underlying base to something, e.g. the streambed.
Tenosol	A soil type that is a little more structurally developed than a rudosol.
Topography	The study of the Earth's surface, relief, shape and features.
Topsoil	The upper most layer of soil where most plant nutrients are found.
Total dissolved solids (TDS)	The concentration of common dissolved salts found in water and reported by volume (mg/L).
Total suspended solids (TSS)	The concentration of filterable particles in water (retained on a 0.45 m filter) and reported by volume (mg/L).
Toxicity	The degree of poison or ill effects that a substance produces.
Traditional owners	Traditional Aboriginal owners or other Aborigines to whom the protection of an area is entrusted in accordance with Aboriginal tradition.
Trenching	A narrow excavation made below the surface of the ground, to a depth of typically 1,800 mm.
Turbidity	A measure of the cloudiness of water which is determined by the amount of light scattered by suspended particles.
Vertosol	Clay soils with shrink-swell properties that exhibit strong cracking when dry and at depth have clay accumulations on the ped surfaces (slickensides) and/or lenticular structural aggregates.
Wastewater	Water used in a process to carry unwanted materials away or process water that can no longer be used or is surplus to the process.
Water Table	Level below which the ground is saturated with water.

1 Introduction

Arrow Bowen Pipeline Pty Ltd (Arrow), a wholly owned subsidiary of Arrow Energy Pty Ltd (Arrow Energy), is proposing to construct approximately 580km of high pressure gas pipelines and associated above ground infrastructure in Central Queensland. The Arrow Bowen Pipeline (ABP) project will convey coal seam gas (CSG) for subsequent export as liquefied natural gas (LNG). The objective of the project is to deliver CSG from Arrow's tenements in the Bowen Basin to the proposed LNG Plant near Gladstone in a cost effective manner.

This Environmental Management Plan (EM Plan) has been prepared to address the requirements of a Terms of Reference (TOR) for a voluntary submitted Environmental Impact Statement (EIS) under the *Environmental Protection Act* 1994 (EP Act).

1.1 Overview of Project

An overview of the proposed pipeline route is provided in Figure 1-1.

The project involves the construction of a 580 km long buried high pressure gas pipeline of up to 1,050 mm in nominal diameter and consists of the Arrow Bowen (KP) mainline and three laterals, the Elphinstone Lateral (EL), Saraji Lateral (SL) and Dysart Lateral (DL). The project also includes above ground facilities and temporary support facilities. The proposed pipeline route is a 30m ROW with 10m additional working space to facilitate safe construction and construction activities along the ROW. The additional work space will not be taken where there are sensitive environmental conditions.

The project will deliver gas from Arrow Energy's gas fields in the Bowen Basin to the proposed Arrow Energy Gladstone Gas Hub (GGH) in the Aldoga precinct of the Gladstone State Development Area (GSDA) for further transmission to Arrow Energy's proposed Arrow LNG Plant on Curtis Island.

Construction of the project is anticipated to commence in 2016, with the first gas supplied to the proposed Arrow LNG Plant at Curtis Island scheduled for 2017.

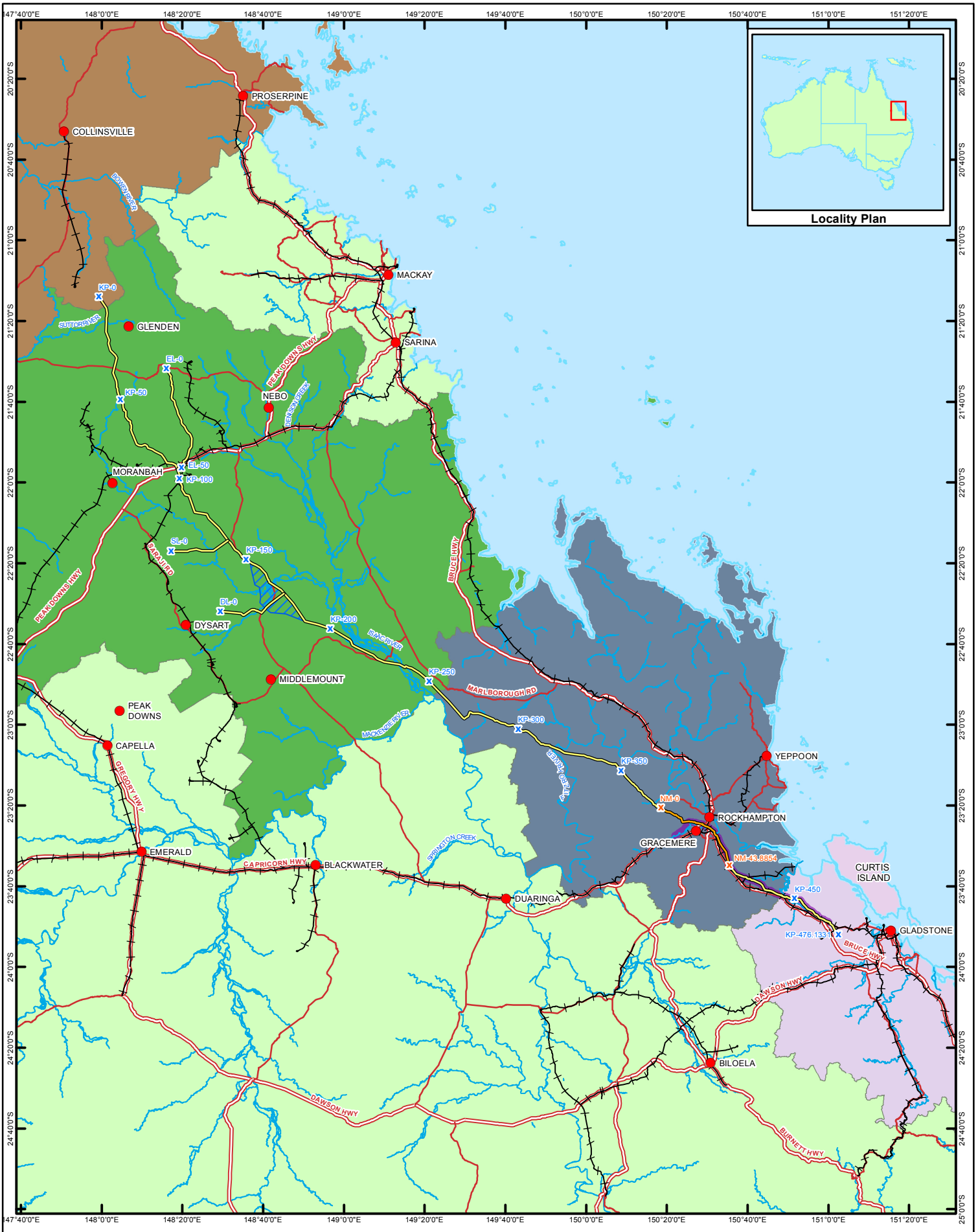

Figure 1 - 1: Overview of the pipeline route

Legend

- Major Towns
- Kilometre Point - ABP Route
- Kilometre Point - ABP Route SGIC Nine Mile
- ABP Route - Revision SR
- ABP Route - Revision SR SGIC Nine Mile
- Railways
- Highways
- Major Roads
- Major Watercourses
- Upper Isaac River Corridor
- Stanwell-Gladstone Infrastructure Corridor

Local Government Area 2011

- Gladstone Regional
- Isaac Regional
- Rockhampton Regional
- Whitsunday Regional

Data Sources:
StreetPro: Major Towns, Roads, Railways
DEHP: LGA, Major Watercourses
Data Supplied by Arrow Energy: ABP Routes, Kilometre Points, Upper Isaac River Corridor, Stanwell-Gladstone Infrastructure Corridor

N

arrow energy go further

0 25 50
Kilometres

Scale: 1:2,250,000 @ A4
Coordinate System: GCS GDA 1994

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1.2 Environmental Management Plan

The EM Plan is intended to guide the development of detailed subordinate and activity based management plans and procedures to be prepared prior to commencement of the project's construction and operation. The EM Plan also identifies the environmental avoidance, mitigation and management strategies and commitments that will be implemented to protect the environmental values identified in the project area.

The key objectives of this EM Plan are to:

- Provide a methodology for ensuring that construction activities manage and prevent unacceptable environmental harm
- Outline management strategies to be applied during construction
- Address TOR requirements in the Arrow Bowen Pipeline EIS
- Describe environmental protection commitments to manage impacts on the environmental values as a result of proposed activities and, in doing so, to assist the administrating authority in deciding the conditions of the Environmental Authority (EA).

It should be noted that this EM Plan will be revised to ensure that it meets the requirements of an EM Plan for an application for an EA under Chapter 5a provisions of the EP Act in support of an application for a PPL.

For each of the environmental values to be protected, environmental protection commitments are proposed in terms of objectives and associated standards, measurable indicators and control strategies to ensure the objectives will be achieved. The environmental protection commitments are based on practical options and are derived from site-specific environmental surveys and desk-based studies. The commitments include provisions for monitoring.

1.3 Structure of the EM Plan

The Guideline *Preparing an Environmental Management Plan for Coal Seam Gas Activities* (EHP 2010) was used to inform the content and structure of this EM Plan. Table 1-1 cross references the requirements of the Environment and Heritage Protection (EHP) CSG guidelines to the relevant section in the EM Plan.

Table 1-1 EM Plan elements

Section	CSG Guideline Headings	EM Plan Section
Part 1:	Introduction	Section 1
	Legislative framework	Section 5
	Relationship between the EM Plan and the EA	Section 1.2
Part 2:	Structure of EM Plan	
	Description of petroleum tenures/petroleum authorities	Section 2.1 Section 3.6
	Description of project activities	Section 3
	Description of environment	Section 7 – all relevant sections
	Identification of environmental values and potential impacts on environmental values from the activities	Section 7 – all relevant sections
	Environmental protection commitments	Section 7 – all relevant sections
	Supporting documentation	Section 4.12 and Appendices
Part 3:	Content of an EM Plan	
3.1	General section	
	Financial assurance	Section 6
3.2	Air section	Section 7.1
	Description of environmental values	Section 7.1.1
	Potential adverse or beneficial impacts on identified environmental values	Section 7.1.2
	Project environmental commitments, objectives and control strategies	Section 7.1.3
3.3	Dam Section	Section 7.2 Not relevant to the project
	Description of environmental values	
	Potential adverse or beneficial impacts on identified environmental values	
	Project environmental commitments, objectives and control strategies	
3.4	Land Section	Section 7.3 and Section 7.4
	Description of environmental values	Section 7.3.1 and Section 7.4.1
	Potential adverse or beneficial impacts on identified environmental values	Section 7.3.2 and Section 7.4.2
	Project environmental commitments, objectives and control strategies	Section 7.3.3 and Section 7.4.3
3.5	Noise Section	Section 7.5
	Description of environmental values	Section 7.5.1
	Potential adverse or beneficial impacts on identified environmental values	Section 7.5.2

Section	CSG Guideline Headings	EM Plan Section
	Project environmental commitments, objectives and control strategies	Section 7.5.3
3.6	Social Section	Section 7.6
	Community	Section 7.6.1
	Description of environmental values	Section 7.6.1
	Potential adverse or beneficial impacts on identified environmental values	Section 7.6.2
	Project environmental commitments, objectives and control strategies	Section 7.6.3
	Heritage	Section 7.6.4
	Description of environmental values	Section 7.6.4.1
	Potential adverse or beneficial impacts on identified environmental values	Section 7.6.4.5
	Project environmental commitments, objectives and control strategies	Section 7.6.5
3.7	Waste Section	Section 7.7
	Activities	Section 7.7.1
	Description of environmental values	Section 7.7.2
	Potential adverse or beneficial impacts on identified environmental values	Section 7.7.3
	Project environmental commitments, objectives and control strategies	Section 7.7.4
	Coal Seam Gas (CGG) Water	Not relevant to the project
	Coal Seam Gas Water Management Plan	
	CSG water management hierarchy	
3.8	Water Section	Section 7.8
	Description of environmental values	Section 7.8.1
	Potential adverse or beneficial impacts on identified environmental values	Section 7.8.2
	Project environmental commitments, objectives and control strategies	Section 7.8.3
3.9	Rehabilitation Program	Section 8
Part 4	Definitions	Glossary Acronyms and Abbreviations

Source: EHP 2010

2 Project Proponent

2.1 Introduction

The project proponent is Arrow Bowen Pipeline Pty Ltd (Arrow), a wholly owned subsidiary of Arrow Energy Pty Ltd (Arrow Energy), which is, in turn, a subsidiary of Arrow Energy Holdings Pty Ltd (the Parent Company). Arrow Energy is a leading Australian-based integrated energy company with its primary business activities focused on the exploration, appraisal and development of CSG, a cleaner burning fuel commonly used for electricity generation. The corporate contact details for ABP are provided in Table 2-1.

Table 2-1 Project proponent details

Project proponent:	Arrow Bowen Pipeline Pty Ltd (Arrow)
Australian Company Number (ACN):	141 181 295
Registered address:	Level 19, AM 60, 42-60 Albert Street, Brisbane QLD 4000

Arrow Energy is an integrated energy company with interests that cover the spectrum of CSG activities ranging from exploration to production, transportation and electricity generation.

Arrow Energy is wholly owned by subsidiaries of Royal Dutch Shell plc (Shell) and PetroChina Company Ltd (PetroChina). Both Shell and PetroChina have an established history of working together on the development of energy projects and bring the technical capabilities, capital backing, major project experience and LNG marketing ability to accelerate Arrow Energy's business goals.

Shell has had a presence in Australia since 1901. Current operations include refining, sale of petroleum products and retail businesses. Shell maintains equity in the exploration and development of large gas resources off the coasts of Western Australia and the Northern Territory. As an internationally recognised leader in LNG production, Shell has delivered some of the world's largest and most complex LNG projects in the last 40 years including facilities in Qatar, Nigeria, Russia and various projects throughout Southeast Asia. Through its subsidiary, Shell International Trading and Shipping Company Ltd, Shell operates one of the largest LNG carrier fleets in the world.

PetroChina is a subsidiary of China's largest state-owned oil and gas producer and distributor, and one of the world's largest oil companies. PetroChina was incorporated as a joint stock company in 1999, as part of the restructuring of the China National Petroleum Corporation. PetroChina brings extensive experience in exploration, refining and marketing of oil and natural gas in China and other countries.

Arrow Energy has access to an estimated contingent CSG resource in excess of 74,000 PJ across its acreage in Queensland and northern New South Wales.

Arrow Energy currently operates, or is a major participant in, a number of gas production facilities and supporting infrastructure as well as power stations utilising CSG. Arrow Energy's acreage position and current CSG assets in Queensland are illustrated in Figure 2-1.

Arrow Energy and its equity partner, AGL Energy, have access rights to the existing North Queensland Pipeline (PPL89) which supplies gas to Townsville from the Moranbah Gas Project. Arrow Energy, together with AGL Energy, also holds the pipeline licence (PPL121) for the proposed 440km long Central Queensland Gas Pipeline (CQP) between Moranbah and Gladstone. The proposed ASP, formerly known as the Surat Gladstone Pipeline, connecting Arrow's Surat Basin CSG developments to Gladstone, has been approved and a pipeline licence (PPL144) was granted by the Department of Employment, Economic Development and Innovation (DEEDI) (now known as Department of Natural Resources and Mines (DNRM)).

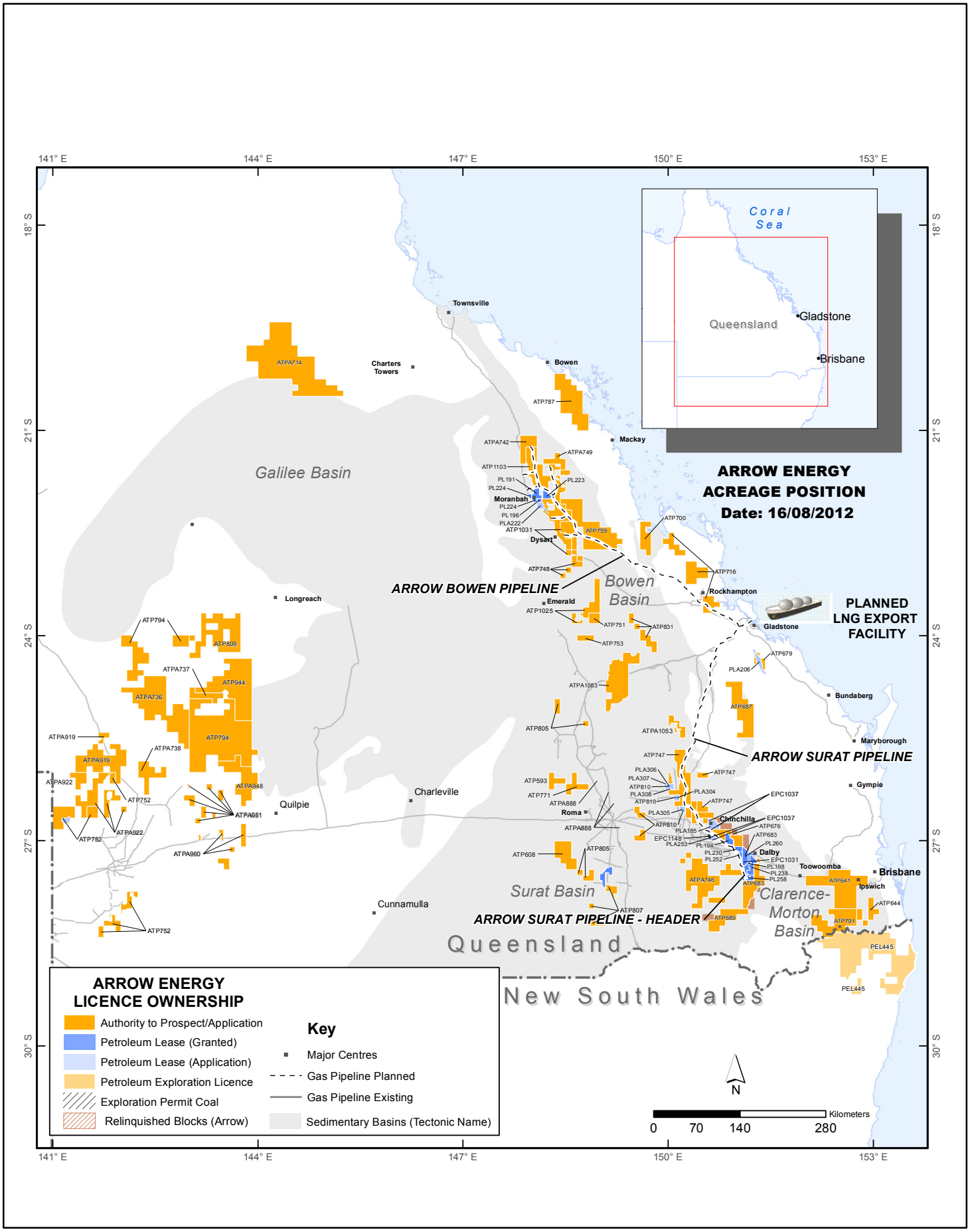

Figure 2-1: Overview of Arrow Energy Petroleum Acreage in Queensland

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2.2 Arrow Energy's Queensland activities

Arrow Energy's CSG projects related to the midstream of their projects are in various stages of assessment and development as outlined in Table 2-2.

Table 2-2 Arrow Energy's related projects

Project name	Description
Bowen Gas Project (Upstream)	The proposed upstream gas field development in the Bowen Basin is located between Collinsville in the north and Middlemount in the south, approximately 475km north of Brisbane and 75km south of Mackay. It will see the staged development of Arrow Energy's tenures adjacent to the existing Moranbah Gas Project which is one of the largest operating CSG projects in Australia. Preparation of an EIS for the Bowen Basin Gas Project is currently in progress.
Surat Gas Project (Upstream)	Arrow Energy proposes an expansion of its CSG operations in the Surat Basin as part of the proposed Surat Gas Project. The project area covers approximately 8,600km^2 and will involve the staged development of approximately 7,500 production wells, compression facilities and associated pipelines in an area from near Wandoan in the north, via its existing fields near Dalby, to near Goondiwindi in the south. In December 2011, Arrow Energy lodged the draft EIS for the project. The EIS for the Surat Gas Project was approved by the State Government for public release in March 2012. The public review period closed on 14 June 2012 and submissions are currently being considered by the State Government.
Arrow Bowen Pipeline (ABP) (Midstream) THIS PROJECT	The ABP project will involve the construction of approximately 580km of high pressure gas pipelines in Central Queensland, comprising a main pipeline, three lateral pipelines and associated infrastructure. The pipelines will connect Arrow Energy's fields in the Bowen Basin to the proposed Arrow LNG Plant at Curtis Island. In December 2011, Arrow lodged the draft ABP EIS with the State Government, which was approved for public release and comment in March 2012. The public review period closed on 24 May 2012 and submissions are currently being considered.
Arrow Surat Pipeline (ASP) (formerly the Surat Gladstone Pipeline) (Midstream)	The proposed 470km long high pressure steel gas transmission pipeline will connect Arrow Energy's fields in the Surat Basin to the proposed Arrow LNG Plant at Curtis Island. The project proponent is Surat Gladstone Pipeline Pty Ltd, a subsidiary of Arrow Energy. An EIS for the project under the EP Act has already been approved and an EA issued by EHP (PEN100369209). A petroleum pipeline licence (PPL144) was granted by DNRM.
Arrow Surat Pipeline - Header (ASP-H) (Midstream)	A 60km transmission pipeline will connect Arrow Energy's CSG reserves in the Surat Basin to the ASP at Daandine, adjacent to the Kogan North Central Gas Processing Facility, near Dalby.
Arrow LNG Plant (Downstream)	The proposed Arrow LNG Plant on Curtis Island, off Gladstone will be supplied with CSG from Arrow Energy's reserves in the Surat and Bowen Basins. The project has been declared a 'Significant Project'. It has three key components: the LNG Plant and its supporting infrastructure to berth the LNG carriers, the feed gas pipeline (and tunnel), and dredging activities. Arrow Energy lodged the draft EIS for the project in December 2011 and was approved by the Coordinator-General for public release in March 2012. The submissions on the EIS are currently being considered by the State Government.

Project name	Description
Port of Gladstone Western Basin Strategic Dredging and Disposal Project	Gladstone Ports Corporation's Port of Gladstone Western Basin Strategic Dredging and Disposal Project was declared a significant project on 24 April 2009. The project involves dredging required to facilitate the development of LNG facilities in Port Curtis. Key features of the project include: ■ Deepening and widening of existing channels and swing basins ■ Creation of new channels, swing basins and berth pockets ■ Use of dredged material to reclaim land, including 153 ha north of Fisherman's Landing. This project was approved in July 2010.

2.2.1 Arrow Energy's customers and contracts

Arrow Energy currently has a number of Gas Sales Agreements with external parties including:

- CS Energy
- Queensland Nickel Industry Pty Ltd
- Copper Refineries Pty Ltd
- Moranbah Power Station
- Braemar 1 and 2 Power Stations
- Daandine Power Station
- Dyno Nobel

Arrow Energy supplies gas to the Daandine, Braemar 1 and 2, Townsville and Swanbank E power stations which participate in the National Electricity Market. With Arrow Energy's full ownership of Braemar 2, and the commercial arrangements in place for Daandine and Townsville power stations, Arrow Energy has access of up to 600 MW of power generation capacity.

Arrow Energy is also developing the approved ASP which will facilitate the supply of gas from Arrow Energy's Surat Basin projects to the planned Arrow LNG Plant in Gladstone.

All activities associated with the proposed pipeline, including regulatory approvals, stakeholder liaison, detailed engineering, specialist studies, construction and maintenance will be carried out by experienced contractors under Arrow's direct supervision. These contractors will be made aware of the Health Safety Environment (HSE) standards expected by Arrow, and are required to apply them to all aspects of the project.

3 Project Description

3.1 Project Area

The project will commence approximately 90km north of Moranbah in Central Queensland and terminate at the proposed Arrow Energy GGH approximately 22km west of Gladstone where it will join the Arrow Surat Pipeline (ASP), formerly known as the Surat Gladstone Project, for further transmission to the proposed Arrow LNG Plant on Curtis Island.

The proposed pipeline route will commence in the southern part of the Whitsunday Regional Council Local Government Area (LGA), traverse the Isaac and Rockhampton Regional Council's LGAs in a southerly direction and terminate in the Gladstone Regional Council LGA. The proposed pipeline route also traverses land included within two State Development Areas (SDAs), being the Stanwell-Gladstone Infrastructure Corridor (SGIC) SDA and the Gladstone SDA (GSDA).

The proposed pipeline route traverses a number of petroleum production and exploration tenements within the Bowen Basin and is centrally located to Arrow's CSG reserves. The majority of land traversed by the proposed pipeline route is rural, much of which has been cleared for agricultural purposes, particularly grazing and cropping. The countryside is generally flat or undulating, crossed by waterways and marked occasionally by mountain ranges, hills, rocky outcrops, gullies and steep slopes.

The proposed pipeline route traverses the flat floodplain areas of the Isaac River before crossing the Broadsound Range where it follows a modified route of the proposed Gladstone Nickel Slurry Pipeline (Gladstone Pacific Nickel Ltd, formerly Marlborough Nickel Pty Ltd) along Marlborough Creek near Develin to Nine Mile Road.

The proposed pipeline route then enters the SGIC SDA declared by the Queensland Government for pipeline infrastructure northwest of Gracemere and enters the GSDA, continuing southeast to the GGH in the Aldoga precinct.

3.2 Overview

The project comprises the construction and operation of:

- The Arrow Bowen (KP) mainline, which runs approximately 477km from 18km northwest of Glenden to approximately 90km north of Moranbah in Central Queensland and terminates at a proposed Arrow Energy gas gathering station near the Bruce Highway west of Gladstone where it will join the Arrow Surat Pipeline. The mainline utilises the SGIC corridor for a distance of approximately 81km
- The Elphinstone Lateral (EL), which runs approximately 52km from 25km southeast of Glenden to the AB mainline, 29km east of Moranbah
- The Saraji Lateral (SL), which runs approximately 26km from 11km east of the Peak Downs Mine to the AB mainline about 36km east of the Peak Downs Mine
- The Dysart Lateral (DL), which runs approximately 33km from 14km northeast of Dysart to the AB mainline about 37km northeast of Dysart

- Temporary support facilities including laydown areas for equipment and pipe delivery and storage and access including the ROW
- Temporary gates and fences as required
- Above ground facilities including main line valves, scraper stations and cathodic protection systems
- A buried fibre optic cable for monitoring and control
- Gladstone Gas Hub located in the GSDA east of the Bruce Highway.

The project's construction will be typical of modern gas pipeline projects and will involve the following key steps:

1. Clearing of vegetation and grading of the ROW to prepare a safe construction working area.
2. Separating and stockpiling of topsoil and subsoil to protect and preserve topsoil
3. Crossing watercourses, roads and rail lines by open cut trench or a trenchless technique (e.g. Horizontal Directional Drilling (HDD) depending upon the type and nature of the crossing)
4. Creating a trench in which to lay the pipeline. This will be undertaken by trenching machines and may include the use of rock saws, excavators, rock hammers or blasting in hard rock terrain
5. Welding of pipe sections to form a string and checking weld integrity
6. Lowering the pipeline string into the trench and placing padding (e.g. screened trench subsoil), where required, around the pipe to protect the external coating from damage
7. Backfilling the trench with excavated material and replacing topsoil to its original horizons
8. Testing the structural integrity of the pipeline by filling it with water, and pressurising it to 125% of the Maximum Allowable Operating Pressure (MAOP)
9. Safely disposing of, or reusing hydrostatic test waters
10. Cleaning up and restoring the construction ROW.

The design life of this pipeline is a minimum of 40 years. At this point a decision will be required regarding ongoing operation or closure of this pipeline. In the event that the pipeline is no longer required, it will be decommissioned in accordance with the legislative requirements in place at that time. At this stage, construction of the project is anticipated to commence in 2016 with the first gas supplied to the proposed Arrow LNG Plant at Curtis Island scheduled for 2017.

Following construction, land users can generally resume previous uses over the pipeline which do not involve excavation activities or the erection of permanent buildings. Grass and cropping is encouraged to re-establish a stable surface across the easement. However, deep-rooted vegetation cannot be planted directly over the buried pipeline because of the potential for damage to the corrosion protection coating system and the need for continued access along the pipeline for maintenance.

Construction will require a corridor or ROW with a width of 30m, with an additional 10m temporary workspace during construction (i.e. up to 40m in width during construction). In sensitive environments, the temporary workspace will not be cleared and the construction ROW will remain at 30m. Post construction, the full ROW and additional workspace will be rehabilitated and the 30m easement will be used for operational requirements.

Above ground structures will be located within the operational easement and will include valves and scraper stations which will be fenced and appropriately signed. Pipeline markers will be provided at fences, road crossings and other locations as required by the Australian Standard (AS) 2885.1 - Pipelines – Gas and Liquid Petroleum.

A routine operation and maintenance program, which will include a variety of maintenance activities, will be implemented during operation. Aerial and ground inspections will include checking of the easement condition, checking of cathodic protection performance, monitoring of rehabilitation success and detection of weed species and potentially incompatible land uses. Continued access to the easement will also be necessary for maintenance and follow up of any issues identified from inspections.

Inspection of the easement to ensure success of the rehabilitation, including erosion and weed management, is likely to be necessary, particularly during the first year following construction.

In the event that the pipeline is no longer required, it will be decommissioned and all above ground infrastructure will be disposed of appropriately in accordance with the legislative requirements applicable at the time.

Key features of the pipeline route, Kilometre Points (KPs) and Arrow Energy's petroleum leases are presented in Map Series 1 in Appendix A.

The EIS provided an overview of the expected size and number of camps (Section 3.3.3 of the EIS) however specific details on each temporary workers' accommodation camp, including their locations, are unknown at this stage. A detailed assessment will be undertaken separately to the EM Plan and will require inputs from the Engineering Procurement and Construction (EPC) Contractor to be awarded by Arrow in 2014/2015. Each temporary workers' accommodation camp is likely to be subject to approval under the *Sustainable Planning Act 2009 (SP Act)* under the relevant local government planning scheme prior to lawful construction and operation.

3.3 Project Justification

Buried pipelines are internationally considered to be one of the safest forms for the transportation of natural gas in terms of the risk of impact to the public and environment.

The pipeline will connect Arrow Energy's CSG reserves in the Bowen Basin to a proposed Arrow Energy GGH in the Aldoga precinct of the GSDA for further transmission to Arrow Energy's proposed LNG Plant on Curtis Island, and ultimately international markets. The proposed pipeline will form part of Arrow Energy's transmission pipeline network, which along with the existing North Queensland Gas Pipeline and the planned Arrow Surat Pipeline, will link Arrow Energy's gas reserves with customers in Townsville, Moranbah, Gladstone, Dalby and Kogan. Depending on final configurations and end sales agreements, the pipeline may also supply Braemar Power Stations 1 and 2, Daandine Power Station, the Roma to Brisbane Pipeline and the Darling Downs Power Station.

The project will ultimately support continued development of Queensland's gas resources in the Bowen Basin and will contribute to the state's overall energy supply infrastructure and regional investment.

In addition to the above, construction of the pipeline may achieve the following benefits:

- Greater competition in energy supply and associated lower pricing, by furthering opportunities for CSG power generation
- Provide gas supply for international sale of CSG
- Environmental benefits through offsetting the overall reliance on coal-based electricity generation (the traditional power source in Queensland) leading to an overall reduction in greenhouse gas emissions and other pollutants of concern (e.g. NO_x, and particulates)
- Additional CSG gas royalties to the state of Queensland, contributing to the state's overall economic benefit
- Providing opportunities for local employment
- Additional employment opportunities for industry operators (including those potentially affected by the current economic downturn) throughout construction and operational sectors
- Opportunities for training and up-skilling of the local workforce
- Boosting the local economic activity and business along the pipeline route through expenditure by construction contractors and employees
- Economic benefits for local businesses (e.g. food preparation and accommodation services).

3.4 Project Timing and Life

The pipeline will be constructed over the course of 15 months, commencing in April 2016. Operation of the pipeline is planned to commence in 2017.

It is proposed to award the contract for pipeline construction following Final Investment Decision (FID). The EPC contractor will have the responsibility for development of a detailed construction schedule that meets the completion deadline.

Restoration will be undertaken progressively as the pipeline is buried, such that rehabilitation is expected to be predominantly complete, approximately three months after commencing construction.

The pipeline will have a minimum technical design life of 40 years. However, with ongoing integrity management, the operational life is expected to be in excess of this timescale.

3.5 Route and Site Selection

The proposed pipeline route is the result of detailed planning and targeted field assessments (including surface water studies, ecological - terrestrial and aquatic surveys, and soil surveys) which aim to achieve the project's engineering and safety requirements, whilst minimising risks to the

environment and community. Modifications have been made to the Revision D pipeline route. The current Revision SR pipeline route (as shown in Figure 1-1) is described in this EM Plan.

Route selection has considered the relevant criteria of the Australian Pipeline Industry Association *Code of Environmental Practice – Onshore Pipelines 2009* (the APIA code), as listed in Table 3-1 below.

Table 3-1 Pipeline route selection criteria

Aspect	Criteria
Safety	Relevant safety standards Assessment of safety risks
Commercial	Present market requirements The ability to meet future consumer needs Construction and operating costs
Engineering	Relevant engineering, construction and operation standards Terrain, seismic and geotechnical constraints and hazards Climatic implications (e.g. cyclones, flooding, tidal and storms) Access requirements for construction and operation
Environmental and Social Aspects	Conservation of terrestrial and aquatic flora and fauna Protection of habitat and ecosystem integrity Protection of surface and ground water quality Maintenance of surface stability Potential for successful rehabilitation Air and noise pollution Management of historical and cultural heritage values Impacts on local residents, traditional owners, existing land users and infrastructure Zoning requirements Protection of landscape values

Source: APIA, 2009

3.6 Mining and Petroleum Tenements

The proposed pipeline route crosses a number of mining and petroleum tenements including Petroleum Leases (PLs), Petroleum Pipeline Licences (PPLs) and Mining Leases (MLs), which are summarised in Table 3-2 and Table 3-3. Mining and petroleum tenements are illustrated on Map Series 1 in Appendix A.

Table 3-2 Petroleum tenements traversed by the project

Location	Tenement type	Tenement no.	Status	Principal holder
Arrow Bowen Mainline				
KP96.8	PL	223	Granted	CH4 Pty Ltd
KP394	PPL	88	Granted	Stanwell Corporation Limited
KP461.4	PPL	121	Granted	Central Queensland Pipeline Pty Ltd
KP468.7	PPL	121	Granted	Central Queensland Pipeline Pty Ltd
KP469.1	PPL	154	Granted	QCLNG Pipeline Pty Ltd
KP469.2	PPL	163	Granted	Australia Pacific LNG Gladstone Pipeline Pty Ltd
KP469.3	PPL	166	Granted	Santos GLNG Pty Ltd
KP475	PPL	121	Granted	Central Queensland Pipeline Pty Ltd
KP475.4	PPL	144	Granted	Surat Gladstone Pipeline Pty Ltd
KP476.1	PPL	30	Granted	Jemena Queensland Gas Pipeline (1) Pty Ltd
Saraji Lateral				
SL1	PPL	121	Granted	Central Queensland Pipeline Pty Ltd
Elphinstone Lateral				
EL52	PL	223	Granted	CH4 Pty Ltd

Table 3-3 Mining tenements traversed by the project

Location	Tenement type	Tenement no.	Status	Principal holder
Arrow Bowen Mainline				
KP72.7	ML	70109	Granted	Peabody (Burton Coal) Pty Ltd
KP99.7	ML	70290	Granted	Peabody Coppabella Pty Ltd
KP112.7	ML	70355	Granted	Coppabella Coal Pty Ltd
KP475.9	ML	7629	Granted	Cement Australia (Queensland) Pty Limited

3.7 Petroleum Activities

The project consists of a total of approximately 580km of pipe (including laterals), which deliver CSG from Arrow Energy's gas fields in the Bowen Basin to Arrow Energy's proposed Arrow LNG Plant on Curtis Island.

Above ground facilities will include main line valves, scraper stations and cathodic protection systems within the operational easement. Cathodic protection system posts and pipeline information markers will be located on the pipeline corridor following rehabilitation.

3.8 Relevant Resource Authorities

This EMP has been prepared under an EIS process and is not related to an application for a resource authority. It will be updated in the future to support a PPL application.

3.8.1 Relevant Blocks

Block Identification Maps (BIM) utilise a linear grid to cover the whole of Queensland at a scale of 1:1,000 000. The approximate area of a block is 80 square kilometres. The relevant BIM blocks which intersect the pipeline route are listed in Appendix B.

3.9 Scale

Construction will require a corridor or ROW with a width of 30m, with an additional 10m temporary workspace during construction (i.e. up to 40m in width during construction). In sensitive environments, the temporary workspace will be removed and the construction corridor will remain up to a maximum width of 30m. Post construction, the temporary workspaces will be rehabilitated and the 30m easement will be used for operational requirements.

3.10 Schedule

Arrow proposes to award the EPC contract in 2014/2015. The EPC contractor will have the responsibility for development of a detailed construction schedule that meets the completion deadline.

It is envisaged that the project will be constructed over 15 months, beginning in April 2016 and spread over the 2016 and 2017 dry seasons. However, circumstances such as adverse weather and potential collaboration with other pipeline construction projects in the region could extend the proposed construction period. Operation of the Project will commence in 2017/2018.

The overall proposed project schedule is provided in Table 3-4.

Table 3-4 Project schedule

Milestone	Target date
Front End Engineering and Design (FEED)	2013
Financial Investment Decision (FID)	End 2013
Contract award	2014/2015
Commence pipeline construction	April 2016
Commence pipeline commissioning	End 2017
Commercial pipeline operation	2017/2018

3.11 Design and Engineering

The pipeline will be designed and constructed in accordance with *AS 2885.1 – Pipelines – Gas and Liquid Petroleum* as well as other applicable standards and regulations, including the APIA code. Key engineering and design features of the pipeline are provided in Table 3-5.

Table 3-5 Gas pipeline specifications

Design Element	Details
Approximate length (including laterals)	580km
Maximum diameter	Up to 1,050mm
Wall thickness	TBA depending on diameter
Line pipe specification	API 5L X70 PSL2
Factory-applied external coating	Tri-laminate or dual layer Fusion-bonded Epoxy (FBE) coating
Factory-applied internal lining	2 pack epoxy (or equivalent)
Pipeline medium	Sales quality gas
Normal operating pressure	10.3 or 15.3MPa (inlet)
Maximum allowable operating pressure (MAOP)	13.5MPa
Specified minimum yield stress	485MPa
Standard construction ROW width	30m + 10m additional temporary work area
Operational easement width	30m
Minimum depth of cover	In accordance with AS 2885.1, typically: ▪ Cross country sections – 750mm ▪ Beneath roads and watercourses – 1,200mm
Corrosion protection	External coating and impressed current cathodic protection
Non-destructive testing	100% radiography or ultrasonic testing of welded joints. Hydrostatic pressure testing of completed pipeline to 125% of MAOP.
Pipeline monitoring system	Supervisory Control and Data Acquisition (SCADA) system for remote monitoring and control of all facilities at each end of the pipeline and at key intermediate points (MLVs) along the pipeline; routine periodic patrolling along the pipeline.

3.12 Project Stakeholders

Arrow has developed a Stakeholder Consultation Plan (SCP), which describes the stakeholder and community engagement goals, processes and outcomes, and how these will be achieved in a timely and effective manner.

The SCP is a 'live' document, which will be continually updated and maintained for the duration of the planning, construction and commissioning phases of the project. Arrow will maintain an active stakeholder liaison program during the operational phase.

In accordance with the SCP, Arrow has undertaken consultation (and is continuing to undertake consultation) with a range of stakeholders for the project, including affected landholders, government agencies and local government. While other interested parties may be identified as the project is progressed, key stakeholders already identified are outlined in Table 3-6.

Table 3-6 Project stakeholders

Category	Entity
State government departments, agencies and elected representatives	Environment and Heritage Protection
	Department of State Development, Infrastructure and Planning
	Department of Transport and Main Roads
	Department of State Development, Infrastructure and Planning
	Department of Community Safety and Employment
	Department of Education, Training
	Department of Natural Resources and Mines
	Queensland Police Service
	Queensland Treasury and Trade
	Department of Communities, Child Safety and Disability Services
	Department of Housing and Public Works
	State and Commonwealth Members of Parliament
	Whitsunday Regional Council
	Isaac Regional Council
	Rockhampton Regional Council
	Gladstone Regional Council
Community associations and landcare groups	Capricorn Conservation Council Inc.
	Fitzroy Basin Association
	Gladstone Economic and Industry Development Board
	Mackay Conservation Group
	North Queensland Conservation Council
	Calliope Landcare
	Yarwun Targinnine Progress Association
	Mackay-Whitsunday-Isaac Regional Economic Development Corporation
	Mackay Public Health Unit
	Central Queensland Public Health Unit
	Fitzroy Basin Association
	Gladstone Area Water Board
Registered Native Title parties	Birri People (QUD6244/98
	Jangga People (QUD6230/98
	Wiri People (QUD372/06
	Barada Barna People (QUD380/08
	Darumbal People 2 (QUD6001/99
	Darumbul People (QUD6131/98
	Port Curtis Coral Coast People (QUD6026/01)
Other LNG proponents	QCLNG (Queensland Gas Company (a BG Group Company))
	GLNG (Santos / PETRONAS / TOTAL / Kogas)
	APLNG (Origin Energy / Conoco Philips / Sinopec)

Category	Entity
Petroleum and mineral tenement holders	CH4 Pty Ltd (PL)
	Central Queensland Pipeline Pty Ltd (PPL)
	Stanwell Corporation Limited (PPL)
	Jemena Queensland Gas Pipeline (1) Pty Ltd (PPL)
	QCLNG Pipeline Pty Ltd (PPL)
	APLNG Pipeline Pty Ltd (PPL)
	Santos GLNG Pty Ltd
	Surat Gladstone Pipeline Pty Ltd (PPL)
	Peabody (Burton Coal) Pty Ltd (ML)
	Vale Australia (CQ) Pty Ltd (ML)
	Marlborough Nickel Pty Ltd
	Coppabella Coal Pty Ltd (ML)
	Macarthur Coal Pty Ltd (ML)
	Queensland Coal Corporation (QCC)
	Xstrata plc.
	BHP Billiton Ltd.
	Aquila
	Ergon Energy
	Powerlink
	Optus
	Telstra
	Queensland Rail (passenger) and Queensland Rail National (freight)
	SunWater
	Gladstone Ports Corporation / Central Queensland Port Authority
	Queensland Coal Corporation (QCC)
Other	Crushing Industries Australia
	Skills Queensland
Landholders	All affected landholders along the proposed pipeline route

3.13 Arrow Energy's Land Access Policies

As part of Arrow Energy's land access policies, Arrow Energy communicates with landholders at least three months before any activities, including commencing environmental studies on private property. Arrow Energy is committed to working closely with landholders to ensure work practices minimise impacts on land and existing agricultural activities.

When determining temporary and permanent locations for the proposed pipeline, plant and equipment, all aspects of the property are considered in consultation with the landholder. Agricultural activities, stock considerations, seasonal conditions, topography, drainage lines, service corridors, vegetation and fauna are all taken into account.

Arrow Energy's Land Liaison Officers are the primary point of contact for all negotiations and discuss site access, schedule cultural heritage and environmental clearances, co-ordinate other activities on the property and ensure rehabilitation of the site. At each stage, whenever possible, Arrow aims to accommodate the landholder's requirements and existing land uses.

Arrow Energy also collaborates and consults with Aboriginal parties potentially affected by the project to avoid sites of cultural heritage significance, and where feasible, develops management programs for relevant Aboriginal parties.

3.14 Construction

The pipeline will be typical of a modern gas transmission pipeline designed, constructed and operated in accordance with the Australian Standard series *AS 2885 Pipelines – Gas and Liquid Petroleum*, particularly:

- AS 2885.0 Part 0 – General Requirements
- AS 2885.1 Part 1 – Design and Construction
- AS 2885.2 Part 2 – Welding
- AS 2885.3 Part 3 – Operations and Maintenance
- AS 2885.5 Part 5 – Field Pressure Testing.

All materials and workmanship shall be in accordance with the applicable codes and standards of AS2885.1. In addition, the design shall comply with the specific requirements of:

- Petroleum and Gas (Production and Safety) Act 2004 (P&G Act)
- PPL - issued by Department of Natural Resources and Mines (DNRM) and associated EA to be issued by EHP.

At the commencement of the detailed design phase, a risk assessment database will be developed to identify risks. The detailed design phase will ensure that major risks are treated and mitigated. The following risk studies will be conducted by the project as part of the design process:

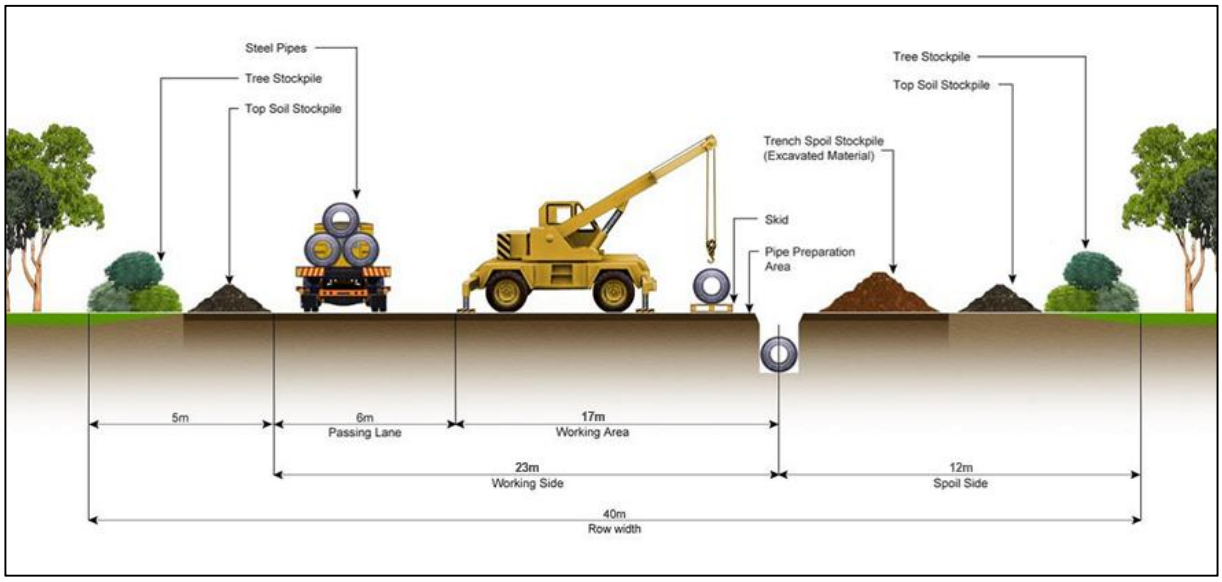
- A Pipeline Safety Management Study (SMS) in accordance with AS 2885.1. The outcomes of the SMS will be incorporated into a Safety and Operating Plan
- A Hazard and Operability (HAZOP) Study.

The proposed pipeline will be constructed in accordance with the requirements of AS 2885.1 and the APIA Code, 2009.

The width of the Right of Way (ROW) for construction of the proposed pipeline route is 30m with an additional 10m temporary working area to facilitate traffic movements and safety (total of 40m), as illustrated in Plate 3-1 and Figure 3-1. In sensitive areas the additional construction workspace of 10m will not be utilised. A narrower construction width may be considered for short distances, such

as at watercourse crossings. As part of construction, the pipeline trench will be backfilled and restored, typically within three months of clear and grade.

Plate 3—1: Typical pipeline ROW



Source: Queensland Curtis LNG Project EIS (QGC Limited, 2009)

Figure 3-1 Typical corridor layout for pipeline construction

On completion of construction, a 30m operational easement will be negotiated with landowners and other parties along the pipeline. Above ground structures will include main line valves, scraper and meter stations. Typically, these facilities may be located within the 30m wide easement and will be fenced. Pipeline markers will be provided at fences, roads crossings and other locations as required by AS 2885.

Normal agricultural activities can occur over buried pipelines following construction and thus the presence of a buried pipeline will not create any long-term adverse impact upon good quality

agricultural land (GQAL) or Strategic Cropping Land (SCL). Construction of the project will not result in the permanent alienation of GQAL or SCL. Compensation will be offered to the landowner for any temporary disruption to agricultural production during construction and rehabilitation of the pipeline.

Construction activities will be managed in accordance with the environmental management procedures for the construction phase.

3.14.1 Proposed Plant and Equipment

The machinery and equipment associated with pipeline construction includes:

- Flat bed articulated trucks or extendable tri-axle trailers to transport pipes to site
- Tip trucks to transport bedding sand onsite and excavated burden offsite
- Cranes and side booms for pipe laying
- Excavation machinery, including excavators/trenching machines
- Bulldozers
- Mobile welding plant
- Mobile crusher
- Mobile chipper/mulcher or tub grinder
- Generator sets to supply power for HDD
- Light trucks/utility vehicles.

3.14.2 Workforce

The project is anticipated to require a workforce of 693 people during construction, 10 people during commissioning and 15 people during operation.

3.14.3 Construction Depots and Stockpile Sites

The majority of equipment and materials associated with construction will be offloaded either directly onto the construction ROW or to a pre-existing cleared area. Construction related materials and equipment may include:

- Construction vehicles
- Diesel fuel and lubricants
- Vehicle maintenance equipment
- Tools and consumables
- Sandbags, sediment fencing, star droppers and wooden stakes, pipe wrapping and joint coating materials
- Line pipe

3.14.4 Transport and access

Equipment and personnel will require regular access to the ROW and worksites during construction. Access will generally be via existing roads and tracks as well as the ROW. Access planning will include consultation with all relevant landowners and regulatory authorities.

There are a number of public roads and tracks in the region and these are likely to be sufficient for construction access; however, it is possible that some new access tracks may need to be created following consultation with appropriate stakeholders. Existing access roads and tracks will be used wherever practicable and all project-related movements will be restricted to approved access tracks, the ROW and identified turnaround or lay-down areas. Approximately 8km of access tracks are currently proposed for the project.

3.14.5 Detailed Pre-construction Survey

The pipe centreline will be surveyed and pegged after detailed geotechnical, engineering, ecological and cultural heritage surveys are completed. Markers will be placed along the entire route to identify the pipeline centreline, ROW and any additional workspaces. Vegetation boundaries will be well defined. Trees to be retained, areas of reduced ROW and any transected Regional Ecosystems (REs) will be flagged.

Areas outside the ROW used for extra workspace, truck turnarounds or lay-down areas will be subject to appropriate heritage and environmental assessment and landholder approval.

3.14.6 Fencing

Where fences are intersected by the pipeline, they will be strained and then cut. Temporary construction gates will be installed where fences are cut prior to clearing of the surveyed ROW for construction access. Crews will be instructed to leave gates as found in accordance with landholder requirements and this will be monitored with gate condition maintained to a high standard. Fences will be restored to original condition on completion except where permanent access points are required, with landholder approval.

3.14.7 Clear and Grade

Clear and grade, as illustrated in Plate 3—2 and Plate 3—3 will be carried out to provide a safe construction ROW for vehicular movement, trenching and other construction activities.

A total width of 40m (30m easement and 10m additional working space) will generally be required to enable construction to be safely and efficiently carried out. The ROW may be reduced in width through sensitive areas.

The ROW will be cleared of vegetation, although rootstock will be left in the ground where practicable to stabilise the area and reduce erosion potential. In woodland / scrubby areas, with landowner approval, some vegetation will be stockpiled for re-spreading to assist with erosion and

sediment control where required as part of the restoration process. Breaks will be left in stockpiled vegetation to allow continued access to stock, fence lines, property tracks and drainage lines.

Large mature or hollow bearing trees will be preserved where feasible. Trees generally will be pushed over and windrowed alongside the ROW. Millable timber will be offered to the landholder.

Through areas requiring trenching, topsoil will be removed and temporarily stockpiled separately for reuse during rehabilitation. Topsoil will not be mixed with subsoil or vegetation. Topsoil will be carefully stockpiled in low mounds (<1m high) to preserve the composition and structure. The ROW will be levelled to the required gradient using graders, backhoes and bulldozers.

The clear and grade will generally be 15km in advance of the trenching works. Trenching will occur on a 'just in time' basis to minimise the length of open trench. Progressive rehabilitation will occur immediately behind the pipeline laying operations.

Plate 3—2: Typical clearing of the ROW and avoidance of sensitive vegetation

Plate 3—3: Typical grading of the ROW

3.14.8 Stringing

Stringing (illustrated in Plate 3—4) is the term used to describe the laying out of the pipe in preparation for welding. Required lengths of pipe will be transported to site on trucks. The pipe will

be laid out adjacent to the trench and held off the ground on skids and sandbags, which protects the pipe coating from damage.

Where required, pipe lengths will be bent to match changes in either elevation or direction of the route using hot or cold bending machines.

Plate 3—4: Pipeline stringing

3.14.9 Line-Up, Welding, Radiography and Joint Coating

Once the pipe is strung, a line-up crew will position the pipe using side boom tractors and internal line-up clamps. Specialised construction crews undertake the welding phase of the project (illustrated in Plate 3—5) in accordance with AS 2885. Pipes are typically welded into strings of up to 800m in length, allowing for stock and landholder access breaks where needed.

Plate 3—5: Pipeline welding

Each weld will be subjected to a non-destructive testing inspection, including visual and either X-ray analysis or ultrasonic testing process, in accordance with AS 2885 to check for compliance to specification, thus ensuring the integrity of each weld. This is illustrated in Plate 3—6.

Source: www.ge-mcs.com

Plate 3—6: Non-destructive testing being conducted

Following welding, the weld joints will be cleaned by grinding, power wire brushing or pressure cleaning with a naturally occurring inert substance (Garnet) and an external coating, compatible with the factory applied external coating, will be applied to prevent corrosion, after which the weld joints are wrapped and coated, as illustrated in Plate 3—7. In areas of certified organic farming, a closed cycle blasting rig will be used.

Plate 3—7: Coating and wrapping of the weld joint

3.14.10 Trenching

A wheel trencher, rock saw or excavator or a combination of this machinery will be used to excavate the trench as illustrated in Plate 3—8. The distance covered per day will depend on terrain and weather conditions, but typically on projects of this nature, a production rate of two to three kilometres per day is anticipated.

The depth of the trench will be determined by a risk assessment conducted in accordance with AS 2885, with the minimum depth of cover being 750mm and 1,200mm for creek and infrastructure crossings. Trench depth, typically 1,900mm to 2,000mm, depends on the current or anticipated use of the land. Trench spoil will be stockpiled separately from topsoil (in low mounds < 1m in height) on the non-working side of the ROW. Other than changes in depth for the above reasons, the pipeline is generally laid to follow the contours of the land.

The length of open trench will be minimised to reduce risks of fauna entrapment. Trenching will be conducted on a 'just in time' basis. Furthermore, breaks in the trench will be left to facilitate stock

and wildlife crossing, agricultural vehicle movements and at drainage lines (in consultation with landowners). In addition, methods will be adopted to minimise fauna entrapment and mortality, such as trench plugs, ramped ends of trench and safe havens and inspection of the trench by fauna handlers and spotter catchers.

Other breaks will occur in the trench for tracks, watercourses, drains, roads and buried services crossed by the pipeline route.

Installation of the pipeline at key roads and rail lines will use techniques to bore under the crossing points to avoid disruption. Discussions will be held with relevant stakeholders to confirm crossing points and methods to minimise impacts on road or rail operations.

Plate 3—8: Trenching machine in operation

3.14.11 Watercourse crossings

The pipeline route crosses a number of watercourses. Access across these watercourses will be required for both pipe laying and for the movement of construction equipment. This will be achieved by fords or flumed crossings. The primary watercourse crossing locations are listed in Appendix H.

To minimise the period of construction and subsequent environmental disturbance, it is anticipated that construction will occur during winter months when there is less rainfall and watercourses are usually at their lowest flow level.

Common pipeline construction methods used for crossing of the watercourses include open cut trenching, including flow diversion, or a trenchless technique.

3.14.11.1Dry rivers, minor creeks and streams

Where possible, crossings will be constructed while the watercourse is dry using the open cut trenching method. If water flow is present, it will be transported across the trench via flume pipes or, alternatively, the watercourse will be temporarily dammed and the water flow pumped around the crossing site.

Standard open cut / flow diversion

The majority of watercourse crossings are expected to be constructed using standard open cut (trenching) construction. This technique is most suited for dry or low flow conditions and involves establishing a stable working platform either side of the watercourse and creating a trench using excavators. Tie-in points will be located on high ground well away from any water flow.

Flow diversion is a modification of the standard open cut method where higher water volumes and flows (typically <1,000 L/s) are present.

Permanent flowing waterways

Permanent flowing watercourse crossings may be constructed using a trenchless technology e.g. HDD in which a hole is drilled under the watercourse bed and the pipeline section is pulled through the hole. The HDD technique is being considered for selected crossings, including the Fitzroy River and parts of the Isaac River and Raglan Creek, subject to geotechnical verification (refer to Appendix H).

Whilst HDD is generally used to cross major watercourses, it may also be used for crossings of some roads or railways.

3.14.12 Lowering-in and Backfill

Where required, the trench is prepared by placing bedding and padding (fine sub-soil) on the base and around the pipe to protect the pipe coating from damage. Padding machines are generally used to generate padding by sifting excavated trench spoil to remove coarse materials to produce a fine substrate, as illustrated in Plate 3—9. Topsoil will not be used as padding.

Plate 3—9: Padding machine in operation

The pipe coating will be inspected and tested for defects and the pipe will then lifted off the skids and lowered into the trench using side-boom tractors, as illustrated in Plate 3—10 to Plate 3—12.

Plate 3—10: Pipe after welding and coating, before lowering-in

Plate 3—11: Lowering pipe into trench

Plate 3—12: Pipe lowered into trench and spoil backfilled

Where required, impermeable trench blocks, known as trench or sack breakers, will be installed prior to backfilling of the trench to control water movement along the backfilled trench. Trench breakers are commonly installed in a number of environmental conditions, such as adjacent to watercourses, or where drainage patterns change.

Excavated material will be bladed into the trench by a bulldozer or grader. The material will be placed in layers and wheel-rolled to provide compaction and prevent subsequent settlement.

3.14.13 Hydrostatic Testing (Hydrotesting)

Hydrostatic testing is the pressure testing of a section of the pipeline with water to establish the strength and leak tightness of the test section and to confirm the strength of the pipeline for the purposes of confirming the MAOP.

Hydrostatic testing will be completed following construction. All pipe sections will be subject to a hydrostatic pressure test, as shown in Plate 3—13. Hydrotesting will be undertaken in accordance with a Hydrostatic Test Water Management Plan which will be developed and submitted to EHP for review and comment prior to undertaking the testing procedures (refer to Section 7.8).

Key elements of the proposed hydrotesting are described below. Potential impacts and control strategies for the management of hydrotest waters are described in Section 7.8.2 and Section 7.8.3 respectively.

Plate 3—13: Hydrostatic testing in progress

3.14.14 Test Water

Water is normally obtained from existing sources in the area, such as property dams and local watercourses. Where required, approvals will be obtained from EHP or the owner of the water. Source and disposal options will be explored to maximise efficiency of testing, timing of construction and commissioning, as well as ensuring environmental good practice. Beneficial reuse of treated CSG water may also be considered in some locations at this time.

Hydrostatic testing water will not be extracted from significant aquatic habitat areas. Water sourced from natural waterways will be screened with a medium mesh to protect aquatic life and again with a finer mesh to limit particle size intake into the test section and flow rates and water levels will be maintained. Where hydrostatic test water is sourced from natural watercourses, it will, where necessary, be recycled to minimise future extraction and disposal volumes. Permits will be obtained where required for the sourcing of hydrostatic test water.

Alternatively, in areas where CSG is being produced, and sufficient volumes of treated CSG water of adequate quality for hydrostatic testing purposes, is available, treated CSG water will be used.

Prior to filling the test section with water, the section will be flushed with a slug of water to ensure that no construction rubbish remains that may inhibit the cleaning, drying or commissioning processes. This slug of water will be captured on release from the test section and not permitted to discharge directly to the ground. The slug of water will be collected and strained to remove any impurities and either treated or disposed of through trade waste.

Additives, such as biocides and oxygen scavengers, may be added to hydrostatic test water, if required, to remove biological organisms and reduce corrosion potential during testing. If test water is used for more than 30 days, it may need to be treated with a combination of oxygen scavenger and biocide to ensure that corrosion attributable to bacterial, oxygen or microbial action is prevented.

Where biocides or oxygen scavengers are required, dosing concentrations will be in accordance with the manufacturer's recommendations and international best practice. Where reagents are required, they will be selected on the basis they degrade rapidly under aeration, or similar natural treatment.

3.14.15 Water Discharge

All test water will be tested to comply with limits for the application of waters to land. No hydrotest water will be discharged directly to watercourses (refer to Section 7.8).

3.14.16 Dewatering and Drying

After satisfactory hydrostatic testing of a section, it will be dewatered and dried. Swabbing / cleaning pigs[1] (illustrated in Plate 3—14) will be passed through the test section using oil-free compressed air until the acceptance criteria for dryness and cleanliness are met. These criteria will have been established and will be included in the procedures developed and approved prior to the commencement of hydrostatic testing.

1 A pipeline inspection gauge (PIG) is propelled by pressure between a launcher and receiver station or hydrostatic test sections to clean pipelines or provide physical barriers between different substances being conveyed in it.

Plate 3—14: Pipeline cleaning pigs

When clean and dry, the test section will be tied-into any preceding sections and left sealed and full of dry air in readiness for commissioning with gas.

3.14.17 Waste Generation

Relatively small amounts of domestic and industrial wastes will be generated during the construction and operation of the pipeline. The sources, types and estimated volumes of wastes generated by pipeline construction and possible disposal options are provided in Section 7.7. Some key waste streams are described below.

3.14.17.1Excavated Waste

There will be very little excavated waste during construction of the pipeline. All suitable material extracted during trenching will be refined by a padding machine and re-used in the trench as bedding and padding for the pipeline. Subsoil and topsoil will be reused during rehabilitation of the construction corridor.

No additives will be introduced in the excavation process, while a crusher may be utilised to crush any excavated rock for reuse in the trench as padding material.

3.14.17.2Liquid Waste

The volume of water used to hydrostatically pressure test the pipeline has been calculated as up to 25ML per test section (approximately every 25km). Approximately 1ML of this water will be discharged at the end of each test section (approximately every 25km) after use as a first flush ‘slug’. The total volume of hydrotest water over the length of the proposed pipeline route has been estimated to be 100ML.

It is not proposed to add additives to hydrostatic test water. This water will be offered to landholders or disposed over grassed areas and not to any watercourses.

Some areas may be inundated with rainwater which will be pumped from the trench or worksites as necessary. Rainfall will be directed away from chemical storage areas and pumped to trade waste.

Waste oils, lubricants and other similar substances will be recycled where possible or otherwise removed by a waste disposal contractor. Liquid waste chemicals, such as solvents and photographic chemicals will be disposed of by a contractor to a suitably licensed disposal facility.

3.14.18 Clean-up, Restoration and Rehabilitation

Clean-up, restoration and rehabilitation measures will be applied to all areas disturbed during construction, including the ROW and access tracks as soon as practical after pipe laying and backfill. Management strategies for clean-up, restoration and rehabilitation are described in Section 8 and Appendix E.

Generally, clean up and rehabilitation of the ROW will involve removal of foreign material (construction material and waste), surface contouring, respreading of topsoil, respreading vegetation and revegetation and/or reseeding, typically via natural regeneration or seeding of native grass or matching improved pasture species (refer to Plate 3—15) .

Plate 3—15: Clean-up of ROW

Generally, the landscape will be rehabilitated to pre-existing contours with natural drainage lines restored and protected. In certain cases, rehabilitation will be tailored to site-specific conditions in consultation with the landholder. To promote vegetation re-growth and protect against the loss of topsoil, the ROW surface will normally be lightly scarified prior to respreading of topsoil.

Where watercourses are crossed, banks will be reinstated as near as practicable to their original profile. Where required, geofabric (for example, jute matting), which remains permeable to water and enhances plant growth, will be used to hold soil in place during re-establishment. Vegetation will then be reinstated, usually involving initial seeding with sterile grasses (for example, millet or rye corn) to facilitate re-vegetation and stabilisation of watercourse banks.

Subsequent re-vegetation of the crossing will aim to re-establish native plant species through natural regeneration and / or seeding. An example of rehabilitation across a watercourse is illustrated in Plate 3—16 and Plate 3—17.

Plate 3—16: Rehabilitation of ROW across a Watercourse

Plate 3—17: Rehabilitation of ROW across a watercourse

All rehabilitation, as illustrated in Plate 3—18 to Plate 3—21 will be undertaken in accordance with industry practice, including the APIA Code and will ensure that:

- Compaction is relieved through ripping subsoil prior to respreading topsoil
- Topsoil cover is re-established and all land and waterways disturbed by project activities are returned to a stable condition as soon as possible after construction
- Land is returned as close as possible to its previous productivity
- Stable landforms are re-established to original topographic contours
- Natural drainage patterns are reinstated
- Erosion control measures (e.g. contour banks, filter strips) are installed in erosion prone areas
- The pre-construction environment is reinstated and disturbed habitats recreated
- Fences and gates are restored
- Pipeline marker signs are installed.

Following construction, reinstatement will be monitored and access will be restricted to facilitate rehabilitation.

Pipeline clean-up and rehabilitation is described in Section 8 and Appendix E.

Plate 3—18: Rehabilitation of ROW across a road

Plate 3—19: Rehabilitated ROW in rural area

Plate 3—20: Rehabilitated ROW in rural area

Plate 3—21: Rehabilitated ROW in rural / wooded area

3.14.19 Signage

Pipeline information markers (as illustrated in Plate 3—22) will be erected in line of sight along the pipeline as per AS 2885 and will be placed at regular intervals. They will be closer together at bends, on either side of road crossings, at fences and at watercourse crossings.

Plate 3—22: Pipeline information marker

3.14.20 Operation

The pipeline will be operated in accordance with approval documentation (i.e. the EA), operational management strategies, AS 2885 and the APIA code.

The pipeline will be a high-integrity pressure vessel constructed from high strength steel. It will be integrity tested by 100% examination of welds and a high-pressure hydrostatic test at pressures in excess of the MAOP. Operational activities will ensure that this integrity is maintained over the life of the pipeline.

An operational pipeline easement of 30m will be maintained. Following reinstatement and revegetation of the ROW, above ground infrastructure will be limited to marker posts to identify the location of the pipeline and cathodic protection test points.

A routine operation and maintenance program will be implemented, which will include leak detection surveys, ground patrols, repair or replacement of faulty pipe, pigging of the pipeline, corrosion monitoring, remediation and maintenance of the easement and lease area. Ground inspections will include checking vegetation for discolouration (an indicator of a gas leak), monitoring erosion and rehabilitation success and detecting weed species.

All maintenance activities will be conducted in accordance with the EM Plan and the operational management strategies. Prior to commencing any extensive work, or where numerous sites are involved, operations personnel will consult with landholders and regulatory agencies.

Continued access to the easement will be necessary to follow-up issues identified from inspections. Low level maintenance for erosion, subsidence and weeds is likely to be necessary, particularly during the first twelve months following construction. A light vehicle access track may be maintained along the pipeline to allow inspection and maintenance, although existing access tracks will be utilised wherever possible. Consultations will be maintained with landowners whose properties are traversed by the pipeline. The-Dial-Before-You-Dig service will be promoted for use by third parties wishing to locate the pipeline prior to undertaking excavations.

A summary of pipeline operational activities is provided in Table 3-7.

Table 3-7 Summary of pipeline operational activities

Activity / issue	Description / management
Weed control	Localised weed spraying (in consultation with landholders) undertaken along the easement as required (primarily in the first 12 months following commissioning) will form a key part of ongoing maintenance of the project site.
Line of sight clearance	To maintain line of sight, shrubs and trees will be cleared within 3m of the proposed centreline. Deep-rooted vegetation will not be allowed to grow within 3.5m of the centreline to preserve continued pipeline integrity. Regeneration of shrubs and trees elsewhere on the easement will be encouraged.
Aerial inspection of easement	Inspections may be undertaken using rotary or fixed-wing aircraft, particularly in areas where only limited public road access is available. Frequency will vary depending upon the particular issue being inspected, but is typically monthly or quarterly.
Patrolling / inspections easement access	This will be undertaken, in conjunction with aerial inspections, by travelling along the project site in vehicles on an as-needed basis. This will involve access to private property and use of private access tracks.
Pipeline operations	
Cathodic protection surveys	Surveys travelling the pipeline easement and stopping to measure cathodic protection point output. Typically, these inspections are conducted annually. Depending upon the results detected, this may also involve coating repairs – refer to 'excavations'.
Testing and inspection valves	Valves will be operated to ensure their availability in the event of an emergency. Extremely small volumes of gas may be released during this activity as the valves are likely to be powered by the pressure in the pipeline. Typical frequency is annually.
Erosion repair	Following major rainfall events, the pipeline easement will be subject to aerial inspection (particularly during the first 24 months after commissioning) to determine if any areas have suffered from erosion or subsidence. Any areas detected will be repaired immediately to match existing ground contours.
Emissions	Throughout the lifetime of the project, small amounts of gas may be released to the atmosphere under controlled conditions during pipeline and facility maintenance.

Activity / issue	Description / management
Pipeline incident	The main threats to public safety from pipeline operation and maintenance are fire and explosion risk associated with pipeline rupture. Pipeline risk assessments have identified that these threats are associated with factors such as third party or external interference to the pipeline and pipeline (external) corrosion. All identified threats presenting an unacceptable level of risk will be mitigated through adoption of AS 2885. The pipeline will also be constructed and operated according to the Pipeline Protection Safety Measures contained in the approved Safety and Operating Plan and in accordance with an approved Emergency Response Plan.
Pipeline maintenance	
Coating integrity surveys	Immediately after commissioning, and generally in conjunction with the annual cathodic protection surveys referred to above, a coating conductance test (Direct Current Voltage Gradient survey) will be carried out to determine if there are any defects in the external pipe coating that might compromise the continued long term integrity of the pipeline. Where these readings indicate that such defects cannot be controlled by the cathodic protection system, the section will be excavated and the pipeline coating repaired.
Pigging	Pigging is periodically undertaken to assess the continued integrity of the pipeline. An 'intelligent pig' is placed into the pipeline at a launcher station and is propelled through the pipeline by the gas flow before removal at a pipeline receiver station (refer to Plate 3—23). This pig detects any damage to the pipeline and is used to direct repairs if significant damage is detected. Minor venting of gas to the atmosphere results during pig removal.
Excavations, including coating refurbishment, installation of anode beds, emergency response exercises and new tie-ins	Excavations of the proposed pipeline include clearing and grading, trenching, backfilling and restoration and rehabilitation, albeit on a much smaller scale. Once vegetation and topsoil have been cleared and stockpiled, the excavation is performed and spoil stockpiled. The pipeline maintenance is then undertaken which this may include welding, non-destructive testing, blast cleaning and painting/coating. Once complete, the trench is then backfilled, the ground surface re-contoured and topsoil re-spread. Some reseeding may also be undertaken if needed. These activities are expected to be very rare during the operational lifetime of the pipeline.
Replacement of pipeline section	The pipeline is isolated and a controlled release of gas may be required from the affected section. The affected area is then excavated, the old pipe removed and a new section installed – this includes welding, blasting and coating. This is expected to be a particularly rare event during the operational lifetime of the proposed pipeline.
Welding	Welding is usually only required during pipeline repairs or when modifications to existing infrastructure may be required. Pipeline welding requires excavation of the pipeline as described under excavations earlier in this table.
Coating	Heat shrink sleeves or tape are expected to be applied to effect coating repairs occasioned during any of the above repair work.
Pressure testing	When a section of pipe is replaced, a section of pre-tested pipe, from stock held for this purpose, is used. Where a facility is installed that has to tie-in to the pipeline, additional sections will generally be pre-tested prior to installation.
Facility operation and maintenance	
Gas hub	The proposed GGH is where the pipeline will join with the ASP. It will consist of pipeline isolation valves and scraper station plus an interconnector. These operate continuously.
Scraper station	A facility for the launching and receiving of pipeline pigs.
Weed control	Localised weed spraying or removal.
Production of hazardous wastes	Waste hydrocarbons are generated from maintenance / pigging operations.
Waste disposal	General waste generated during operations is collected on site and removed to licensed facilities for disposal.
Station blow downs	All venting during emergency situations is controlled by Emergency Response Procedures.

Plate 3—23 Intelligent pig

3.14.21 Decommissioning

When the pipeline is no longer required, it will be decommissioned in accordance with the regulatory requirements and accepted environmental best practices of the day. Currently, decommissioning procedures will result in the removal of above ground infrastructure (e.g. mainline valves) and restoration of disturbed areas, such as the ROW. Rehabilitation and decommissioning is discussed in Section 8.

At the time of decommissioning, a decision will be made regarding the opportunities for future use of the pipeline. If no longer required, the pipeline will be purged of gas and allowed to gradually degrade in-situ. However, if it is considered that the pipeline may offer some future benefits, it will be filled with an inert material and the cathodic protection system maintained to prevent corrosion.

4 Arrow Energy's Environmental Management System

Arrow Energy is committed to the sound management of health, safety and the environment throughout all its business activities. To this end, Arrow Energy maintains a comprehensive integrated Health, Safety and Environment Management System (HSEMS) based on the principles of the International Standard for Environmental Management Systems (AS/NZS ISO 14001:2004) and the Australian Standard for Occupational Health and Safety Management Systems (AS/NZS 4801:2001).

4.1 Environmental Policy

As a wholly owned subsidiary of Arrow Energy, ABP is committed to complying with Arrow Energy's Environmental Policy which is presented in Appendix C.

Arrow Energy's aim is to achieve a high standard of care for the natural environment in all of its activities including gas exploration, development, production and decommissioning of gas supply service, planning, design of new infrastructure, management of existing infrastructure, the provision of technical services, and at all times, to minimise the impact of these activities on the environment.

Arrow Energy's vision is to supply these services in an environmentally sustainable manner, with due regard to community values and heritage. By implementing the Environmental Management System and site-based environmental management plans, Arrow Energy aims to:

- Conduct operations in compliance and consistent with all relevant environmental legislation, regulations, licences, permits, standards, approvals and authorities
- Clearly allocate responsibilities for environmental performance at all levels within Arrow Energy and its business associates, and build environmental competency through provision of structured environmental training to its employees, contractors and other service providers
- Seek continuous improvement in environmental performance through setting objectives and targets for improved environmental performance, providing sufficient financial and human resources to meet these objectives and targets, applying research and development and cleaner production principles and, where applicable, using environmentally sustainable products and resources
- Apply best industry practice in the management, supply and delivery of CSG
- Communicate with customers and the community about commitments to this vision, its application and their view of Arrow Energy's performance
- Report annually on environmental performance.

4.2 Key Roles and Responsibilities

Arrow Energy is ultimately responsible for the ongoing environmental management of the project activities. The day-to-day environmental management of project activities will be the responsibility of

all personnel, while Arrow Energy, as the holder of the EA, will assume overall responsibility for environmental compliance.

Targeted inductions will ensure that all individuals involved in the project, including personnel and contractors are aware of their environmental responsibilities and are accountable for their actions. All employees and contractors will be responsible for the environmental performance of their activities and must demonstrate compliance with Arrow Energy's procedures and policies and with commitments made as part of the HSEMS and this EM Plan.

Key personnel have specific environmental responsibilities when managing environmental issues as presented in Table 4-1.

Table 4-1 Key roles and responsibilities

Role	Responsibility
Chief Executive Officer	■ Performance of Arrow Energy ■ Corporate environmental policy ■ Fostering a partnership that promotes 'ownership' of Arrow Energy's environmental responsibilities ■ Ensuring that sufficient resources are allocated to environmental management of Arrow activities
VP Major Pipelines	■ Implementation of corporate environmental policy ■ Systems and resources to ensure compliance with corporate environmental policy and conditions of approval
Approvals and Compliance Manager	■ Environmental approvals management ■ Approval of operational procedures and practices relevant to the environment ■ Coordinating incident response and implementing corrective actions ■ Accountable for compliance ■ Reporting and compliance related issues ■ Performance measurement and reporting, including improvement measures and corrective actions
All site and field personnel	■ Environmental approvals management ■ Coordinating incident response ■ Reporting and compliance-related issues ■ Training in and implementing procedures, including those that address environmental management, at a site or operational level ■ Overseeing day to day activities ■ Carrying out specific activities that ensure compliance with EA conditions, including monitoring and data collection

The Construction Manager and Environmental Officer will have specific roles, as follows.

4.2.1 Construction Manager

The Project's Construction Manager will direct work in a manner that complies with all relevant environmental procedures, adheres to all legislative requirements and ensure that the requirements of this EM Plan and the EA are implemented. The Construction Manager will have 'stop task' and 'stop work' authority.

4.2.2 Environmental Officer

The Environmental Officer will be responsible for monitoring and reporting the implementation of the EM Plan. The Environmental Officer will also be responsible for implementation of the Cultural Heritage Management Plan (CHMP), the Complaints Register and for establishing and managing compliance audits and monitoring programs. Construction compliance auditing will be conducted against the requirements of this EM Plan, construction safe work method statements, licence and permit conditions.

4.3 Training and Inductions

All workers, sub-contractors and visitors engaged in the construction and operation of the pipeline will be trained in the management of this EM Plan and the objectives of subordinate and activity based management plans. Specific training will be provided to personnel engaged in specialist roles (such as rehabilitation). All personnel will be trained in their duty to report incident where environmental harm may be caused or threatened. This will include notifying their supervisor or manager within Arrow of events.

As part of the Environmental Induction Management Plan, training plans will be developed to attain, improve and maintain personnel competencies and the overall environmental performance of Arrow. The Environmental Induction Management Plan will be reviewed following change, incident investigations and hazard studies. Training will:

- Cover environmental issues related to carrying out the petroleum activity
- Cover all emergency response procedures
- Review hazards and control measures
- Review environmental standard operating procedures
- Present consequences and impacts of departure from hazard and control measures.
- Reinforce the role of hazard and control measures in achieving company and business unit objectives and targets
- Be evaluated to ensure the required learning outcomes are being achieved.

Training, competency and awareness of site personnel will be tracked via a database that addresses the needs stipulated by an individual's work area. This database will be reviewed through the course of internal and external compliance audits and will be maintained onsite and available on request.

Prior to commencing work, all staff, including construction and field staff, will complete a comprehensive project induction including environmental induction training in line with the Environmental Induction Management Plan(refer to Table 4-2). The induction will include safety, access, environmental and cultural heritage requirements and standards. Environmental inductions will cover, as a minimum, erosion risk and management, fuel and chemical handling/storage procedures, waste management and weed hygiene and control procedures. All supervisory to managerial level project personnel will undergo additional training sessions on the use and

implementation of the EM Plan. The Construction Manager will be responsible for ensuring training records are maintained.

All visitors to the site will be required to undergo an environmental induction and awareness to an understanding of the environmental protection commitments and standards adopted for construction and operation of the pipeline.

Table 4-2 Construction workforce - training and induction requirements

Aspect	Training and Induction Requirements
General environmental duties	*Environmental Protection Act 1994* *Vegetation Management Act 1999* *Water Act 2000* *Aboriginal Cultural Heritage Act 2003* *Queensland Heritage Act 1992.*
Specific performance objectives and management measures	Responsibilities with respect to: ■ Complying with and implementing EA conditions at all times ■ Implementing management measures, monitoring, reporting and implementing corrective actions ■ Responsibilities in the event of an environmental incident ■ Internal and external communication processes ■ Community perspectives and expectations ■ Project systems, including quality, safety and document control.

4.4 Meetings

4.4.1 Toolbox Meetings

The Construction Manager will ensure that supervisors hold weekly toolbox talks with staff and crews to discuss issues associated with the scheduled work.

This will include highlighting and discussing relevant environmental and safety issues as required. The sessions will include discussion of strategies to be implemented as identified in Job Hazard Analysis (JHA) of current work activities.

4.4.2 Job Hazard Meetings

Work Method Statements will be used to record procedures for daily activities while new works will be subject to a JHA.

The JHA is a tool that is used in helping personnel identify, analyse and manage the hazards that exist in the work they undertake. It formalises the process of hazard identification and risk management that most people follow when working. The JHA requires personnel to examine the task they are about to undertake and:

- Break the job down into separate, defined steps

- For each step, identify the potential hazards, including potential environmental or cultural heritage hazards that could occur within that job step
- For each potential hazard, list the method to be followed to prevent the hazard causing an injury, loss, damage or environmental incident.

Weekly job hazard meetings will be held in conjunction with toolbox meetings.

4.5 Monitoring and Reporting

4.5.1 Monitoring

Monitoring of each environmental element will be conducted for the various project phases to ensure the necessary and agreed mitigation measures are implemented. Planned monitoring includes:

- Environmental monitoring, involving the collection of quantitative data to establish whether environmental values are being impacted as a result of project activities
- Monitoring implementation of specific environmental management plans and programs
- Reporting and analysis of regulated discharges, emissions and waste disposal
- Any other prescribed monitoring in accordance with the conditions of the EA.

The EPC Contractor will undertake monitoring for specific environmental elements in accordance with the requirements of the relevant EA.

Monitoring equipment will be calibrated and the results of the calibrations recorded. All monitoring and sampling undertaken will be in accordance with the relevant agency guidelines or Australian Standards (AS). All analytical testing performed will utilise the National Association of Testing Authorities (NATA) approved procedures or if this is unavailable, be performed to the best relevant standard. New technologies or materials may be used, provided standards and outcomes are equal to, or exceed current recognised standards. All monitoring conducted under the EA will be conducted by a suitably qualified person.

4.5.2 Reporting

Project documents, including the construction and operations management plans and programs, are intended to be 'living documents' and will be subject to updates and revisions during delivery of the project. Project documents will be available for inspection on request by an agency with regulatory responsibilities for aspects of project delivery. Revisions to the EM Plan will be made available to the relevant regulatory agencies prior to the commencement of works to which the revisions relate.

4.6 Incidents, Non-conformances and Emergencies

Incident reporting will be implemented to record any safety or environmental non-conformances, incidents or complaints. These shall be recorded on an Incident Report Form and forwarded to the Construction Manager for reporting within the Arrow Energy system and for a process of continuous improvement to be implemented.

All incidents shall be investigated in a timely manner and any necessary steps implemented to minimise the likelihood of a recurrence.

Non-conformances will be resolved according to the procedure outlined in the HSEMS. The Environmental Officer or delegate will issue a Non-Conformance Report (NCR) or an Environmental Improvement Notice (EIN) in response to identified issues, incidents, events or concerns. An NCR will be issued for deficiencies that are minor in nature but require rectification. An EIN will be issued for more serious issues that present an immediate need for action or for repeat non-conformances where a warning is required to be issued for poor performance. NCRs and EINs will be tracked to ensure that the appropriate correction measures are adopted and closed out.

In the event of a non-conformance:

- The nature of the event will be investigated by the Environmental Officer
- A report on the event will be prepared and communicated to the site management, internal management and the regulatory authority as required
- Advice may be sought from a specialist
- Monitoring may be undertaken
- The effectiveness or need for new or additional controls will be reviewed
- An appropriate preventative and corrective action will be implemented
- Strategies will be identified to prevent recurrence
- The NCR will be closed-out
- Environmental documentation will be reviewed and revised.

If the environmental non-conformance is significant, it will be documented on the HSEMS.

Section 320 of the EP Act requires that any person who becomes aware of an event that may or has caused environmental harm, reports the event / incident to their employer (the General Environmental Duty). Details of the nature and circumstances of the event will be provided.

Any such incidents will be immediately reported to the Construction Manager and recorded on an Incident Report Form. The Construction Manager will ensure that the appropriate actions are taken with reference to the approvals and for reporting to the regulatory authorities as necessary. Arrow Energy has plans and procedures for preparedness and response to emergencies. These are applied to both environmental and safety events.

4.7 Inspections, Reviews and Audits

Inspections, reviews and audits will be undertaken both as scheduled and unscheduled activities to evaluate performance and compliance with EA conditions and Arrow Energy's HSEMS.

During construction, the implementation of this EM Plan will be monitored and inspections will be undertaken to ensure the principles and commitments are being adhered to. The Environmental

Officer will be required to record daily and weekly site activities on checklists in order to demonstrate compliance with EM Plan requirements.

Audits will be conducted for construction and operations activities, in conjunction with site environmental improvement plans and review meetings.

Third party audits will include as a minimum, a construction audit and post-construction audit. Construction audits will evaluate compliance with the conditions of the EA, relevant environmental management plans, any non-compliances identified during the previous audit period and corrective actions taken. Post-construction audits will evaluate the effectiveness of rehabilitation management plan and associated documentation (e.g. Erosion and Sediment Control Plan and Weed Management Plan). Non-compliances or observations identified during audits will be recorded and corrective action implemented.

Audits will be undertaken by independent and suitably qualified specialists who will present the findings of each audit carried out. The audit report will include the following:

- A summary of any conditions activated during the reporting period
- A summary of any non-compliances identified during the audit period
- A summary of any non-compliances identified during the previous audit period, with details of site remediation activities, corrective actions taken, or to be taken and revised practices implemented, or to be implemented
- A compliance evaluation table detailing whether compliance with the condition was achieved and how compliance was evaluated
- A list of the evidence used to support the findings of the audit. The list will detail the documents reviewed, the date and locations of any site inspections conducted.

The audit report will be accompanied by an audit certification statement which will be completed and signed by the auditor.

Any recommendations arising from the audit report will be acted upon by:

- Investigating any non-compliance issues identified
- As soon as reasonably practicable, implementing measures or taking necessary action to ensure compliance with the requirements of the relevant legislation and EA.

4.8 Continuous Improvement and Corrective Action

Arrow Energy's HSEMS, including management plans, procedures and guidelines will be reviewed and updated as a result of audit outcomes, subsequent corrective actions, response to incidents and events, changes in activities, procedures or improved technology. Updates will also reflect legislative amendments together with relevant project changes or issues that arise during project activities.

4.9 Complaints Procedure

Arrow Energy is committed to managing all community concerns in an accountable, transparent, timely and meaningful way. Arrow Energy has a complaints management system that outlines how

staff should handle, report and address complaints. This system is consistent with *AS ISO 10002-2006, Customer Satisfaction – Guidelines for Complaints Handling in Organizations.*

All complaints about the project will be directed to, and recorded by, the Community Liaison Officer. Contact details for the Community Liaison Officer will be provided to all affected landowners. A register will be kept of all complaints received, the action taken in response and any corrective actions or procedural changes implemented to prevent a recurrence. The initiator of the complaint will be advised of the results of all actions taken.

The Community Liaison Officer will review the register and advise the Environmental Officer of any relevant environmental complaints. The Environmental Officer will then investigate the complaint and instigate any corrective action required.

The register will be audited by the Construction Manager to ensure responses to any complaint are dealt with in a timely and effective manner.

4.10 Document Control and Records Management

As required by ISO 14001, Arrow Energy will maintain a database for storage and retrieval of environmental data, records and other relevant information to the project.

4.11 Implementation of the EM Plan

The EM Plan incorporates the requirements of the APIA Code. The Construction Manager will be responsible for implementing the EM Plan for the whole project and ensuring compliance with the performance requirements in the EM Plan. The Construction Manager will also be responsible for ensuring appropriate corrective action is taken for any failure to meet stated performance requirements.

4.12 Project Specific Documentation

The EM Plan will include the preparation and implementation of environmental management procedures for construction and operation, as well as relevant sub-plans. Detailed procedures will be prepared and approved prior to the commencement of the project phase to which they relate.

Construction environmental management procedures will address environmental impacts that may result from construction and be in accordance with the EA conditions. These requirements will be presented in a concise format that will be suitable for use by onsite personnel.

Operational environmental management procedures will address all environmental impacts that may result from the operation phase of the pipeline. These procedures will:

- Incorporate all of the imposed EA conditions for operation and any other approvals that are relevant to environmental management during operation
- Include elements of the construction environmental management procedures that have ongoing requirements during the operational phase.

4.12.1 Other Project Documentation

A range of other project documentation will be implemented to support activity based management plans. These management plans will be uncontrolled in hard copy and will be continuously improved throughout the project development and execution cycle.

Arrow is committed to developing activity based management plans, as shown in Table 4-3.

Table 4-3 Description and scope of activity based management plans

Topic	Deliverable	Outline of Scope	Deliverable Schedule
Flora and Fauna	Species Specific Management Plan	To be developed for listed threatened species, migratory species or their habitat, or a listed ecological community.	To be prepared prior to construction.
	Weed Management Plan	To be developed in consultation with the Department of Agriculture, Fisheries and Forestry (DAFF), local governments and Biosecurity Queensland. Pursuant to Section 52 Division 2 of the *Land Protection (Pest and Stock Route Management) Act 2002.*	Outline Plan provided in Appendix D. Detailed Plan to be prepared prior to construction.
	Pest Management Plan		To be prepared prior to construction.
	Aquatic Values Management Plan	To address impacts on riparian, aquatic and water dependant flora and fauna along the pipeline ROW.	To be prepared prior to construction.
	Offset Management Plan	To address the Queensland Government Environmental Offsets Policy 2008 and include specific policies and requirements for listed/scheduled species under the *Nature Conservation Act 1992.*	Arrow Energy Offset Management Strategy provided in Appendix F. Detailed Plan to be prepared prior to construction.
Land (including soils)	Erosion and Sediment Control Plan	To include erosion protection management measures and sediment control management measures to minimise erosion and the release of sediment to surface waters.	To be prepared prior to construction.
	Rehabilitation Program	To include the rehabilitation of the pipeline to achieve a stable landform.	Outline Plan provided in Appendix E. Detailed program to be prepared prior to construction.
	Soils Management Plan, incorporating an Acid Sulfate Soil Management Plan	To address the handling and treatment of soil materials exposed during construction activities. To describe how the design and operation of activities will avoid or minimise impacts on GQAL and SCL. To provide management measures for excavated materials containing and potentially containing Acid Sulfate Soils.	To be prepared prior to construction.

Topic	Deliverable	Outline of Scope	Deliverable Schedule
Air	Air Quality Management Plan	To mitigate dust and vehicle emissions when working in the vicinity of sensitive receptors.	To be prepared prior to construction.
Waste	Waste Management Plan	To mitigate waste risks, provide management processes for key waste streams and guidance on the adoption of the waste hierarchy.	To be prepared prior to construction.
Water	Hydrostatic Test Water Management Plan	Pipe integrity will be verified by hydrostatic testing using water recycled from one test section to another. All hydrostatic testing water released to land will be tested and comply with discharge limits before being released to land.	To be prepared prior to hydrostatic testing.
Cultural Heritage	Indigenous Cultural Heritage Management Plan	To include the findings of any pre-construction surveys and agreed management measures to deal with any potential impacts on Indigenous and historic cultural heritage.	To be submitted to Cultural Heritage Coordination Unit (CHCU) for approval prior to construction. Majority of CHMPs will be contained within Indigenous Land Use Agreements (ILUAs) for the relevant native title area as registered by the National Native Title Tribunal (NNTT)
	Non-Indigenous Historic Heritage Management Plan	To include the findings of any pre-construction surveys and management measures to deal with any potential impacts on non-Indigenous cultural heritage.	To be prepared prior to construction.
Noise and Vibration	Noise and Vibration Management Plan (including Blast Management Plan)	To be developed for activities where noise and/or vibration must be controlled and mitigated. A Blast Management Plan will be prepared should rock blasting occur.	Outline Plan provided in Appendix G. Detailed Plan to be prepared prior to construction.
Hazard and Risk	Emergency Response Plan (including a Fire Risk Management Plan)	To be prepared for all likely emergency situations and incidents that could occur as a result of project construction or operations by natural hazards, systems and equipment failure or by human error.	To be prepared prior to construction.
	Risk Management Plan	To develop an integrated risk management plan for the whole of the life of the project including construction, operation and decommissioning phases.	To be provided prior to construction.

Topic	Deliverable	Outline of Scope	Deliverable Schedule
Health and Safety	Safety Management Plan	To manage health and safety during construction and reduce risks to community health and safety. The management of vectors such as mosquitos and the potential for vector borne diseases such as Ross River Virus will be developed by the EPC Contractor. To ensure the pipeline will be constructed and operated according to the pipeline protection safety measures. To ensure the safe management of storage and handling of hazardous materials, particularly dangerous goods and combustible liquids.	To be provided prior to construction.
Social	Stakeholder Consultation Plan (SCP)	As outlined in the EIS - to ensure the community and stakeholders are informed about the project.	This is a living document and will be updated as required throughout the project.
	Social Impact Management Plan (SIMP)	To protect and promote the social values of the community.	As outlined in the EIS. This is a living document which will be updated as required throughout the project.
Transport	Transport Management Plan	To avoid, or mitigate and manage impacts of construction traffic on local communities, transport networks and the environment.	To be prepared prior to construction.

4.12.1.1 Environmental Line Lists

An Environmental Line List (ELL) will be used to identify site specific environmental management requirements for construction including the location of specific environmental features such as important vegetation, watercourses, sensitive receptors and associated management measures.

The ELL is derived from information collected during surveys and specialist studies of the pipeline route and will be used by construction personnel to identify special management areas on the pipeline as work progresses. Rehabilitation objectives and specific environmental management requirements will be added to the ELL, as required. Requirements to check and comply with the ELL are included in the procedures.

4.12.1.2 Alignment Sheets

Alignment Sheets will show the pipeline route with community, engineering and environmental information attached at the relevant location along the pipeline. Alignment Sheets will be developed by the EPC contractor and designed for use in the field by construction supervisors and will provide:

- Details of engineering requirements, such as the type of pipe, degree of bend and depth of cover
- Landholder and tenure information

- Environmental information, which will identify where specific management for the protection of various aspects of the environment must be implemented (e.g. width of the ROW) and cross- referenced to the ELL.

4.12.1.3 Technical Drawings

Technical drawings will be distributed to relevant construction personnel prior to the commencement of construction and will provide the following information:

- A visual interpretation of the engineering specifications, work procedures or work method statements for the project
- Environmental considerations in the technical notes, where appropriate, which may cover a range of design aspects
- Typical construction situations, e.g. erosion and sediment controls
- Site-specific construction issues, e.g. the methodology for crossing a specific watercourse.

5 Legislative Framework

A range of national and state legislation is relevant to the pipeline as described below.

5.1 Relevant Legislation and Policy Requirements

5.1.1 Commonwealth Legislation

5.1.1.1 Environmental Protection and Biodiversity Conservation Act 1999

The *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) protects the environment in relation to Matters of National Environmental Significance[2] (MNES). Under the EPBC Act, if a development proposal involves an action that is likely to result in a significant impact on a MNES, the proposal must be referred to the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC).

The project has been referred to DSEWPaC for assessment against the EPBC Act (Reference Number: 2012/6459).

5.1.1.2 Native Title Act 1993

Under the *Native Title Act 1993* (NT Act), indigenous land rights may exist in areas such as vacant or unallocated crown land, some reserve lands, some types of pastoral lease and waters that are not privately owned. Native title can be extinguished by certain actions, for example where the land is held under freehold title.

The native title process being undertaken involves the development of Indigenous Land Use Agreements (ILUAs) with the registered native title claimants along the route, with these ILUAs to be lodged for registration with the National Native Title Tribunal.

5.1.1.3 Aboriginal and Torres Strait Island Heritage Protection Act 1984

The *Aboriginal and Torres Strait Island Heritage Protection Act 1984* (ATSIHP Act) provides Indigenous (Aboriginal and Torres Strait Island) people in any Australian state or territory (with certain caveats pertaining to Victoria) with the right to request the relevant Commonwealth Minister to intervene in matters where traditional cultural heritage interests are considered to be at risk.

Cultural Heritage Management Plans (CHMPs) will be contained in the relevant ILUAs, or will be developed separately for approval by the Department of Aboriginal and Torres Strait Islander and

[2] Matters of National Environmental Significance include: listed threatened species and ecological communities; migratory species protected under international agreements; Ramsar wetlands of international importance; the Commonwealth marine environment; World Heritage properties; National Heritage places and nuclear actions.

Multicultural Affairs (DATSIMA) (previously part of DERM) to satisfactorily address the cultural heritage interest of the relevant Aboriginal Endorsed Parties along the proposed pipeline route. It is proposed that the ILUA / CHMP will comply with the ATSIHP Act and the NT Act as well as applicable state government cultural heritage legislation.

5.1.2 State Legislation

5.1.2.1 Petroleum and Gas (Production and Safety) Act 2004

The *Petroleum and Gas (Production and Safety) Act 2004* (P&G Act) facilitates and regulates the carrying out of responsible petroleum activities and the development of a safe, efficient and viable petroleum and fuel gas industry in Queensland. Under the P&G Act, Arrow is required to obtain a Petroleum Pipeline Licence (PPL) for the ABP.

A PPL authorises the construction and operation of the pipeline including ancillary activities that are necessary for pipeline operation, such as valve, scraper, meter and compressor stations, plant and equipment and apparatus used for corrosion protection.

A PPL application for the project will be submitted to DNRM for assessment. The PPL can be granted after an EA has been issued by EHP.

5.1.2.2 Environmental Protection Act 1994

The *Environmental Protection Act 1994* (EP Act) is the overarching legislation for the regulatory management of the environment in Queensland. The EP Act is based on self-regulation and a duty of care, which places the responsibility for protection of the environment on all persons during the conduct of all activities.

The object of the EP Act is to '*protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains ecological processes on which life depends (ecologically sustainable development).*'[3]

Construction of a new transmission pipeline greater than 150km is classified as a Level 1 Chapter 5A petroleum activity under the EP Regulation. To undertake a Level 1 petroleum activity (which is also defined as Level 1 Environmentally Relevant Activity (ERA) under the EP Act), an EA must be issued by EHP before a PPL can be granted. Applications for an EA (chapter 5A activities) for a Level 1 chapter 5A activity must be accompanied by an EM Plan under Section 310C of the EP Act.

[3] Part 2, Section 3, *Environmental Protection Act 1994*

5.1.2.3 State Development and Public Works Organisation Act 1971

The *State Development and Public Works Organisation Act 1971* (SDPWO Act) establishes an environmental assessment process for projects declared to be 'significant projects' by the Queensland government. Projects declared significant are generally economically or strategically important for the state, or highly complex requiring centralised coordination or assessment by the Coordinator-General (Department of State Development Infrastructure and Planning (DSDIP)). Division 3 of the SDPWO Act is not relevant to the project as it is not a significant project and Arrow has opted to undertake a voluntary EIS under the provisions of the EP Act.

There is provision for the State to provide access to land for the purposes of an infrastructure facility of significance, such as a pipeline, under Section 125 of the SDPWO Act. Where landholders or native title claimants do not enter into land access agreements, Arrow may rely on state intervention to obtain access to these parcels of land through a compulsory acquisition process provided that Arrow can demonstrate that it has made genuine and repeated attempts to obtain this access by direct agreement with the landholder.

5.1.2.4 Water Act 2000

The *Water Act 2000* (Water Act) regulates the use, flow and control of water including water in a watercourse, lake or spring, underground water, overland flow water, water that has been collected from a dam and recycled and desalinated water.

Under the Water Act, activities that will involve vegetation destruction, excavation and fill in a watercourse are exempt from assessment under sections 49, 50 and 51 of the *Water Regulation 2002* (Water Regulation) as long as they are authorised under a licence, petroleum lease or authority to prospect under the P&G Act. If works are undertaken outside the PPL area, a Riverine Protection Permit (RPP), which will require the written consent of adjacent land owners, will be required under the Water Act to remove vegetation, excavate and fill within the waterways.

A permit is also required to source water from a watercourse, lake, spring or aquifer for an activity of a temporary nature under section 237 of this Act. Water may be temporarily required during construction of the proposed pipeline route for trenchless crossing techniques, hydrotesting and dust suppression. This permit process is separate to the *Sustainable Planning Act 2009* (SP Act) and is required regardless of the PPL granted under the P&G Act.

5.1.2.5 Vegetation Management Act 1999

The *Vegetation Management Act 1999* (VM Act) provides for the conservation of native vegetation in Queensland and regulates the clearing of mapped remnant vegetation (termed Regional Ecosystems (RE)) and high value regrowth vegetation on freehold and leasehold land. Approval under the VM Act is required if remnant vegetation is to be cleared, with applications for approval likely to be accompanied by a Property Map of Assessable Vegetation (PMAV). An exemption applies where the clearing is for a 'specific activity' listed in Schedule 24 of the SP Regulation, which includes clearing for a Chapter 5A activity (Part 1, Item 1(6)).

Vegetation clearing on freehold and leasehold land is exempt from assessment under the VM Act where the construction of the proposed pipeline, including incidental activities, is undertaken within the area covered by the PPL. Clearing related to incidental activities outside the PPL area, such as borrow pits, which involve vegetation clearing will require development approval.

5.1.2.6 Nature Conservation Act 1992

The *Nature Conservation Act 1992* (NC Act) has a number of associated regulations, plans and orders to protect Endangered, Vulnerable and Near Threatened (EVNT) species.

The NC Act and regulations state that any person taking, using or interfering with protected EVNT fauna is required to have a Wildlife Rehabilitation Permit (spotter-catcher) and to possess the training and skills required to undertake this activity. Such a permit will allow a person to rescue and release a sick, injured or orphaned protected animal; or a protected animal whose habitat has been, or will be, destroyed by human activity or a natural disaster.

A clearing permit (protected plants) is also required to be obtained from EHP where taking, using or interfering with EVNT flora under the NC Act.

5.1.2.7 Land Act 1994

The *Land Act 1994* (Land Act) provides a framework for the allocation of state land as leasehold, freehold or other tenure. Under Chapter 4, Part 4 of the Land Act, a permit to occupy is required from the Department of Natural Resources and Mines (DNRM) where the project is developed on a reserve, road or unallocated state land.

Further, a permit is required under section 113 of the Land Act for clearing of vegetation on all state lands. The application must be made to DNRM regardless of whether the clearing will take place within or without the PPL area.

5.1.2.8 Aboriginal Cultural Heritage Act 2003

All objects and areas of Aboriginal cultural heritage significance in Queensland are dealt with under the *Aboriginal Cultural Heritage Act 2003* (ACH Act). The ACH Act covers places of archaeological and historical significance.

The ACH Act operates on the basis of a duty of care owed by development proponents and others to Aboriginal cultural heritage.

In this case, it is necessary that a CHMP or native title agreement be prepared in consultation with the relevant Aboriginal parties to ensure that Aboriginal cultural heritage duty of care is fulfilled. A native title agreement may include an ILUA, Section 31 agreement or use of the Native Title Protection Conditions. ILUAs are being prepared for the project with the relevant parties for the project and will include specific measures for the management of Aboriginal cultural heritage. If an ILUA cannot be finalised in accordance with the project's requirements, an approved CHMP will be agreed with the relevant parties.

5.1.2.9 Queensland Heritage Act 1992

Historic heritage in Queensland is protected under the provisions of the *Queensland Heritage Act 1992* (QH Act). This legislation protects all those places included on the Queensland Heritage Register (QHR). It also protects archaeological places where there is an expectation of sub-surface material that can provide information regarding the history of Queensland. Although this Act contains provisions for the protection of indigenous cultural heritage, items that derive their significance solely from their association with Aboriginal custom or tradition are excluded from protection under the QH Act. A non-indigenous heritage assessment was prepared for the project which addresses the QH Act.

5.1.2.10 Fisheries Act 1994

The *Fisheries Act 1994* (Fisheries Act) regulates the management, use, development and protection of fisheries, resources and fish habitats and the management of aquaculture activities. The disturbance of marine plants and the construction and raising of waterway barrier works are administered under the Fisheries Act.

Where waterway barrier works are deemed self-assessable, the works must comply with the Code for self-assessable development, temporary waterway barrier works. If waterway barrier works are not deemed self-assessable, an approval from the Department of Agriculture Forestry and Fisheries (DAFF) will be required prior to works commencing.

5.1.2.11 Transport Infrastructure Act 1994

The *Transport Infrastructure Act 1994* (TI Act) regulates infrastructure, including roads, rail, light rail, busways, ports, air, marine and miscellaneous, throughout Queensland and encourages effective integrated planning and efficient management of transport infrastructure.

Approval is required from the Department of Transport and Main Roads (TMR) to work on or interfere with roads. Approval is required from Queensland Rail (QR) or Queensland Rail National (QRN) to work on, or interfere with railways.

5.1.2.12 Strategic Cropping Land Act 2011

Strategic Cropping Land (SCL) is protected under the *Strategic Cropping Land Act 2011* (SCL Act) and *State Planning Policy 1/12: Protecting Queensland's Strategic Cropping Land* (SPP 1/12). SCL is land in Queensland that has been identified as being highly suitable for cropping, requiring preservation and protection from unacceptable development. Development being undertaken under an EA is subject to the SCL Act. Consequently, the ABP is required to comply with the requirements of the SCL Act.

SCL and Potential SCL are identified through trigger mapping that has been carried out by the Department of Agriculture, Fisheries and Forestry (DAFF).

Section 95 of the SCL Act requires that an application must be made for an 'SCL protection decision' where an EA impacts on SCL. As part of the SCL protection decision, 'SCL protection conditions' may be imposed on the EA. Section 100 of the SCL Act provides a guide of the SCL protection conditions

may contain, including the prohibition, limitation or restriction to the carrying out of the resource activity on the land, or part of it. Risks to SCL are described in Section 7.3.

5.2 Environmentally Relevant Activities

Environmentally Relevant Activities (ERAs) are defined under Schedule 2 of the EP Regulation. These are activities with the potential to release contaminants to the environment and cause environmental harm. The Level 1 Chapter 5A Activities and ERAs considered to apply to the project are identified in Table 5-1.

Table 5-1 Environmentally Relevant Activities

ERA no.	Description and threshold	AES	Reason for consideration	Applicability
Chapter 4 Environmentally Relevant Activities				
8 (3)(a) – Chemical storage (minimum threshold)	Storing the following total quantity of chemicals of class C1 or C2 combustible liquids under AS 1940 or dangerous goods class 3 under subsection (1)(c)— (a) $10m^3$ to $500m^2$.	No Score	During construction of the project, diesel will be stored in designated areas to support construction vehicles and plant.	Will be required
ERA 63 (3) – Sewage treatment	Operating one or more sewage treatment works at a site that has a total daily peak design capacity of100-1500EP.	No Score	During the operation of the temporary workers' accommodation camps sewage treatment may be required.	Will be required for temporary accommodation camps only.
Level 1 Chapter 5A Activities				
5	Constructing a new pipeline of more than 150km under a petroleum authority	165	The project involves the application for a Petroleum Pipeline Licence for the construction of approximately 580km of pipeline.	Will be required

5.3 Notifiable Activities

Notifiable Activities are activities listed in Schedule 3 of the EP Act and have been identified as activities likely to cause land contamination. Landowners are responsible for informing EHP that Notifiable Activities are taking place on their land. These activities must be included on the Environmental Management Register.

Of the following Notifiable Activities, only b) iii is applicable. This is associated with the supporting site laydown/store/workshop areas established with the accommodation camps and will not be undertaken in the ROW.

29 Petroleum product or oil storage – storing petroleum products or oil:

a) In underground tanks with more than 200 litre capacity; or

b) In above ground tanks with:

   i. For petroleum products or oil in class 3 in packaging groups 1 and 2 of the dangerous goods code - more than 2,500 litre capacity; or

   ii. For petroleum products or oil in class 3 in packaging groups 3 of the dangerous goods code - more than 5,000 litre capacity; or

   iii. For petroleum products that are combustible liquids in class C1 or C2 in Australian Standard AS 1940, 'The storage and handling of flammable and combustible liquids' published by Standards Australia - more than 25,000 litre capacity.

6 Financial Assurance

Provision of financial assurance may be required for environmental authorities under the EP Act. This is to be calculated in accordance with EHP's draft guideline Financial Assurance for Petroleum Activities (EHP 2012) and must include the cost of rehabilitation of any disturbed land that has been the subject of whole or partial surrender due to the grant of a new petroleum authority over the land.

As soon as practical after pipe laying and backfill, the ROW will be re-contoured to match the surrounding land and erosion controls constructed. Separately stockpiled topsoil will then be spread evenly across the disturbed surface to assist in soil retention and seed-stock will be spread to enhance rehabilitation. Particular attention will be given to regeneration processes in areas of erosion risk and watercourse crossings.

Areas of improved pastures will be discussed with landholders and reseeding initiated to complement existing grasses. Local ground conditions and climatic circumstances will influence these decisions. Other situations where the natural regeneration processes may need to be augmented include areas at risk of erosion and watercourse crossings. Rehabilitation strategies are described in Section 8 and Appendix E.

When the pipeline is no longer required, it will be decommissioned in accordance with the regulatory requirements and accepted current environmental best practices of the day. Currently, decommissioning procedures require the removal of all above ground infrastructure and the restoration of associated disturbed areas.

Costs associated with rehabilitation and financial assurance for the project, including justification and supporting calculations, are provided in the following sections. These costs have been calculated on the basis of engineering estimates and through consideration of the Level 2 EA Addendum issued by EHP.

6.1 Construction Rehabilitation

In the unlikely event that pipeline construction could not continue, calculation of a suitable rehabilitation package for the open section of the ROW has been determined. The ROW will be subject to progressive rehabilitation during construction over its entire length, so rehabilitation at any time of abandonment will be minimised.

The indicative costs in Table 6-1 are provided for rehabilitation of the pipeline ROW and associated access tracks used for construction. The indicative costs also include the costs for restoration of one watercourse crossing. Given the length of the pipeline and the distances between watercourses, it is unlikely that more than one watercourse would be disturbed during any phase of construction.

Table 6-1 Rehabilitation cost for construction activities

Activity	Unit	Unit rehabilitation cost	Rehabilitation Cost
Removal of access tracks	8km	$650 per km	$5,200
Rehabilitation of pipeline ROW	60km	$3,500 per km	$210,000
Reinstatement of watercourse crossing	1	$20,000 ea	$20,000
Total rehabilitation liability for term of the work			$235,200
Maintenance and monitoring costs (20% of the rehabilitation costs) (max $20,000)			$20,000
Financial Assurance			$255,200

6.2 Decommissioning Plan

In the event that the pipeline is no longer required, it will be decommissioned in accordance with the current best practice of the day. At the time of decommissioning, a decision will be made regarding the opportunities for future use of the pipeline and the following two options will be considered:

- Moth-balling – this will involve depressurising the pipeline, capping and filling it with an inert gas (such as nitrogen) or water with corrosion inhibiting chemicals. The cathodic protection will be maintained to prevent the pipe corroding. A monitoring program will be maintained.
- Abandonment – this could involve purging the pipe of CSG, disconnecting it from the manifolds and removing above ground infrastructure. The pipe will then be filled with water and left to corrode in-situ. Removing the pipe from the ground is not considered to be an environmentally or commercially viable option. A detailed rehabilitation program will be developed and implemented in consultation with landholders and the regulatory agencies at the time of abandonment.

Abandonment of the pipeline is unlikely as the pipeline feeds the proposed Arrow LNG Plant, and provides a strategic link for CSG fields in the Bowen Basin to CSG fields in the Surat Basin, as well as providing the potential to supply gas from the Bowen Basin to numerous industries in the greater Gladstone region, power stations and gas processing facilities. The pipeline will be subject to ongoing rehabilitation over its planned life, so remediation at any time of abandonment will be minimised.

The following indicative costs are provided for decommissioning:

Waste metal is usually sold to a waste metal merchant, and installed equipment also has a recovery value.

Pipe abandonment Gas 550km @ $550 per km = $302,500

- Purge the pipe of natural gas with compressed air
- Disconnect the pipe from the inlet manifold
- Remove any above ground infrastructure
- Fill the pipe with water.

Removal of Access Roads 12km @ $650 per km = $7,800
Removal of Main Line Valves (MLV) 2 valve sites = $50,000

- Recover valves for reuse;
- Remove chain wire fence;
- Remove above ground pipework;
- Grade site (gravel usually offered to landholder for their use);
- Apply topsoil; and
- Rehabilitate site in accordance with landholder agreement.

Removal of MLV & Scraper Station 1 site = $40,000

- Recover valves for reuse;
- Remove chain wire fence;
- Remove above ground pipework;
- Grade site (gravel usually offered to landholder for their use);
- Apply topsoil; and
- Rehabilitate site in accordance with landholder agreement.

Removal of Launcher or Receiver Station 2 sites = $60,000

- Recover valves for reuse;
- Remove chain wire fence;
- Remove above ground pipework;
- Grade site (gravel usually offered to landholder for their use);
- Apply topsoil; and
- Rehabilitate site in accordance with landholder agreement.

The financial assurance for rehabilitation during decommissioning is summarised in Table 6-2.

Table 6-2 Rehabilitation Costs for Decommissioning

Activity	Unit	Unit rehabilitation cost	Rehabilitation Cost
Pipe abandonment	550km	$550 per km	$302,500
Removal of access roads	8km	$650 per km	$5,200
Removal of Main Line Valves (MLV)	2 off	$25,000 per site	$50,000
Removal of MLV & Scraper Station	1 off	$40,000 per site	$40,000
Removal of Launcher or Receiver Station	2 off	$30,000 per site	$70,000
Total rehabilitation liability			$470,300
Maintenance and monitoring costs (20% of the rehabilitation costs) (max $40,000)			$40,000
CPI (3% of total rehabilitation costs x number of years covered by work program / development plan (15 years, compounded)			$262,412
Financial Assurance			$770,112

7 Existing Environment, Potential Impacts and Management Strategies

7.1 Air

This Section describes the existing air environment, the potential impacts of the project on ambient air quality and the management strategies identified to address potential impacts.

7.1.1 Description of the existing environment and environmental values

Existing air quality along the proposed pipeline route is influenced by local and regional sources including:

- Coal mines
- Windblown dust from exposed agricultural land and unsealed roads
- Dust storms and bushfires (agricultural burning)
- Motor vehicle emissions from local, regional and state highways along the pipeline
- Industrial sources around Rockhampton and Gladstone.

Sensitive receptors within the project area include:

- Residential dwellings
- Educational facilities, e.g. schools, kindergartens, child care centres, and schools
- Medical institutions, e.g. hospitals and surgeries
- Public parks and recreational areas
- Religious buildings, e.g. churches.

The locations of sensitive receptors in the project area are shown in Map Series 7 in Appendix A. A total of 137 residential dwellings have been identified within a 1km buffer either side of the proposed pipeline route.

7.1.1.1 Air Quality

Ambient air quality monitoring data recorded at West Mackay monitoring station were reviewed to describe existing air quality within the project area. The West Mackay station is the nearest monitoring station to the proposed pipeline and is located approximately 120km east of the northern extent of the proposed pipeline route. Table 7-1 presents ambient air quality monitoring results for the West Mackay monitoring station.

Table 7-1 Ambient air quality monitoring results

Pollutant	Avg. Period	Air Quality Objective	Concentration			
			Year	Max	90% percentile	Annual Average
PM_{10}	24 hours	50 (µg/m^3)	2008	307	42	23
			2007	298	37	22
			2006	209	33	20
			2005	332	38	22
			2004	141	35	21

Source: http://www.ehp.qld.gov.au/air/reports/reports.html

Due to the rural nature of the land along the proposed pipeline route, background air quality data is generally expected to be good. Typically, particulate concentrations are expected to be lower along the proposed pipeline route than recorded at West Mackay.

7.1.1.2 Greenhouse gas

The National Greenhouse Accounts (NGA) Factors (DCCEE, 2011) were used in the preparation of the estimated greenhouse gas inventory for the construction and operation of the project. The relevant emission factors are summarised in Table 7-2.

Table 7-2 Greenhouse gas emission factors

Source	Emission Factor				Energy Content Factor (GJ/kL)	Derived Emission Factor
	Carbon Dioxide (CO_2)	Methane (CH_4)	Nitrous Oxide (N_2O)	Units		
Diesel oil (stationary energy)	69.2	0.1	0.2	t CO_2-e/GJ	38.6	2.681 (t CO_2-e/kL)
Diesel oil (transport energy)	69.2	0.1	0.5	t CO_2-e/GJ	38.6	2.71 (t CO_2-e/kL)
Natural gas transmission	0.02	8.7	-	t CO_2-e/km	-	8.72 (t CO_2-e/km)

[1] Derived E.F = Σ EF (CO_2 + CH_4 + N_2O) x Energy Content / 1000

Source: DCCEE 2011

It is estimated that during the operation of the project, fugitive releases of natural gas will be approximately 8.72 t CO_2e/km on an annual basis, and 5,232 Mt CO_2-e (DCCEE 2010) for the 2009 reporting year.

7.1.1.3 Environmental Values

Ambient air quality guidelines in Queensland are provided in the *Environmental Protection (Air) Policy* 2008 (EPP (Air)). The air quality objectives for the project are shown in Table 7-3.

Table 7-3 Ambient air quality objectives

Environmental Value	Pollutant	Air Quality Objective	Averaging Period	Allowance Exceedances
Human Health	Particulate matter (PM_{10})	50 µg/m^3	24 hours	5 days each year
	Total Suspended Particulates	90 µg/m^3	1 year	none
Nuisance	Dust Deposition	120 mg/m^2/day	1 month	none

The environmental values relevant to the air environment for the project include:

- The qualities of the air environment that are conducive to protecting the health and biodiversity of ecosystems
- The qualities of the air environment that are conducive to human health and wellbeing
- The qualities of the air environment that are conducive to protecting agricultural use of the environment.

7.1.2 Potential adverse or beneficial impacts of the project activities on the identified environmental values

7.1.2.1 Air contaminants with the potential to affect environmental values

The main types of air emissions associated with the project are from:

- Particulate matter (dust)
- The combustion products of construction vehicles including nitrogen dioxide (NO_2) and PM_{10}.

Due to the nature of the project, both in terms of vehicles used and a non-static construction site, these emissions are predicted to be minor and will not significantly impact on the identified environmental values. No sources of odour are expected during construction of the pipeline.

7.1.2.2 Greenhouse gas emissions

Construction of the project is estimated to result in approximately 53,601 t CO_2-e of greenhouse gases, representing 26,801 t CO_2-e on an annual basis. The annual emissions represent a small fraction of Queensland's (0.02%) and Australia's (0.005%) annual greenhouse gas emissions of 155.1 Mt CO_2-e (DCCEE 2010) and 564.4 Mt CO_2-e (DCCEE 2010) for the 2009 reporting year.

Fugitive emissions from project operations are anticipated to be negligible. No scheduled releases of gas will occur, other than extremely small quantities associated with the pipeline pigging activities and other limited releases during certain routine operational activities (e.g. valve testing). The gases released during the pigging activities are primarily methane and are not identified as air pollutants or odorous compounds. Minimal risks to local air quality are expected from occasional maintenance vehicles.

Ecological assessments undertaken for the project have identified that the majority of the proposed pipeline route (approximately 73%) runs through non-remnant vegetation, mainly comprising

cropping and grazing land which does not meet the Kyoto Protocol definition of a forest. As such, and in accordance with the National Carbon Accounting System (NCAS), removal of vegetation has been found to have a minimal impact on GHG emissions.

7.1.3 Management strategies

This Section describes measures to manage potential impacts on environmental values relevant to the air environment. Management strategies for construction and operation are summarised in Table 7-4 and Table 7-5.

The use of dust suppression measures during construction, such as water trucks will be utilised to ensure that any dust nuisance is minimised on environmental values.
Mitigation measures to minimise greenhouse gas emissions during construction activities will include:

- Maintaining all plant and equipment in line with manufacturer's recommendations to maximise fuel efficiency
- Avoiding engine idling for extended periods
- Raising awareness of energy efficiency and greenhouse gas emissions through workshops or toolbox talks
- Using appropriately sized equipment for construction activities
- Minimising waste from construction (refer to Section 7.7).

During operation, the following management measures will be implemented to minimise greenhouse gas emissions:

- Reviewing annual energy use to assist in identifying opportunities to improve the energy efficiency of operations
- Reducing the risk of accidental releases of gas
- Monitoring the cathodic protection system.

Arrow Energy will report greenhouse gas emissions for all its operations under the *National Greenhouse and Energy Reporting Act 2007*.

Table 7-4 Air quality and Greenhouse Gas management procedures – construction

Element / Issue	Reduced air quality through dust generation from construction activities. Greenhouse gas emissions.

Performance Objectives	Implementation / Management Strategies	Performance Criteria	Monitoring	Corrective Action
Workforce personnel are aware of environmental issues relating to dust management.	▪ A program to train staff involved in carrying out dust generating activities and in dust management practices (EM001).	▪ Inclusion of dust management strategies in induction and staff training programs.	▪ Monitor feedback from staff training to ensure the workforce understand their responsibilities with respect to dust management.	▪ Review staff training and implement measures improve staff training.
To minimise the generation of fugitive dust emissions to protect the health and wellbeing of humans and ecosystem.	▪ Watering trucks will be employed to control dust in dry and/or windy conditions (C062) ▪ Limiting vehicle speeds on the Right of Way (ROW) to reduce impacts (such as wheel-generated dust or noise) (C064). ▪ Community notified in advance of construction activities (EM002). ▪ Complaints database established and all complaints investigated properly (C063).	▪ Change in dust levels at potentially affected sensitive receptors.	▪ Meteorological forecasts will be monitored to determine local conditions and dust control measures. ▪ Visual observations of dust emissions during windy / dry periods will be undertaken and watering frequency altered.	▪ In the event of dust nuisance at nearby residences: ▪ increase frequency of watering to achieve noticeable dust suppression ▪ limiting dust-generating activities until more favourable meteorological conditions occur.
To maintain acceptable limits of vehicular and machinery emissions.	▪ Raising awareness of energy efficiency and greenhouse gas emissions will be introduced through workshops or toolbox talks (EM003). ▪ Vehicles, plant and equipment will be maintained in accordance with manufacturers' requirements (C065).	▪ Maintenance schedule for vehicles and plant.	▪ Service records will be maintained.	▪ Ensure regular servicing of vehicles, plant and equipment in line with manufacturer's service intervals. ▪ Minimise idling for extended periods of time.
To minimise the generation of air emissions to protect the health and wellbeing of humans	▪ Fire control measures will be implemented during welding operations (EM004). ▪ Smoke generation will be avoided through the implementation of a strict no burning policy (EM005).	▪ Implementation of a no burning policy.	▪ No fires as a result of construction activities.	▪ Water carts and fire extinguishers available along the ROW, in particular, with any hot work.

Performance Objectives	Implementation / Management Strategies	Performance Criteria	Monitoring	Corrective Action
and ecosystems.				

Auditing	▪ Audits and reviews (non-compliance and incident reporting) undertaken in accordance with Section 4 of this EM Plan.
Reporting	▪ Maintain check sheets of visual dust nuisance. ▪ Maintain records of vehicle, plant and equipment servicing. ▪ Maintain records of complaints in Complaints Register. Address complaints and close out. Refer to Section 4 of this EM Plan. ▪ Maintain records of any non-compliances, incidents or accidents. Address and close out in accordance with Section 4 of this EM Plan.
Responsible Person(s)	▪ Construction Superintendent. ▪ EPC Construction Manager. ▪ Environmental Officer.
Associated Documentation	▪ *Environmental Protection Act 1994.* ▪ *National Greenhouse and Energy Reporting Act 2007.* ▪ The National Greenhouse Accounts (NGA) Factors 2011. ▪ Queensland Environment Protection (Air) Policy 2008. ▪ Corrective Action Procedure. ▪ Environmental Reporting Procedure. ▪ Air Quality Management Plan.

Table 7-5 Air quality and greenhouse gas management procedures – Operation

Element / Issue	No detriment to ambient air quality in the project area. Greenhouse gas emissions.

Performance Objectives	Management Strategies	Performance Criteria	Monitoring	Corrective Action
The release of dust or any other airborne contaminants from the petroleum activity must not cause an environmental nuisance at any sensitive place or commercial place.	▪ Repair of any detected leaks (EM007).	▪ Number of complaints about dust nuisance.	▪ Monitor leak-detection surveys at flanges. ▪ Monitor pipeline pressure. ▪ Estimate and record volumes of any gas vented.	▪ Review air quality complaint and investigate if maintenance procedures (e.g. leak detection) are adequate to control potential impacts.

Auditing	▪ Audits to be conducted in accordance with Section 4 of this EM Plan.
Reporting	▪ Works deviating from normal operating conditions will be reported and action initiated to prevent a recurrence of the incident. ▪ An inventory of estimates of greenhouse gas emissions will be maintained. Reporting on greenhouse gas emissions will be conducted in accordance with the National Greenhouse and Energy Reporting Act 2007. ▪ Prepare and submit annual returns to comply with the requirements of greenhouse and pollutant reporting legislation. ▪ Maintain records of complaints in Complaints Register. Address complaints and close out. Refer to Section 4 of this EM Plan. ▪ Maintain records of any non-compliances, incidents or accidents. Address and close out in accordance with Section 4 of this EM Plan.
Responsible Person(s)	▪ Environmental Officer. ▪ Operations Manager.
Associated Documentation	▪ *Environmental Protection Act 1994.* ▪ Queensland Environment Protection (Air) Policy 2008. ▪ *National Greenhouse and Energy Reporting Act 2007.*

7.2 Dams

Permanent dams will not be required for this project. Temporary dams may be required for the transfer of hydrostatic test waters between hydrostatic test sections. Where these dams are required landholders will be consulted. These dams will be lined and following use the site will be rehabilitated to the original profile. It is expected that the dams will be in service for a short period (typically one to two months):

- Surface storages such as water dams and weirs
- Municipal water supply in Gladstone and other areas
- Water generated through CSG production in the Bowen Basin
- Underground bores.

7.3 Land

7.3.1 Description of the existing environment and environmental values

This Section describes the existing values relevant to the land environment with respect to the following:

- The topography, geology and geomorphology of the project area
- The physical and chemical properties of soils
- Land tenure and use - other resource tenures, roads, easements and other major infrastructure
- Land contamination, with respect to existing and historical use.

7.3.1.1 Topography

Topography along the proposed pipeline route is summarised in Table 7-6. In general, the changes in height (slope) along the mainline are gentle (3% slope or less), with occasional moderately inclined slopes (7-15% slope) present.

The DL elevation varies from 149m AHD to 190m AHD with gentle slopes between 0% and 2.7%. The EL elevation varies from 242m AHD to 374m AHD, with gentle to moderately undulating slopes from 0% to 7.8%. The SL elevation varies from 169m AHD to 215m AHD, with level and gently undulating plains and slopes varying between 0% and 3.4%.

Table 7-6 Topography

Section of the proposed pipeline route	Landform	Elevation (m AHD)	Predominant slope (%)
AB Mainline			
KP0 to KP111	Undulating to gently undulating lands, plateau and mesas with steep-scarped dissected margins. High hills or rugged mountains with massive sandstone outcrops between KP20 to KP39.2 and KP55.2 to KP79.2 south of Glenden.	Between 206m and 441m	Slopes generally <3%, up to 6% in creeks and can reach 15% in mountainous area (KP73 to KP76)
KP111 to KP273	Level alluvial plains subject to flooding particularly along the Isaac River	Between 97m and 240m	Slopes typically <1.5% but can be up to 5.3% (KP26)
KP273 to KP317	Strongly undulating to very high hilly and mountainous lands of Mount Gardiner with igneous rock outcrops	Between 32m to 172m	Slopes commonly <5%, but slope can reach 8.6% (KP279)
KP317 to KP363	Level alluvial floodplain of Fitzroy River to undulating lands, less commonly strongly undulating lands	Between 28m to 91m	Slopes generally <3% but side slopes are up to 7% (KP359)
KP363 to KP447 (Including NM0 to NM43.8)	Coastal plain at the west of Port Alma and low hills, undulating terrain to flat associated with Fitzroy River, Casuarina Creek and Raglan Creek floodplain	Between 2.6m and 53m	Generally <2% with one area of slopes up to 10.4 % (NM10 to NM12)
KP447 to KP477	Low rounded hills to mountainous country around Mount Larcom	Between 10m and 106m	Slopes are typically <4% but side slopes up to 12.7% (KP467 to KP468)
Laterals			
EL0 to EL52	Moderately undulating with broad valleys becoming gently undulating or undulating	Between 242m and 374m	Slopes are typically <5%, with side slopes up to 7.6%
SL0 to SL26	Gently undulating or level plains	Between 16m and 21 m	Slopes are typically <2%, with side slopes up to 3.4 %
DL0 to DL32.2	Undulating or gently undulating plains and Level alluvial plains	Between 144m and 189m	Slopes are typically <1% but can reach 3%

7.3.1.2 Geology

To the north and west toward the Great Dividing Range, Pre-Tertiary and Tertiary rocks, primarily the Rewan Group of lithic sedimentary deposits and conglomerates (Geoscience Australia 2012) and mafic volcanics (including basalts), dominate the surface geology and underlay the mainline pipeline route and the EL to approximately KP82.

Beyond KP82, the mainline, SL and DL traverse large areas of sand plains to KP248, with the notable exception of KP143 to KP163 and KP187 to KP217 where the proposed pipeline route is underlain by the Eocene Dauringa Formation (comprised of mudstone and sandstones) (Geoscience Australia

2012). Chemical weathering activity has been far less pronounced throughout these areas, and parent materials have weathered to sandier soil profiles then their lateritic counterparts further north (Story 1967). The continued erosion of these materials has resulted in the deposition of weathered material in lowlands, resulting in a typically depositional soil profile.

From approximately KP248, the parent geology is typically more volcanic in origin. The proposed pipeline route traverses the Lizzie Creek Volcanics (basaltic and volcaniclastic deposits, minor siltstones and shale; KP248-279), the Back Creek Group (quartzose to lithic sandstones, siltstones, shale with minor coals; KP248-305) and the Rookwood Volcanics (basalt and mafic intrusives; KP313-317) (Geoscience Australia 2012).

During the Permian, sediments eroded from the Bowen Basin were widely deposited throughout the area generally are consistent with that traversed by the southern half of the proposed pipeline route, eventually forming sedimentary deposits which have been subject to erosion since (Gunn et al. 1967; Gunn and Nix. 1977). Sandstone, siltstone and mudstone formations dominate the surface geology from KP323-NM4 (Rockhampton Group, Craigilee Beds) (Geoscience Australia 2012). Minor areas of volcanic formations (typically basalt and granodiorite dominant) may occur along this portion, as do incised areas of alluvia typically associated with drainage channels.

Beyond KPNM4, the pipeline traverses primarily Quaternary alluvia, and beyond KP446 (to termination at KP468), this may be incised with the Rockhampton Group and Mount Alma Formation (sandstone and siltstone dominated geological units) (Geoscience Australia 2012).

Mapped geology along the pipeline route is illustrated Map Series 2 in Appendix A.

7.3.1.3 Geomorphology

The majority of the northern portion of the proposed pipeline route traverses mid-catena tertiary weathered materials, characterised by undulating terrain (Gunn and Nix 1977). This is periodically incised with coarse to fine textured alluvium in plains and argillaceous sediments (Gunn and Nix, 1977). Subsequently, lateritic and volcanic profiles are likely to occur in discrete areas throughout the northern areas of the pipeline route. Similarly soils derived from basalts and shales are expected throughout the central region of the proposed pipeline route (KP248-317).

Typically, depositional lithologies (including sand flats) are likely throughout the region in plains, depressions and lower slopes across the proposed pipeline route. Sand plains and various consolidated sedimentary rocks are typically associated with nearby adjacent sedimentary formations, resulting in deeper erosion based soil profiles in foothills and nearby valleys, and shallower soils with areas of rock outcrop in upslope areas. Soils derived from these units are generally consistent with texture-contrast soil profiles, including Sodosols.

Limited residual basaltic and lateritic geological units are incised throughout the proposed pipeline route. These areas are generally consistent with the heavily weathered, deep soil profiles identified during the field assessment, including Kandosols and some Vertosol/Dermosol units.

7.3.1.4 Soils

A soil survey of the pipeline route was conducted in July, August and September 2012 (SKM 2012). Field mapping involved a total of 63 detailed site descriptions and a further 70 observation sites.

Site locations were initially pre-determined, based on existing soil and land use mapping, access constraints and proximity to the pipeline route (<500m). Final site selection was also based on access constraints and proximity to the pipeline route, and confirmed after an on-ground assessment. Where access to properties was granted, sample density adhered to one sample per 1.9km in areas mapped as 'High Risk', including land identified as potential SCL on the *Trigger map for strategic cropping in Queensland* (DERM 2011) ("*Trigger Map*") and GQAL Class A, and one sample per 3.7km in areas mapped as 'Low Risk'.

Along the pipeline route, 63 sites were described in detail to 2m below ground level (bgl). The samples for 12 of these 63 sites were submitted for laboratory analysis to confirm a selection of relevant soil physical and chemical parameters. The remaining locations were advanced to 0.6m bgl or until the diagnostic (B) horizon was observed.

Soils were described according to the Australian Soil and Land Survey Field Handbook (NCST, 2009) ('the ASLS Field Handbook') and classified according to the Australian Soil Classification (Isbell 2002) ('the ASC').

Soil Survey

The soil types identified during the soil survey were defined on the basis of their physical and chemical properties. These soil types were grouped based on similar morphological properties and selected laboratory properties and classified using the ASC scheme of Isbell (2002). Some soil types, for example those classified according to their stage of soil development, may belong to more than one of the ASC soil orders. Seven soil orders of the ASC were identified along the pipeline route and these are listed in Table 7-7.

Soil Mapping Units

The seven soil orders were classed into five Soil Mapping Units (ABP SMUs) which were developed from the soils of the Project area that could be grouped based on their similarities. Recognisable landscape features were also considered in the development of the ABP SMUs, which may consist of one or more ASC soil orders.

In addition to the characteristics of each individual soil profile investigated, the ABP SMUs provide the basis for the GQAL and SCL assessments for the project area. The ABP SMU boundaries were predicted from digital terrain images and existing topographic and land systems maps during the desktop review and refined after interpretation of the results of the field program. The Project site locations are shown in Table 7-8 and the ABP SMU's located on the pipeline route are illustrated on Map Series 3 in Appendix A.

The concept of the ABP SMUs and the classification of the soil profiles according to the ASC (Isbell 2002) are presented in Table 7-9.

Table 7-7 The field verified ASC soil orders identified during the 2012 field survey

Field verified ASC soil order	Concept
Chromosols	Texture-contrast soils with non-acidic subsoils
Dermosols	Non-cracking clays with structured subsoils
Kandosols	Lacking texture contrast with subsoils that have little (weak) or no structure
Rudosols	Soils with negligible pedological organisation (e.g. young soils)
Sodosols	Texture-contrast soils with sodic subsoils
Tenosols	Soils with only weak pedological organisation
Vertosols	Cracking and self-mulching clays with > 35% clay

Table 7-8 The field verified ASC soil orders by sample location

Field verified ASC soil order	Field Site
Chromosols	17, 18, 21, 23, 24, 35, 47, 109, 110, 116, 118, 126, 52, 101, 133, 158, 159, EL1, EL3, EL10, SL4, SL6
Dermosols	2, 3, 22, 32, 37, 41, 42, 48, 78, 78A, 79, 93, 96, 98, 100, 101A, 102, 111, 117, 119, 123, 126A, 130, 143, 146, 154, 191, 193, EL6, EL9, EL11, S1, NM1, NM2
Kandosols	27, 80, 99, 106, 115
Sodosols	39, 82, 103, 121, 155, 156, 192, EL7, SL1
Tenosols/ Rudosols	1, 16, 26, 31, 51, 85, 97, 104, 105, 114, EL 8, SL 2, SL 3, SL 8
Vertosols	29, 30, 38, 40, 43, 44, 45, 46, 49, 49A, 50, 83, 84, 86, 87, 87A, 92, 93A, 107, 108, 112, 113, 125, 140, 141, 142, 144, 145, 157, DLA, DL3, DL4, DL5, DL6, DL7, DL8, DL9, DL10, DL11, DL12; S2, S3, NM3, SL5, SL7

Notes: KP = Kilometre Point along the mainline; EL = Kilometre Point along the Elphinstone Lateral; DL = Kilometre Point along the Dysart Lateral; SL= Kilometre Point along the Saraji Lateral; S=Sunland NM = (Nine Mile and SGIC SDA)

Table 7-9 ABP SMUs, concept and field verified ASC soil orders

ABP SMU	Concept	Field verified ASC soil order	% Revision SR Pipeline
1 (TcS)	Texture-contrast sodic soils	Sodosols	40.1%
2 (Tc)	Texture-contrast non-sodic soils	Chromosols	11.5%
3 (NTc)	Non texture-contrast soils	Dermosols and Kandosols	13.5%
4 (CC)	Well-structured cracking clays	Vertosols	29.9%
5 (Nd)	Soils with little or no pedological development	Rudosols and Tenosols	5.0%

ABP SMU 1 *(TcS) - Texture-contrast sodic soils*

The site locations within ABP SMU 1 are Sites 39 (KP99.1), 82 (KP227), 103 (KP311.7), 121 (KP368.2), 155 (KP464.4), 156 (KP466.3), 192 (KP52.4), EL7 (EL18.2), SL1 (SL0).

Texture-contrast sodic soils (Sodosols) have sodic B horizons of ESP 6 or greater in the upper 0.2m that are not strongly acid (pHw 5.5 or more). Due to the dispersive nature of these sodic clay B horizons, these soils often experience restricted hydraulic conductivity. In general these soils have low fertility, ESPs of >25 and low Ca to Mg ratios which restricts their effective rooting depths. Due to their shallow effective rooting depths, the cropping potentials of these soils are limited. These soils are highly susceptible to erosion due to their dispersive nature when wetted.

ABP SMU 2 *(Tc) – Non sodic, texture-contrast soils*

The site locations within ABP SMU 2 are Sites 17 (KP33), 18 (KP34.7), 21 (KP43.5), 23 (KP55), 24 (KP59.5), 35 (KP88.8), 47 (KP130.8), 52 (KP152.7), 101 (KP303.5), 103 (KP311.7), 109 (KP325.9), 110 (KP327.4), 116 (KP343.8), 118 (KP353.2), 158 (KP473), 159 (KP476), EL1 (EL47), EL3 (36.5), EL10 (EL3.8), SL4 (SL10.6) and SL6 (SL19.5).

These soils have a clear or abrupt increase in clay content between the A and B horizons. Along the proposed pipeline route the only texture-contrast soils other than Sodosols that were identified were Chromosols. Other than their strong texture-contrast, a feature of Chromosols such as identified at Site APB18, is a B horizon that is not strongly acid or sodic. The Chromosol identified at Site 18 has a loose sandy A1 horizon and a sporadically bleached, sandy A2 horizon overlying a medium clay B2 horizon that is not well structured. This soil has imperfect drainage from 700-1300mm depth. These soils are commonly used for agriculture and are used for mixed farming in southern Queensland, supporting better quality pastures for cattle grazing in northern Queensland.

ABP SMU *3 (NTc) - Non texture-contrast soils*

The site locations that are Dermosols within ABP SMU 3 are Sites 2 (KP2.3), 3 (KP4.5), 22 (KP46.9), 32 (KP83), 37 (KP92.5), 41 (KP104.1), 42 (KP108.9), 48 (KP135.1), 78 (KP216), 78A (KP217.7), 79 (KP221), 93 (KP268.1), 96 (KP283.3), 98 (KP289), 100 (KP298.8), 101A (KP306.2), 102 (KP308.7), 111 (KP329), 117 (KP348.8), 119 (KP358.1), 123 (NM0.3), 143 (KP432), 146 (KP445), 154 (KP461), 191 (KP61), 193 (KP116.5), EL 6 (EL22.5), EL9 (E8.1), EL11 (EL0.5), S1 (NA), NM 1 (NM4.4), NM 2(NM8). Those that are Kandosols are ABP 27, 80, 99 (293.2), 106 (KP320) and 115 (KP338.6).

Dermosols often grade to other soil orders, for example, some Dermosols may be difficult to distinguish from finer-structured Vertosols where the presence of slickensides and cracking when dry cannot be confirmed. Dermosols such as that identified at Site NM1 are recognised as having moderate to strong structured B horizons with low free iron oxide content. Although the fertility of these soils is satisfactory, they have marginal cropping potential due to restricted effective rooting depth and water availability as a result of their light sandy clay and silty clay texture, and very hard, coarse structure. Kandosols lack a strong texture-contrast and have a massive (no structure) or weak structured B horizons with clay contents greater than 15%.

ABP SMU *4 (CC) - Well-structured cracking clays*

The site locations within ABP SMU 4 are Sites 29 (KP83), 30 (KP73.6), 38 (KP95.2), 40 (KP101.6), 43 (KP109.5), 44 (KP114.1), 45 (KP120.2), 46 (KP125), 49 (KP139), 49A (KP139), 50 (KP143), 83 (KP231), 84 (KP231.5), 86 (KP239), 87 (KP243.1), 87A (KP243.7), 92 (KP263, 93A (KP69.9), 107 (KP321.9), 108 (KP323.6), 112 (KP331.2), 113 (KP333), 140 (KP424.5), 141 (KP427), 144 (KP437.1), 145 (KP442.1), 157 (KP471), DLA (NA), DL3 (DL 3.4), DL4 (DL5.2), DL5 (DL7.3), DL6 (DL9.3), DL7 (DL11.8), DL8 (DL14), DL9 (DL 15), DL10 (DL17), DL 11 (DL19), DL12 (DL21); S2 (NA), S3 (NA), NM3 (NM12.8), SL5 (SL14.3) and SL 7 (SL21.1).

The well-structured cracking clays (Vertosols) of the project area are typically good quality soils with good fertility. Some of these soils may have a sandy crust with coarser, sandier subsoil structure. Other distinctive properties of these soils are slickensides and/or lenticular structural aggregates which may be difficult to confirm depending on the moisture status of the soil at the time of survey. Minor occurrences of gilgai microtopography (often associated with, but not exclusive to Vertosols) were observed. In the project area these soils occur on cleared Brigalow lands and are extensively cropped.

ABP SMU *5 (Nd) - Soils with little or no pedological development*

The site locations within ABP SMU 5 are Sites 1 (KP1), 16 (KP27.3), 26 (KP69), 31 (KP76.2), 51 (KP148), 85 (KP233.4), 97 (KP289), 104 (KP315.8), 105 (KP317.8), 114 (KP334.8), EL8 (EL13), SL2 (SL6), SL3 (SL7.1) and SL8 (SL18.1).

The soils of the project area identified by their minimal pedological development belong to the Rudosol and Tenosol soil orders of the ASC. Rudosols are described as young soils, for example forming on stratified alluvium, but these soils may vary considerably in texture and depth. The Tenosol soil order also includes a wide range of soil types and may be described as intermediate between Rudosols and other soil orders. These soils are generally used for grazing due to their low fertility and poor water retention however those occurrences on alluvium may be used for improved pastures or intensive cropping due to their fertility status.

7.3.1.5 Acid sulphate soils

Acid Sulphate Soil (ASS) is the common name given to soils and sediments containing iron sulphides, the most common being pyrite. When exposed to air due to drainage or disturbance, these soils produce sulphuric acid, often releasing toxic quantities of iron, aluminium and heavy metals.

The proposed pipeline route was reviewed in relation to the Guidelines for Sampling and Analysis of Lowland Acid Sulfate Soils in Queensland (Ahern et al. 1998). A review of topography traversed by the proposed pipeline route indicates that shallow valleys between KP427 and KP440 occur at less than 5m AHD.

Sections of the SGIC SDA are <5m AHD and intersect mapped Quaternary sediments. More detailed investigation for Potential ASS and ASS in this area of the pipeline route is therefore warranted prior

to construction. In addition, the preparation of an Acid Sulphate Soil Management Plan (if ASS is identified) will be required as part of a Soils Management Plan to comply with Queensland Acid Sulphate Soils Investigation Team (QASSIT) requirements.

7.3.1.6 Agriculture

Agricultural land is defined as land used for crop or animal production, but excluding intensive animal uses (i.e. feedlots and piggeries). GQAL is land which is capable of sustainable use for agriculture, with a reasonable level of inputs, and without causing degradation of land or other natural resources.

Existing mapping shows that the pipeline route traverses all GQAL classes, with the majority of land falling into GQAL Class C1 and GQAL Class C2. Areas of GQAL Class B and GQAL Class C3 lands were also identified. Each of these classes are considered to be Good Quality Agricultural Land.

The existing GQAL mapping for the proposed pipeline route and the updated GQAL assessment following the soil field survey is summarised in Table 7-10. GQAL located within the project area is presented in Map Series 4 in Appendix A.

Table 7-10 GQAL mapping for the pipeline route

GQAL Class	GQAL Mapping (km)	GQAL Mapping (%)	Revised Mapping (%)
GQAL Class A – Crop Land Land that is suitable for current and potential crops with limitations to production which range from none to moderate levels (correlates with Class 1 and 2 Land Capability Classes).	59.1	10	0%
GQAL Class B – Limited Crop Land Land that is marginal for current and potential crops due to severe limitations; and suitable for pastures. Engineering and/or agronomic improvements may be required before the land is considered suitable for cropping (correlates with Class 3 Land Capability Class).	4.4	0.7	21.5%
GQAL Class C – Pastoral Land Land that is only suitable for improved or native pastures due to limitations which preclude continuous cultivation for crop production; but some areas may tolerate a short period of ground disturbance for pasture establishment (correlates with Class 4 Land Capability Class).			
C1 - Land suitable for improved pastures. In some circumstances may be considered as good quality agricultural land.	240.4	40.8	23%
C2 - Land suitable for native pastures.	258.2	43.9	18.3%
C3 - Land suitable for limited grazing of native pastures.	25.7	4.4	5.0%
GQAL Class D – Non-agricultural Land. Non-agricultural land - land not suitable for agricultural uses due to extreme limitations. This may be undisturbed land with significant habitat, conservation and/or catchment values or land that may be unsuitable because of very steep slopes, shallow soils, rock outcrop or poor drainage. (Correlates with Class 5 Land Capability Class).	0.14	0.02	0%
No access			32.2%

7.3.1.7 Strategic Cropping Land

The Strategic Cropping Land (SCL) assessment for the proposed pipeline route was undertaken in accordance with the SCL Act (2011). In Queensland, eight criteria define the state's best cropping land (land suitable for a range of crops in most seasons) across five zones. The *Trigger Map* for SCL can either be accepted as SCL or verified through field validation and cropping history. Potential SCL is shown on Map Series 5 in Appendix A.

The assessment of SCL was undertaken for the project area in accordance with the SCL Criteria for the Western Cropping Zone, which covers KP0-KP403 of the proposed pipeline route. From KP403 south, the pipeline route traverses the Coastal Queensland Management Area, however no Trigger Mapped SCL is intersected in this Management Area.

A total of 15 site locations intersected Trigger Mapped SCL. Comparison of the field investigation and laboratory results with SCL assessment guidelines identified 12 of the 15 sites to be SCL, of which six sites were only considered marginal SCL. Further assessment of a cropping history is required to validate SCL. Table 7-11 shows a summary comparison of the 15 soil samples with the criteria and indicates whether the criteria were met along with the qualification as SCL. The letter P indicates a pass and F indicates a fail of the criteria.

Table 7-11 Summary assessment of SCL

Sample Location	Approximate KP	Assessment	Field Verified ASC Soil Order
Site DL3	DL3	P *	Vertosol
Site DL4	DL5.5	P ** marginal	Vertosol
Site DL5	DL7.5	P *	Vertosol
Site DL6	DL9	P *	Vertosol
Site DL7	DL12	P ** marginal	Vertosol
Site DL8	DL14	P *	Vertosol
Site DL11	DL19	P ** marginal	Vertosol
Site DL12	DL21.5	P *	Vertosol
Site 106	KP320	F	Kandosol
Site 107	KP322	P *	Vertosol
Site 108	KP324	P ** marginal	Vertosol
Site 109	KP325.5	F *	Chromosol
Site 110	KP327	F *	Chromosol
Site 111	KP329	P *	Dermosol
Site 123	NM0	P *	Dermosol

* Notes: * Based on field EC data where more detailed analyses and laboratory determined chloride content is not available.

** These sites were observation sites. Based on their similarity to soils of the same classification, these soils would pass the SCL criteria for soil water storage.

Trigger mapped SCL from KP2-KP25, DL22-DL32 and NM14-NM18 were not able to be assessed.

In summary:

- Soils in the vicinity of the Dysart Lateral (DL3-DL19) may be SCL
- Soils between KP320-KP329 intersect 3 different soil types. Constraint to SCL status is generally soil water storage
- Soils at the northern end of the NM (KPNM0) may be SCL.

7.3.1.8 Land contamination

The majority of the pipeline route traverses non-industrial land (native vegetation or agricultural land) which is generally not considered to have potential for land contamination. An exception to this would be points of settlement within agricultural land (e.g. farm buildings and sheds or current / former cattle dips), which pose the potential for contamination sources to be present.

A search of the Environmental Management Register (EMR) / Contaminated Land Register (CLR) was undertaken. Lots listed on EMR / CLR are presented in Table 7-12.

Table 7-12 Contaminated land search results

Property	Location	Identified feature from aerial photography	EMR/CLR status
Lot 1 on SP178466	550m east of KP69.	Rehabilitated mine area	Subdivision of an area listed on the EMR for petroleum / oil storage.
Lot 1 on SP178466	160m north east of KP72.	Dump / stockpile area	Subdivision of an area listed on EMR for petroleum / oil storage.

Potential contamination was observed over additional lots during the 2012 soils field survey. A search of the EMR/CLR was undertaken for these lots and the EMR/CLR results returned that these lots are not listed on the EMR/CLR register.

7.3.1.9 Land use

Land use is regulated under each relevant local government planning scheme and the relevant development scheme for the SGIC SDA and the GSDA. Regional plans also influence land use.

Under each planning scheme and development scheme, land is divided into land use classes or zoning which identify the preferred land use for a particular area / lot (e.g. rural, commercial, community purpose). The majority of land traversed by the proposed pipeline route is included in the rural land use class (87.46%). The land use classes traversed by the proposed pipeline route are provided in Table 7-13.

Table 7-13 Land uses traversed by the proposed pipeline route (%)

Land use	Percentage of land traversed by the proposed pipeline route
Rural	87.46
Unlisted	9.46
Alton Downs Zone - Precinct 2	1.68
Community use	0.05
Gladstone State Development Area	1.26
Major Infrastructure	0.01
Open Space and Recreation	0.08
TOTAL	100

Development on land within the rural land use class should support rural activities such as grazing, agriculture and horticulture. The rural land use class aims to protect GQAL and areas of natural and landscape significance. Residential dwellings are consistent land uses within this land use class.

Land designated for community purposes generally supports development such as a community hall, open space or public facility.

For land included in the GSDA, the applicable land use class as per the development scheme for the GSDA is the 'Materials Transportation and Services Corridor'.

7.3.1.10 Land tenure

Existing land tenure is illustrated in Map Series 6 in Appendix A.

Land tenure traversed by the pipeline route has been identified through use of the Digital Cadastral Data Base Tenure Codes obtained from EHP (July, 2011). In Queensland, land tenure includes two broad tenure types including freehold and non-freehold. In general terms, freehold land refers to land purchased from the State and affords the titleholder the highest level of independence in terms of land use and possession. The land tenure type and number of lots traversed by the project is summarised in Table 7-14.

Table 7-14 Tenure descriptions

Type of tenure	Number of lots
Mainline	
Freehold (FH)	231
Leasehold (LL)	18
Reserve (RE)	3
Sub-total number of lots	252
Laterals	
FH	12

Type of tenure	Number of lots
LL	4
RE	0
Sub-total	16
TOTAL Mainline and Laterals	268

7.3.1.11 Residential dwellings and community buildings

A total of 137 residential dwellings have been identified within a 1km buffer either side of the proposed pipeline route (refer to Map Series 7 in Appendix A). The following facilities have also been identified in proximity to the proposed pipeline route:

- One police station (Mt Larcom)
- One library (Mt Larcom)
- Mount Larcom Ambulance Station
- Mount Larcom State School.

Sensitive receptors are shown on Map Series 7 in Appendix A.

7.3.1.12 Mining tenements

Mining tenements constrain land within the project area from KP0 to about KP151 and associated laterals. The Eastern Creek colliery, Newlands colliery and Goonyella Riverside colliery are the main coal mines within the Project area occupying these tenements. Tenements within the project area are described in Section 3.6 and shown on Map Series 1 in Appendix A.

7.3.1.13 Quarries

The pipeline route passes in the vicinity of, but does not transect, two hard rock quarries located near the Peabody Burton coal mine. The pipeline route also transects Thommo's Quarry haul road owned by Crushing Industries Australia (CIA). Liaison with the operators of these quarries is being undertaken to determine any potential impacts associated with the operations or future expansion of the quarries.

7.3.1.14 Transport, energy and water infrastructure

The pipeline route traverses nine major formed roads at eleven points, including the Bruce, Peak Downs and Capricorn highways, eleven stock route crossing points and nine railway lines. Major road crossings and railway crossings are detailed in Table 7-15 and shown on Map Series 7 in Appendix A.

The proposed pipeline route also transects 11 water/gas pipelines and 9 transmission lines and lies within 25km of a number of airports and airstrips.

Table 7-15 Major formed roads and railways traversed by pipeline route

Road/railway name	Local Government Area	Approximate KP
Road name		
Suttor Developmental Road & Stock Route Crossing	Isaac Regional Council	KP35
Peak Downs Highway Crossing	Isaac Regional Council	KP94.4
Fitzroy Development Road Crossing	Isaac Regional Council	KP163.7
May Downs Road & Stock Route Crossing	Isaac Regional Council	KP227
Capricorn Highway Crossing	Rockhampton Regional Council	NM20.7
Bruce Highway Crossing	Rockhampton Regional Council	NM23
Gladstone Mount Larcom Road Crossing	Rockhampton Regional Council	KP469.9
Laterals		
Peak Downs Highway Crossing	Isaac Regional Council	EL47.6
Dingo Mt Flora Road Crossing	Isaac Regional Council	DL20.8, DL22.46, DL22.54
Railway name		
Goonyella Branch Railway Crossing	Isaac Regional Council	KP89.3
Norwich Park Branch Railway Crossing	Isaac Regional Council	KP100.3
C.Q. Salts Siding Railway	Rockhampton Regional Council	KP439.5
Proposed Xstrata BICET Railway	Rockhampton Regional Council	KP444.1
Proposed Xstrata BICET Railway	Gladstone Regional Council	KP444.7
North Coast Railway Crossing	Gladstone Regional Council	KP469.9
East End Mine Branch Railway Crossing	Gladstone Regional Council	KP473.6
North Coast Railway Crossing	Rockhampton Regional Council	NM23
Goonyella Branch Railway Crossing	Isaac Regional Council	EL47.0

7.3.2 Potential adverse or beneficial impacts of the project activities on the identified environmental values

7.3.2.1 Land use

The main current land uses traversed by the proposed pipeline route are rural. Other current land uses within a 1km buffer of the proposed pipeline route include community and residential uses. Potential impacts of the project on current land uses are provided in Table 7-16.

Table 7-16 Existing land use – potential impacts

Existing land use	Potential impacts
Rural	Current rural uses include grazing, cropping and agriculture. It is expected that the project will have limited long term impacts on rural activities as land is intended to be returned to its original condition post construction. If not managed appropriately, installation of the pipeline and ancillary infrastructure has the potential to degrade GQAL and other agricultural land through clearing, loss of topsoil, topsoil / subsoil mixing, topsoil

Existing land use	Potential impacts
	compaction and erosion.
Community	The proposed pipeline route does not directly traverse any community uses within the project area. Community uses within close proximity to the proposed pipeline route include a library, school, ambulance station and police station. The pipeline lies within the declared SGIC government corridor at these locations. During construction, community uses may be temporarily impacted by project generated traffic, dust, noise and visual amenity. No long term adverse impacts are anticipated during pipeline operations. Land designated for open space and recreation will be able to continue over the operational easement.
Residential	137 residential dwellings are located within 1km of the proposed pipeline route. Impacts on residential dwellings during construction (e.g. transport, air, noise, and visual amenity), will be temporary, as a trenching rate of two to three kilometres per day is anticipated. No existing residential dwellings will be impacted by the project during operation as the proposed pipeline route does not directly traverse any existing houses within the project area.

The only restrictions on future land uses from the project are that no deep-rooted vegetation will be allowed to grow over the pipeline easement and no dams, structures or buildings will be able to be built over the operational easement, in accordance with standard easement conditions.

Land Disturbance

Temporary land disturbance impacts will occur during construction. Land disturbance will include clearing and grading to provide up to a 40m wide construction ROW. The ROW will be cleared of vegetation and levelled to the required gradient. Topsoil will be removed (typically to a depth of 100 to 300mm) over the trench line and will be stockpiled separately from subsoil as outlined in Section 3.14.10. The rate of excavation of the trench will be dependent on terrain and weather conditions, but is anticipated to be at a rate to ensure a pipe lay of approximately two kilometres per day. The depth of cover (typically 750mm), and therefore the trench depth (typically 1,800mm), is dependent on the current or anticipated land use.

Potential impacts from the project on current land use within the ROW include soil compaction, reduced moisture retention, reduced infiltration, increased erosion and loss of topsoil.

Clean-up, restoration and rehabilitation measures will be applied to all areas disturbed during construction, including the ROW and access tracks, as soon as practical after pipe laying and backfill (refer to Section 8).

Monitoring activities include post-construction audits to be conducted annually for two years to evaluate revegetation, erosion control, weed control, watercourse integrity and success of bed and bank reprofiling. Areas of high erodibility will be closely monitored.

Excavation of the trench for the proposed pipeline route during construction may expose fossils, particularly where the proposed pipeline route crosses low ridges. However, it is unlikely that new fossils of fauna or species will be revealed as the fossil record of the Bowen Basin are well-known from 1950s and 1960s regional mapping and associated paleontological studies. No mitigation measures for fossil occurrences are considered necessary during pipeline construction.

7.3.2.2 Soils

Erosion and stability

Based on the soil types identified along the pipeline route, the following soil characteristics may increase the erosion hazard during construction:

- Sodicity (increases the likelihood of slaking or dispersion in soils)
- Low organic matter (fragile soils lacking aggregation)
- Surface and subsoil hardsetting (limits infiltration and root penetration)
- Clay content (increased likelihood of shearing and compaction).

The soils of the project area most susceptible to erosion are:

- Non-saline sodic materials - sodic soil materials (materials with high ESP) are prone to dispersion which may lead to other forms of physical degradation influencing soil structure and air and water movement through the soil. Representative soils of the project area with an ESP >6 that are considered dispersive include Sites 38 (KP95.2), 83 (KP231), 103 (KP311.7) and EL5 (EL28). These sodic soils that are non-saline (ECw <0.4 dS/m) are more likely to disperse and are susceptible to erosion as soon as they are disturbed. In some instances these soil materials may occur close to the soil surface (e.g. Site EL5 (EL28)) making it particularly important to accurately identify topsoil stripping depths to avoid the mixing of sodic and non sodic soil materials.
- Saline and sodic materials - sodic materials that are saline are less likely to disperse while they remain saline, however leaching can remove the salt and make the soil dispersive and prone to tunnel and gully formation.
- Non-sodic soil materials of low cohesion (fine-textured) - soil materials dominated by silt and fine sand components do not disperse as a result of high ESP but may act like dispersive soils. Unlike clay particles, the silt and fine sand components of soil materials carry few electric charges resulting in weak, inter-particle bonds and little cohesion. These soils subsequently have relatively poor structure, further degraded by soil profile disturbance.

In addition to soil dispersion associated with sodic soils, sections of the project area are likely to be susceptible to hillslope erosion. Sheet and rill erosion rates on hillslopes are largely a function of soil type, rainfall intensity, land cover and slope. Potential impacts from the project on current land use are considered as follows:

- Loss of topsoils and organic matter (affecting soil aggregation and fertility)
- Loss of soil structure through stripping and stockpiling operations
- Reduced moisture retention due to topsoil and subsoil compaction
- Reduced infiltration due to topsoil and subsoil compaction
- Dispersion of topsoils and subsoils leading to hardsetting
- Increased soil strength (through compaction of topsoils and subsoils).

Good Quality Agricultural Land

Impacts on GQAL during pipeline construction will be temporary. The temporary disturbance of primarily grazing land will occur during construction, but will not result in the permanent removal of land from agricultural use, provided the saline and sodic soil materials and final landforms are managed appropriately. Pipeline operations will not inhibit the continuity of pre-existing agricultural practices. Cropping land will require additional management measures beyond cropping lands to reinstate the pre-existing land use.

Strategic Cropping Land

Much of the area identified as potential SCL on the EHP Trigger Mapping met the relevant SCL criteria (excluding cropping history assessment) and is potential SCL. Outside of the SCL areas, the soils are limited by saline and/or sodic horizons, plant available water capacity and/or unimproved nutrient levels and are best suited to the grazing of native pastures or bushland. Cropping land will require additional management measures beyond cropping lands to reinstate the pre-existing land use.

7.3.2.3 Visual amenity

Construction

A number of laydown areas for pipe and equipment storage will be provided in the ROW. These laydown areas will be fenced and will be located away from any existing settlements.

Activities during construction, such as clear and grade that may impact on the existing visual amenity of the project area are described in Section 3.14.7. The main visual impact to the existing environment from the project during construction will be the visibility of people, vehicles, plant and equipment, vehicle movements and stockpiles. Activities will be undertaken during the day and will have a limited duration at any one point in time.

Operation

Only above ground infrastructure will be visible for the life of the project and will be limited in scale. Such infrastructure will include small fenced areas containing permanent above ground facilities including main line valves and scraper stations. Cathodic protection system posts and pipeline information markers will also be located along the pipeline alignment. The pipeline terminates at the proposed GGH.

7.3.3 Management strategies

7.3.3.1 Topography, geology and geomorphology

Ground truthing and testing during detailed geotechnical investigations will be used to determine the geological risk of locating the proposed pipeline route in areas of faults, land slips, earthquakes and potential instability. This will allow a better determination of the risk and the selection of appropriate management or mitigation strategies.

As part of construction, the pipeline trench will be backfilled and restored to achieve a stable landform. During operation, visual inspections will be conducted to determine if any areas have suffered from erosion or subsidence. Any areas detected will be repaired to match existing ground contours.

7.3.3.2 Soils

Erosion and Stability

An Erosion and Sediment Control Plan will be prepared and implemented to avoid or minimise erosion and/or transfer of sediment that may occur along the construction ROW. Erosion and sedimentation control measures would be implemented in areas of high slope or where erosion due to high rainfall events may eventuate.

The Erosion and Sediment Control Plan will be prepared with reference to the guidelines *Best Practice Erosion and Sediment Control (IECA 2008)* and will include the following details:

- Site boundaries
- Construction access points
- Proposed construction activities and limits of disturbance
- Retained vegetation
- Soils information
- Environmental features, e.g.watercourses
- Existing topography
- General layout of proposed works
- Location of all drainage, erosion and sediment control measures
- Design and construction details for all drainage and sediment control devices
- Construction specifications for adopted erosion and sediment control measures
- Site revegetation requirements
- Site monitoring and maintenance program.

Erosion control measures described in Table 7-17 should be incorporated into an Erosion and Sediment Control Plan to be developed prior to construction and implemented throughout the life of the project.

Table 7-17 Recommended erosion control measures for project activities

Area	Indicative Control Measures
Cleared areas	Restrict clearing to areas essential for the works Windrow vegetation debris alongside the ROW Minimise the length of time soils are exposed Divert run-off from undisturbed areas away from the works in areas of high slope
Subsoil stockpiles	Avoid placement of dispersive soil materials on the surface Stockpile dispersive soils separately

Area	Indicative Control Measures
	Use non-dispersive soil or cover material to stabilise and protect slopes Progressive backfilling during operations Construct using dozers to reduce minimise the degradation of soil structure
Topsoil stockpiles	Practise return of topsoil where practicable Use non-dispersive soil or cover material to stabilise and protect slopes Construct using dozers rather than scrapers (where possible) to minimise structural degradation
Infrastructure	Confine traffic to maintained tracks and roads Rehabilitate disturbed areas around construction sites promptly
Dams, Banks and Creek Crossings	Install sediment traps, silt fences or hay bales where necessary to control sediment loss Rehabilitate disturbed areas around construction sites as soon as practicable

Landowners will be consulted on erosion and other soil management issues specific to their properties to facilitate reinstatement and prevent ongoing management issues. A copy of the Erosion and Sediment Control Plan will be made available to any potentially affected landholder.

Topsoil Management

A Soil Management Plan will be prepared which will address the management of soil materials exposed during construction activities.

The topsoils of the project area are defined as the uppermost soil layers (A horizons) of the soil profiles. These A horizons contain more organic matter, biota and nutrients than the soil layers below (subsoil). In addition to seed viability and fertility, assessing the depth of topsoil along the Revision SR route is important for the assessment of the stability of the surface soil materials post pipeline installation and the prompt re-establishment of land surface cover (vegetation).

Topsoil from the project area will be stripped and stockpiled separately for placement during the rehabilitation of the ROW. The topsoil stockpiles will need to be managed to minimise erosion and loss of valuable topsoil for rehabilitation, and also to ensure the topsoil is maintained in a condition which supports the most rapid stabilisation of the site during rehabilitation. Typically:

- Topsoils should be stripped and stockpiled separate to subsoil
- Where possible, topsoil replacement as soon as practicable following trench backfill is recommended.

In land areas where cultivation or cropping is practised, topsoil materials should be placed to a depth of at least 250mm over competent subsoil materials. Where topsoil is placed over non-competent subsoil materials, topsoil depth must be deep enough to avoid contamination by the non-competent subsoils if cultivation or deep ripping is practised. In land areas that are grazed topsoils may be placed to a shallower depth than 250mm providing they are placed over stable subsoil materials (competent subsoil).

Subsoil Management

Soil sodicity

The behaviour of sodic soil materials (slaking and dispersion) can lead to surface sealing, hardsetting, low permeability and drainage, and tunnel and gully erosion. The likelihood of these processes occurring are greater for soil materials with a high clay content. However, soil materials with clay contents as low as 10% may still slake and/or disperse when disturbed. Where sodic materials occur close to the ground surface it is important to accurately identify topsoil stripping depths to avoid the mixing of non-sodic topsoils with sodic subsoils.

The application of soil conditioners (type and application rates will be confirmed by further soil analysis) may stabilise potentially dispersive soils. Depending on the type of conditioner, other beneficial nutrients may be released in the newly constructed soil. In addition, the incorporation of organic matter in combination with soil conditioners will further improve the development of soil structure.

Saline soil materials

Capillary rise of salts into the topsoil layers can occur where saline materials are being excavated and placed on or near the reconstructed land surface. Elevated salinity in the topsoil layers can prevent seed germination, retard plant growth and reduce ecosystem diversity. Capillary rise of salts can be minimised by:

- Placing topsoil to depths of greater than 500mm where appropriate volumes of topsoil materials are available.
- Using light textured topsoil materials (sands to sandy loams) with high hydraulic conductivities to reduce capillary rise.

It is important to note that the presence of saline conditions may suppress the dispersion of clays so the method of promoting the leaching of salts should not be implemented on sodic subsoil materials. For example, tunnel erosion often starts from points in the landscape where ponded water results in the leaching of salts, triggering clay dispersion.

7.3.3.3 Land contamination

Should land contamination be encountered as a result of the construction or operation of the project, a specific Plan will be developed which will include the procedures for the notification, mitigation, investigation, remediation and validation of the contaminated land.

Any diesel or oil spills that may occur as a result of the project during construction activities will be contained within the construction location and managed in accordance with the Emergency Response Plan to prevent any impact on the surrounding environment. To minimise risks of environmental harm from the disposal of hydrotest water, all hydrotest activities, including discharge, will be conducted in accordance with a Hydrostatic Test Water Management Plan (refer to Section 7.8).

Pipeline operations are relatively benign, and given the absence of above ground infrastructure, potential contamination will be limited to small quantities of hazardous substances, such as fuels, lubricants or transmission fluids.

7.3.3.4 Acid Sulfate Soils

Should excavated materials contain, or potentially contain, acid sulfate, these will be treated in accordance with an Acid Sulfate Soil Management Plan developed as part of a Soils Management Plan, which will meet the requirements of *State Planning Policy 2/02 Guideline Acid Sulfate Soils*.

7.3.3.5 Land use

The relevant local government stock route officer and landholders will be consulted to minimise any potential temporary disturbance to stock mobilisation. Activities near stock routes will be managed in accordance with the *Land Protection (Pest and Stock Route Management) Act 2002 (Qld).* Fences, gates and access tracks along and across the ROW will be established in consultation with landholders.

Current land uses may be temporarily impacted by the construction of the project in terms of impacts from transport, air, noise and visual amenity (refer to Section 7.1 and Section 7.5). Impacts on current land uses once the pipeline is operational will be minimal. The majority of the proposed pipeline route traverses rural land (principally cattle grazing of native pastures and limited areas of cash and forage cropping land in the vicinity of DL09-DL27), with the land use continuing over the ROW following completion of construction and rehabilitation activities (i.e. soils will be returned to its original condition and crops will be able to grow over the top of the pipeline). Mitigation measures include:

- Compensate landholders for any temporary disruption to agricultural production during the construction of the pipeline
- Carrying out work in accordance with the project EM Plan to avoid or minimise impacts
- Returning the ROW to the former land use following completion of construction and rehabilitation.

7.3.3.6 Infrastructure

Construction

A Traffic Management Plan (TMP) will be developed prior to commencing construction activities to minimise impacts on the road and rail infrastructure. The TMP will include arrangements for any short-term lane closures created by construction activities at road crossings. Consultation with relevant regulatory authorities, including local councils and DTMR will be undertaken, well in advance of any planned activities.

Arrangements will be also made with landowners who require corridor crossings for farming, or other day-to-day activities. There will be an ongoing process of community consultation and collaboration.

An on-site inventory of road conditions along haulage routes and key road links to access the ROW will be carried out in consultation with relevant authorities, prior to construction commencing.

Operation

During pipeline operation, an operations environmental management plan will be implemented to manage risks to environmental values associated with the pipeline easement, maintenance and routine inspections.

7.3.3.7 Management Strategy Tables

Strategies to manage potential impacts on the land environment are summarised in Table 7-18 and Table 7-19.

Table 7-18 Land management strategies: construction

Element / Issue	Land degradation - loss of topsoil material, accelerated erosion of soils, reduction in soil quality.

Performance Objectives	Implementation / Management Strategies	Performance Criteria	Monitoring	Corrective Action
To minimise the potential for land and/or water contamination.	▪ Any diesel or oil spills that may occur during construction activities will be contained and managed in accordance with the Emergency Response Plan. (C005). ▪ Chemical storage will comply with Australian Standards and Material Safety Data Sheets (MSDS) requirements and Dangerous Goods Storage and Handling Guidelines 2010. (C010). ▪ A Safety Management Plan - Construction will be prepared which will include measures to manage exposure of construction workers to hazardous compounds. (C011). ▪ A Contaminated Land Management Procedure will be prepared prior to the commencement of construction. (C012).	▪ Occurrence of soil or water contamination during construction and operation of the pipeline.	▪ Inspections of storage facilities and work practices involving handling flammable / combustible substances or other dangerous substances in accordance with the inspection and monitoring schedule.	▪ Review strategies for managing flammable / combustible substances or other dangerous substances to ensure safe procedures are effective.
To control and minimise soil erosion and sedimentation of waterways during construction.	▪ Install and maintain erosion and sediment control measures (including sediment fences, berms and diversion drains) to minimise erosion of disturbed areas and prevent the contamination of waters (EM008). ▪ Erosion and sediment control measures will be installed, maintained and monitored in accordance with the Erosion & Sediment Control Plan (C008).	▪ Effectiveness of erosion and sedimentation controls in preventing environmental harm associated with construction or operational activities.	▪ Inspections of protection measures e.g. silt fences, erosion and sediment control devices in accordance with the inspection and monitoring schedule. These will also be inspected following any major rainfall event. ▪ The Project will continue monitoring of ROW condition for two years post commissioning. An inspection schedule will be undertaken throughout the Project's operational (C009).	▪ Implement maintenance measures to remediate any failures of protection measures. ▪ Place additional erosion control structures such as diversion banks / drains (whoa-boys) at key locations if additional erosion is detected along the pipeline.
To prevent sediment transport	▪ Stockpile spoil outside watercourses,	▪ Change in turbidity levels	▪ Inspections on the ROW to assess	▪ Implement

Performance Objectives	Implementation / Management Strategies	Performance Criteria	Monitoring	Corrective Action
to adjacent watercourses.	and /or behind containment structures so as to prevent siltation of any land or surface water or blockage of any existing drainage channels (EM009). ▪ Install additional control measures for construction works on slopes >10% (EM010). ▪ Trench breaks will be installed prior to backfilling of the trench to control water movement along the backfilled trench. The location of trench breaks will be identified in the Erosion and Sediment Control Plan. (C006).	between upstream and downstream monitoring results during construction.	the effectiveness of the erosion and sediment control protection measures.	remedial measures of any failures of protection measures.
To preserve topsoil quality for future land use.	▪ Strip, salvage and stockpile topsoil near the worksite separately to subsoils. Stockpile separately to protect topsoil, root and seed stock and protect from erosion. Ensure: - topsoil stockpiles are stabilised; - minimal loss of topsoil from erosion; - seeding of long term topsoil stockpiles to prevent erosion; - constructing a diversion drain around the topsoil stockpile area; - implementing erosion control measures around the topsoil stockpile area. (EM011).	▪ Effectiveness of the Soils Management Plan	▪ Inspections and monitoring of clear and grade activities, including topsoil stockpile management techniques.	▪ In the event of soil mixing or burial of topsoil, implement measures to prevent a recurrence.
To preserve topsoil quality for future land use.	▪ No vehicular movements over stockpiled soil. Topsoil will not be used as padding or backfill. (EM012).	▪ Maintenance of land production capacity.	▪ Inspection of topsoil stockpile management techniques.	▪ Implement maintenance measures to remediate any failures of protection measures.
To minimise land degradation	▪ Compensation is offered to the landowner for any temporary disruption to agricultural production during construction of the project. (C002). ▪ Construction of the project will be progressed sequentially, with clean-up,	▪ Occurrence of land degradation.	▪ Inspections of rehabilitated areas and photomonitoring in accordance with the Rehabilitation Program.	▪ Implement measures to remediate land degradation.

Performance Objectives	Implementation / Management Strategies	Performance Criteria	Monitoring	Corrective Action
	restoration and rehabilitation initiated after backfilling is complete, while trenching and the other activities are advanced. (C003).			
To prevent environmental harm in areas containing ASS.	▪ Prepare and implement a site specific ASS Management Plan for all areas of ASS/PASS disturbance, which include corrective actions for incident management and remediation. This will include management strategies for: ▪ the use of suitably designed treatment pads ▪ leachate collection systems ▪ bunding (EM013).	▪ Implementation of ASS/PASS treatment program.	▪ Monitor for presence of ASS as part of site specific soil testing. ▪ Monitor receiving waters predicted to be influenced by drainage from a worksite or construction works involving ASS.	▪ If ASS is encountered during construction, works will cease and additional testing for ASS will be undertaken.
To manage environmental and public health impacts and risks from potentially contaminated land intercepted during construction works.	▪ In accordance with the 'Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland, 1998': ▪ identify the likely forms of contamination that could occur, ▪ Include procedures for identifying, investigating and managing unforeseen contamination, ▪ Produce a list of properties on the EMR in accordance with the EP Act. ▪ Develop measures for the management, remediation and disposal of contaminated soil and/or spoil generated from properties listed on the EMR/CLR. ▪ Conduct post-construction management and/or monitoring requirements. ▪ Obtain disposal permits obtained from EHP for the removal of contaminated soil in accordance with the EP Act. (EM015).	▪ Management of potentially contaminated land to prevent environmental harm.	▪ Monitor for presence of contaminated land as part of site specific soil testing.	▪ If contaminated land is encountered during construction, testing for contaminated land will be undertaken.
To safely manage the transportation of construction equipment and materials, including pipe.	▪ A Traffic Management Plan (TMP) will be developed to address key safety and logistical issues that may arise due to: - Project vehicles crossing State and Local controlled roads; - Safety risks brought about by increased heavy vehicle traffic;	▪ Effectiveness of the Transport Management Plan.	▪ Monitoring of incidents or complaints received in relation to construction traffic.	▪ In the event of a traffic incident or complaint, review traffic management procedures to prevent a recurrence.

Performance Objectives	Implementation / Management Strategies	Performance Criteria	Monitoring	Corrective Action
	- Lane closures; and - The use of single-lane local access roads. ▪ The Transport Management Plan will be circulated to State and Local Government stakeholders (such as TMR and QPS) for comment. (C013).			
To minimise disturbance or damage to the existing transport infrastructure and remediate where disturbance cannot be avoided.	▪ A road crossing plan will be developed prior to undertaking road crossings. The plan will be circulated amongst State and Local government stakeholders prior to finalisation (C014). ▪ Railways will be crossed using directional drilling or thrust boring techniques (C015).	▪ Disturbance to transport infrastructure.	▪ Conduct inspections to monitor the condition of roads and tracks.	▪ In the event of identifying any deterioration, raise an incident report. Corrective actions will be undertaken in accordance with the outcomes of incident investigations or advice given by the relevant regulatory authority.
To minimise damage to existing roads.	▪ The Project will undertake a road condition report prior to the finalisation of the TMP. (C016).	▪ Deterioration of transport infrastructure.	▪ Conduct inspections to monitor the condition along existing roads.	▪ In the event of identifying any road deterioration, raise an incident report.

Auditing	▪ Audits to be conducted in accordance with Section 4 of this EM Plan. ▪ Prepare construction audits of watercourse crossings.
Reporting	▪ Maintain records of erosion and sediment control protection performance and results of routine inspections. ▪ Maintain records of complaints and responses from landholders and others in Complaints Register. Address complaints and close out register (refer to Section 4 of this EM Plan). ▪ Maintain records of any non-compliances, incidents or accidents. Address and close out in accordance with Section 4 of this EM Plan.
Responsible Person(s)	▪ Construction Superintendent. ▪ Environmental Officer.
Associated Documentation	▪ International Erosion Control Association – Best Practice Erosion and Sediment Control. Australasia, 2008. ▪ *Land Protection (Pest and Stock Route Management) Act 2002* (Qld). ▪ National Environment Protection (Assessment of Site Contamination) Measure 1999. ▪ Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland 1998. ▪ Erosion and Sediment Control Plan. ▪ Corrective Action Procedure in the HSEMS. ▪ Environmental Reporting as outlined in the HSEMS.

Table 7-19 Land management strategies: operation

Element / Issue	Land degradation - loss of topsoil material, accelerated erosion of soils, reduction in soil quality.

Performance Objectives	Management Strategies	Performance Criteria	Monitoring	Corrective Action
Minimise soil erosion and prevent sediment transport to adjacent watercourses.	▪ Maintain erosion and sediment controls to ensure a stabilised easement. Replace erosion control measures following any pipeline maintenance or dig-ups (EM014).	▪ Effectiveness of erosion and sediment controls. ▪ Stability of the rehabilitated landform.	▪ Visual inspections along the length of the ROW to ensure no visible evidence of: ▪ erosion, with respect to adjacent land; ▪ changes to ground level, drainage patterns, etc. which may indicate soil erosion and sedimentation; ▪ collapse/subsidence of banks at nearby watercourse crossings; ▪ subsidence or exposure of pipeline; ▪ damage or failure of erosion or sediment control devices.	▪ Initiate corrective or remedial actions and prevent a recurrence of the incident (e.g. repair or reinstate erosion and sediment control measures).
Minimise modification to drainage patterns.	▪ Erosion and sediment control measures will be installed, maintained and monitored in accordance with the Erosion & Sediment Control Plan (C008).	▪ Effectiveness of erosion and sediment controls.	▪ Visual inspections along the length of the pipeline easement to ensure no visible evidence of erosion following major rainfall events.	▪ Initiate corrective or remedial actions and prevent a recurrence of the incident (e.g. repair or reinstate erosion and sediment control measures).

Auditing	▪ Post-construction audit evaluating revegetation, erosion control, weed control and watercourse bank stability annually for two years.
Reporting	▪ Easement inspection check sheets to record the effectiveness of erosion and sediment control protection measures. ▪ Non-compliance and incident reporting undertaken in accordance with Section 4 of this EMP. ▪ Records maintained of all actions and controls. ▪ Annual Return.
Responsible person (s)	▪ Environmental Officer. ▪ Operations Manager.
Associated Documentation	▪ As required for operations activities e.g. Best Practice Erosion and Sediment Control. IECA, 2008.

7.4 Flora and Fauna

This Section describes:

- Terrestrial flora - vegetation communities, regional ecosystems (REs), essential habitat, bioregional corridors, Endangered, Vulnerable and Near Threatened (EVNT) species, weed species and protected area estates
- Terrestrial fauna - fauna present, including protected animal breeding places, and EVNT species
- Aquatic ecology – catchment and habitat summary, and aquatic flora and fauna EVNT species.

7.4.1 Description of the existing environment and environmental values

7.4.1.1 Terrestrial Flora

Desktop investigations and field surveys were undertaken to describe the flora communities present along the pipeline route (Ecosure 2012a). During these surveys, 504 flora sites were ground-truthed, which included 466 quaternary and 38 tertiary level assessments. Quaternary assessments recorded dominant canopy species and were used to ground truth and record RE boundaries. Tertiary assessments comprised more detailed and intensive investigations.

Based on desktop and field assessments of terrestrial flora values within the project area, the pipeline route is characterised by:

- Non-remnant vegetation (442.9km or 75.4% of the proposed pipeline route), most of which is cropping and grazing land
- High value regrowth (30.1km or 5.1%)
- Remnant vegetation (114.5km or 19.5%) comprising of Endangered REs (0.43km or 0.07 % of the route), Of Concern REs (26.3km or 4.5% of the route) and No Concern at Present REs (87.8km or 14.9 % of the route).

Vegetation Communities and Regional Ecosystems

The pipeline route passes through the Brigalow Belt Bioregion (Bioregion 11). Queensland Herbarium RE mapping recognises 78 REs within the 5km buffer area. Field surveys and examination of satellite imagery identified 29 REs within the ROW (Ecosure 2012a) (refer to Map Series 8 in Appendix A).

The pipeline route is characterised by predominantly non-remnant land (442.9km or 75.4% of the alignment), most of which is cropping and grazing land. Remnant vegetation occurs along 114.5km (19.5%) of the pipeline route and High Value Regrowth (HVR) along 30.1km (5.1%). Remnant vegetation is comprised of 0.43km of Endangered REs (0.07%), 26.3km of Of Concern REs (4.5%) and 87.8km of No Concern at Present REs (14.9%). Based on Queensland Herbarium RE mapping, nine REs with an Endangered biodiversity status, 12 REs with an Of Concern biodiversity status and 16 REs with a No Concern at Present biodiversity status are mapped as occurring within the ROW. Following

ground-truthing of REs by Ecosure (2012a), the ROW was found to transect three REs with an Endangered biodiversity status, ten REs with an Of Concern biodiversity status and 16 REs with a No Concern at Present biodiversity status.

The Queensland vegetation and biodiversity offset policies define two further categories of RE with conservation significance, critically limited REs and threshold REs. Critically limited and threshold REs are listed in the Queensland vegetation and biodiversity offset policies. No critically limited REs are mapped by EHP within the study area and field surveys did not record any of these REs. Likewise, no threshold REs are mapped by EHP within the study area. One Threshold RE is mapped within the 5km buffer (RE 11.5.15 - semi-evergreen vine thicket on Cainozoic sand plains-remnant), however no evidence of this RE was detected during field surveys.

The ROW contains 120.6ha of HVR vegetation, 24.1 and 43.9ha of which are classed as Endangered and Of Concern, respectively. The remaining 52.6ha of HVR is classed as Least Concern.

EPBC Listed Communities

Five Endangered Ecological Communities (EECs) listed under the EPBC Act were identified from the EPBC Protected Matters Search as having the potential to occur within, or adjacent to the pipeline route. Table 7-20 describes EECs, REs included in the EEC and areas of those REs within the ROW and 5km buffer. The ROW contains 45.6ha of remnant REs that form components of EECs (approximately 0.15% of the area within the 5km buffer).

Field surveys recorded 7.4ha of natural grasslands of the Queensland Central Highlands and the northern Fitzroy Basin (RE 11.8.11), 1.1ha of Brigalow dominant EEC (RE 11.4.8 and 11.9.1) and 0.6ha of semi-evergreen vine thickets of the Brigalow Belt (RE 11.11.18) within the ROW. Also, the ROW contains a maximum of 36.5ha of remnant RE 11.3.2 (Poplar Box woodland on alluvial soils), which may contain areas of Weeping Myall (*Acacia pendula*) woodland EEC.

In March 2011, DSEWPaC listed the Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions as an EEC. According to the listing advice, this community corresponds to RE 11.3.3 only where it occurs in the Brigalow Belt South Bioregion. Since all occurrences of RE 11.3.3 in the ROW (KP109.78 to 109.82, 166.84 to 167.69, 237.76 to 237.98 and 283.6 to 283.71) were recorded in the Brigalow Belt North Bioregion, these areas are not considered to form part of the listed EEC and have therefore been omitted from Table 7-20.

Table 7-20 EPBC Listed EECs and Equivalent REs within the ROW (Ecosure 2012a)

EPBC Community Description	EPBC Act Status*	Equivalent RE	Area in ROW (ha)	Area in 5km Buffer (ha)	% in Buffer^
Brigalow (*Acacia harpophylla* dominant and co-dominant)	E	11.3.1	0	4,044.6	0
		11.4.8	0.97	851.6	0.11
		11.4.9	0	2,069.7	0
		11.5.16	0	11.4	0
		11.9.1	0.11	537.8	0.02
		11.9.5	0	1,555.7	0
		11.11.14	0	602.1	0
		11.12.21	0	28.8	0
Natural grasslands of the QLD Central Highlands and the northern Fitzroy Basin	E	11.3.21	0	770.5	0
		11.4.4	0	84.2	0
		11.8.11	7.36	5397.1	0.14
		11.9.3	0	298.1	0
Semi-evergreen vine thickets of the Brigalow Belt	E	11.3.11	0	181.8	0
		11.4.1	0	6.7	0
		11.5.15	0	106.5	0
		11.8.13	0	571.9	0
		11.11.18	0.63	349.6	0.18
Weeping Myall Woodlands (only small component of RE)	E (where *A. pendula* dominant)	11.3.2	36.51[#]	12617.6	0.29
Total			45.58	30,085.7	0.15

Source: Ecosure 2012a.
* Status under EPBC Act: E = Endangered.
^ Percentage of area in 5km buffer that lies within the ROW.
[#] This area is unlikely to contain the weeping myall EEC as field surveys did not detect any weeping myall in RE 11.3.2.

Bioregional Corridors

EHP has conducted comprehensive biodiversity planning assessments (BPAs) for bioregions within Queensland using the biodiversity assessment and mapping methodology (EPA, 2002). The ROW contains 155.9km of bioregional corridors mapped by EHP, including 118.7km of corridor of state significance and 37.2km of corridor of regional significance.

EVNT Flora Species

Four species of threatened flora were recorded in the vicinity of the pipeline Rev SR route during field surveys and are listed in Table 7-21.

Table 7-21 EVNT flora species recorded during field surveys

Scientific name	Status*		Comments
	EPBC Act	NC Act	
Cerbera dumicola		NT	Recorded from KP61.9 to 62.1 and KP63.1 to 63.6.
Desmodium macrocarpum		NT	Recorded from KP59.8 to 60.0 and KP64.7 to 64.9. Populations were also detected adjacent to the ROW from KP66.1 to 66.3, KP99.8 to 102.1 and EL30.8 to 31.2. This species is difficult to detect, therefore other populations may occur in similar habitats elsewhere in the alignment.
Dichanthium queenslandicum King blue grass	V	V	Recorded from KP75.2 to 75.4. Other populations of this species may occur in mountain coolabah open woodland and associated cleared grassland from KP73 to 76.
Eucalyptus raveretiana Black ironbox	V	V	Recorded along watercourse crossings containing RE 11.3.25 on the mainline (KP348.2 to 372.2) and the SGIC (NM 8.8). Also recorded adjacent to four watercourse crossings within the ROW: Two Mile Creek (KP348.2), Limestone Creek (KP370.1 - also mapped as essential habitat for Black ironbox), Deep Creek (KP372.2) and Lion Creek (NM8.8).
Euphorbia sarcostemmoides		V	Recorded about 1km west of KP71 (Revision D alignment only)

Source: Ecosure 2012a.
* Status: E = Endangered, V = Vulnerable, NT = Near Threatened

Weeds

The Commonwealth Government identifies Weeds of National Significance (WONS), based on their:

- Invasiveness and impact characteristics
- Potential and current area of spread
- Current primary industry, environmental and socio-economic impacts.

The *Land Protection (Pest and Stock Route) Management Act 2002* (LP Act) lists declared species for Queensland. Under the Act, pest species for both plants and animals are classified into three categories:

- Class 1 species are not generally established in Queensland and have potential to cause adverse economic, environmental or social impact.
- Class 2 species are established in Queensland and can cause significant adverse economic, environmental or social impact.
- Class 3 species are established in Queensland and have or could have adverse economic, environmental or social impact.

Desktop searches identified 168 species of introduced flora species within the pipeline buffer. Invasive species, including WoNS and other introduced plants considered to pose a particular threat

to biodiversity and that could potentially occur in the ROW are listed in Table 7-22. A total of 13 declared weeds were recorded within the ROW during field surveys including:

- Ten Class 2 weeds, including four WoNS
- Three Class 3 weeds, including one WoNS.

Table 7-22 Invasive plants detected within the pipeline buffer during field surveys (adapted from Ecosure 2012a)

Scientific name	Common name	LP Act status*	National status^	KP of survey record
Asparagus aethiopicus	Asparagus fern	3	-	Mainline - 419.7
Bryophyllum delagoense	Mother of millions	2	-	Mainline - 12.3, 465.3
Bryophyllum pinnatum	Resurrection plant	-	-	Mainline 438.3
Cryptostegia grandiflora	Rubber vine	2	WoNS	Mainline - 249. 261.5, 275.6, 277.7, 284.2, 286.4, 289.1, 303.1, 328.1, 330, 332.2, 336.3, 358.4, 358.4, 358.7, 370.4, 430.1, 430.5, 433.1, 433.5, 438.3, 446.6, 448.5, 458.6, 462.5, 465.3, E of 248.8, W of 358.4, W of 373.3, E of 382.1 SGIC - 2.1, 3.3
Eichhornia crassipes	Water hyacinth	2	WoNS	SGIC - 13.1
Harrisia martini	Harrisia cactus	2	-	Mainline -, 10.5, 13.0, 37.6, 76.8, 87.1, 90.2, 93.5, 95.1, 96.5, 97.7, 232.5, 238.5, 249.0, 261.5, 312.4, 430.5, 433.1, 433.5, 438.3, 445.5, 446.4, 446.5, E of 59.3, E of 72.7 SGIC - 3.5 Elphinstone - 6.2, 18.2, S of 50.2 Saraji - 0.5, 12.9
Hymenachne amplexicaulis	Hymenachne	2	WoNS	SGIC – NE of 35.4
Lantana camara	Lantana	3	WoNS	Mainline - 50.2, 165.5, 239.6, 280.1, 289.1, 358.4, 358.7, 370.4, 433.5, 445.5, 446.4, 458.6, 460.6, 465.3, 466.6, 469.3, 469.3, 410.4, E of 162, E of 248.8, W of 358.4, W of 373.3 Elphinstone - 6.2, 12.8, S of 50.2 Saraji - 17, 19
Lantana montevidensis	Creeping lantana	3	-	Mainline - SGIC - 2.1
Opuntia stricta	Common pest pear	2	-	Mainline - 10.5, 12.3, 19.0, 50.0, 50.2, , 87.1, 93.5, 95.1, 97.7, 144.9, 245.1, 307.9, 358.7, 442.4, 446.4, 448.5, 465.3, E of 59.3, E of 65.2, E of 72.7 Elphinstone - 17.8, 12.8, 51.6, 18.6 Saraji - 12.9, 5.8
Opuntia tomentosa	Velvety tree pear	2	WoNS	Mainline - 0.5, 74.9, 249, 261.5, 312.4, E of 50.2, E of 56.5, W of 373.3 SGIC - 2.1 Elphinstone 50.2
Parkinsonia aculeata	Parkinsonia	2	WoNS	Mainline - 18.4, 167.5, E of 161.8 SGIC NE of 35.4

Scientific name	Common name	LP Act status*	National status^	KP of survey record
Parthenium hysterophorus	Parthenium weed	2	WoNS	Mainline - 35.3, 37.0, 37.2, 58.3, 66.5, 68.2, 74.9, 75.1, 87.1, 110.0, 144.9, 160.1, 232.5, 239.6, 261.5, 319.7, 323.2, 332.2, 336.3, 349.3, E of 156 Dysart - 16.8, 18.4 Elphinstone - 8.3, 12.8, 18.2 Saraji - 17.3
Sporobolus natalensis	Giant rat's tail grass	2	-	Mainline - 92.2, 475.9, 476.2, 477.3 Dysart - 30
Urochloa mutica	Para grass	-	-	SGIC - 12.7-14.5, 21-21.2, 21.4-22.1
Ziziphus mauritiana	Indian jujube; Chinee apple	2	-	SGIC - 2.1, 3.3

Source: Ecosure 2012a.
* Species declared under LP Act.
^ Species listed as Weed of National Significance

Protected Area Estates

Areas protected under the NC Act in proximity to the pipeline are listed in Table 7-23. The pipeline route does not transect any protected area estate, but lies within 5km of five state forests and four nature refuges (refer to Map Series 9 in Appendix A). No national parks or world heritage areas occur with 5km of the project.

Table 7-23 Protected area estates within the project area (Ecosure 2012a)

Estate name	Lot and Plan	Location relative to nearest KP
Newlands Nature Refuge	14 SP225054	1.7km west of KP0
Kemmis Creek Nature Refuge	12 SP236271	4.7km north-east of EL0
Coolibah Nature Refuge	9 CNS42	1.7km south of DL0
Eugene State Forest	65 FTY1503	2km north-east of KP298 - KP302 and 2km north of KP302-KP303
Develin State Forest	66 FTY1343	4.5km south-west of KP312 - KP314
Aricia State Forest	11 4FTY861	2km north of KP334 - KP338
Morinish State Forest	878 FTY842	5km south-west of KP360
Pindari Nature Refuge	181 DS631	3.2km southwest of KP441
Mount Larcom State Forest	208 FTY1451	4.7km north-east of KP463

Source: Ecosure 2012a.

7.4.1.2 Terrestrial Fauna

Desktop investigations and four field surveys were undertaken to provide a detailed assessment of terrestrial fauna and associated ecological issues relevant to the project (EcoSM 2012). The fauna field survey details are summarised in Table 7-24.

Table 7-24 Summary of seasonal fauna field surveys

Season	Dates	Number of sites				
		Mainline	Dysart	Saraji	Elphinstone	Total
Winter	14/06/11 to 3/07/11	43	1	7	10	61
Spring	5/09/11 to 20/09/11	44	-	3	3	50
Summer	5/12/11 to 18/12/11	11	-	-	7	18
Winter*	7/08/12 to 8/08/12	2	-	-	-	2

Source: EcoSM 2012.
* Two nights of microbat survey, only.

Fauna Habitat

Fauna Habitat Description

The pipeline route is characterised by predominantly cleared land (442.85km or 75.39% of the route), most of which is cropping and grazing land. The habitats within, and immediately surrounding the project site can be assigned to six broad categories:

1) Eucalypt woodland and open forest on alluvial soils and old sand plains
2) Woodland and open forest on rocky/stony soils
3) Rivers, creeks and wetlands, both permanent and ephemeral and including billabongs
4) Grasslands and grassy woodlands on basaltic soils and clays
5) Estuarine habitats, namely mangroves and clay plains
6) *Acacia* woodlands on rocky substrates.

Fauna Habitat Condition

Fauna habitat assessments were undertaken throughout the pipeline project area including at systematic field survey sites. A semi-quantitative habitat assessment was completed at 21 of the 62 winter survey sites in an effort to rank terrestrial habitat condition. These sites were chosen because they were considered representative of habitat quality in their general vicinity. The habitat assessment methodology was based on the BioCondition Assessment Methodology (Eyre et. al. 2008). Due to the practical limitations of identifying a suitable and accessible reference site to determine a benchmark for the relevant vegetation type, a simplified BioCondition methodology was developed. This enabled a rapid assessment of vegetation condition, without the requirement for a benchmark reference site. This modified methodology was based on judgement of the difference of the vegetation from undisturbed conditions.

The average habitat condition score for sample sites was 43 out of a possible 100 (range of 10.58-75.26), indicating that overall condition is well below expectation for remnant areas of vegetation. Many of the 76 survey sites inspected during the survey were found to be in poor condition with a high density of exotic species and significant disturbance due to cattle grazing, mechanical clearing and other disturbances.

Essential habitat

Essential habitat for one fauna species, Little Pied Bat (*Chalinolobus picatus*) is found within the ROW. The ROW contains 6.3ha of essential habitat for Little Pied Bat, which is listed as Near Threatened under the NC Act. The essential habitat area is located at KP75, an area found to support caves and ledges which provide habitat for a range of Microchiropteran (microbat) species (the pipeline is located at least 100m from these caves and adjacent to the Vale mine lease). According to the DERM Essential Habitat Database, the Little Pied Bat is associated with associated with areas of dry eucalypt woodland and open forest (e.g. *Eucalyptus melanophloia, E. populnea, E. crebra, E. moluccana, E. tereticornis, Corymbia citriodora* and *C. tessellaris*) at altitudes from sea level to 850m above sea level.

Critical Habitat

Critical habitat is defined under the QLD NC Act as 'habitat that is essential for the conservation of a viable population of protected wildlife or community of native wildlife, whether or not special management considerations and protection are required'. There are currently no declared 'critical habitats' or 'areas of major interest' in the ROW listed under the NC Act 1992.

EVNT Fauna Species
Database searches (Queensland Museum, Wildnet and EPBC databases) for records within 20km of the proposed pipeline route resulted in (EcoSM 2012):

- EPBC Act listed fauna
  - one critically endangered; and
  - five endangered; and
  - fourteen (14) vulnerable fauna species.
- NC Act listed fauna
  - three endangered; and
  - fourteen (14) vulnerable; and
  - sixteen (16) near threatened fauna species.

A range of marine species which are listed as possibly present in the EPBC Protected Matters Search Tool are highly unlikely to occur within the ROW and are even less likely to be impacted by the project. These species have been excluded from further consideration in this assessment.

Field surveys undertaken for the project in winter confirmed the occurrence of three species of conservation significance, the Cotton Pygmy Goose, Squatter Pigeon and Little Pied Bat. The spring survey recorded these three species at multiple locations, as well as an additional four species of conservation significance, the Grey Snake, Powerful Owl, Grey Goshawk and Grey-headed Flying Fox. The summer survey recorded an additional four species of conservation significance, the Dawson Yellow Chat, Water Mouse, Ornamental Snake and Radjah Shelduck. Species record in close

proximity to the ROW is included in Table 7-25, below. A full list, including locations, is available in EcoSM (2012).

Table 7-25 Records of significant fauna species found within 500m of the pipeline route

Species	Seasonal Survey	Nearest KP	Co-ordinates		Distance to nearest KP (m)
Cotton Pygmy Goose	Winter	SL8	150.4077	-23.2823	429
Little Pied Bat	Winter	KP311	149.8008	-23.0673	303
		SL16	148.4379	-22.2817	207
	Spring	KP274	149.5059	-22.9676	31
Squatter Pigeon	Winter	KP311	149.803	-23.0691	33
		KP461	150.9385	-23.7746	309
	Spring	KP65	148.1195	-21.7785	249
		KP274	149.5055	-22.9664	135
		KP311	149.8011	-23.0665	342
Grey Goshawk	Spring	KP275	149.5134	-22.9639	149
Grey Headed Flying Fox	Spring	KP445	150.8164	-23.707	282
Little Pied Bat	Spring	KP461	150.94	-23.7755	130
Powerful Owl	Spring	KP468	150.9938	-23.8104	130
White-bellied Sea-eagle nest	Spring	SL19	148.47	-22.2764	292
Water Mouse	Summer	KP429	150.686	-23.638	150
Radjah Shelduck	Summer	KP446	150.816	-23.709	100

Source: EcoSM 2012

Pest Fauna

Desktop searches identified 24 introduced fauna species within the ROW, seven of which were recorded during field surveys and are listed in Table 7-26.

Table 7-26 Pest species recorded within the ROW

Class	Scientific Name	Common Name	Pest Class*
Amphibian	*Rhinella marina*	Cane Toad	Non declared
Bird	*Passer domesticus*	House Sparrow	Non declared
Mammal	*Bos taurus*	European Cattle	Non declared
Mammal	*Canis familiaris*	Dog	2
Mammal	*Canis lupus dingo*	Dingo	2
Mammal	*Felis catus*	Cat	2
Mammal	*Sus scrofa*	Pig	2

Source: EcoSM 2012.

* Class of declared pests under the Land Protection (Pest and Stock Route Management) Act 2002

7.4.1.3 Aquatic Ecology

The pipeline route traverses three river basins including the Burdekin, Fitzroy and Calliope River basins and watercourse crossings, with the majority of the pipeline route being contained within the Fitzroy Basin. Water quality in the Fitzroy and Isaac catchments is typically high in turbidity, nutrients and pesticides, particularly after rainfall events when overland flow has occurred.

Aquatic habitat ratings for the project area were highly variable, ranging from very poor to very good. Twigs, leaf packs and large logs were the dominant habitat identified; however, overhangs and trailing back vegetation were also recorded. Aquatic fauna passage was generally restricted due to the absence of flows for many reaches; however, log jams, weirs and rapids were also identified as potential waterway barriers. Riparian vegetation condition was highly variable and ranged from very poor to very good. Very poor ratings were associated with narrow riparian corridors and exotic vegetation. There was generally a lack of aquatic vegetation within the catchments.

A total of 39 native aquatic fauna species and two introduced aquatic fauna species are known to occur within the project area. Of these, two species have declared conservation status including the Fitzroy River Turtle (*Rheodytes leukop*) (listed as Vulnerable under the EPBC Act) which has been recorded in the Fitzroy and Isaac River; and the Estuarine Crocodile (*Crocodylus porosus*) (listed as Vulnerable under the NC Act; Migratory and Marine under the EPBC Act) which has been recorded in the Fitzroy River. The Platypus (*Ornithorhynchus anatinus*, listed as "Least Concern" under the NC Act) has been recorded in the Isaac River, with potential habitat at the Fitzroy River, and Limestone and Scrubby Creeks. A total of 16 aquatic weed species, including five WoNS, and two introduced aquatic fish species, mosquito fish (*Gambusia holbrooki*) and the Guppy (*Poecilia reticulata*) are known to occur throughout the project area.

Wetlands

Important Wetlands of Australia

The Directory of Important Wetlands in Australia (DIWA) identifies and classifies nationally important wetlands within three broad categories: marine and coastal zone wetlands, inland wetlands and human-made wetlands. The directory and associated updates provide detailed descriptions of all DIWA wetlands.

The SGIC transects one DIWA wetland, the Fitzroy River Floodplain, from NM 12.9 to 13.5 and NM 25.9 to 26.9. This wetland comprises the Fitzroy River and associated floodplain wetlands to the north, west and immediately south of Rockhampton.

Referable Wetlands

Based on EHP's referable wetland mapping and field surveys, the pipeline route traverses referable wetlands containing five REs (refer to Map Series 8 in Appendix A):

- 11.1.1: *Sporobolus virginicus* grassland on marine clay plains (no concern at present)
- 11.1.2: Samphire forbland on marine clay plains (no concern at present)
- 11.1.4: Mangrove forest / woodland on marine clay plains (no concern at present)

- 11.3.25: *Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines (of concern)
- 11.3.27: Freshwater wetlands (of concern).

The majority of wetlands observed within the pipeline route were narrow bands of fringing riparian vegetation (RE 11.3.25) along streams. Most riparian vegetation has been degraded by clearing, frequent fires, weed invasion, grazing, erosion and changes in stream hydrology (e.g. weirs, sedimentation). Some larger watercourses also contain seasonal to permanent pools that support aquatic vegetation.

Non-riverine freshwater wetlands within the ROW (RE 11.3.27) were recorded from KP166.2 to KP166.4 and KP322.5 to KP322.7. These non-riverine freshwater wetlands appeared to be ephemeral, with low abundance and diversity of aquatic vegetation. Marine wetlands containing RE 11.1.1, 11.1.2 and 11.1.4 were associated with several tidal creeks in the southern section of the mainline.

A natural waterhole (Ungle Waterhole on Clarke Creek) lies approximately 800m upstream of the pipeline route at approximately KP237. This waterhole has been avoided by the project and will not be directly impacted.

Marine Flora

The pipeline route transects saltmarsh (RE 11.1.1 and 11.1.2) and mangrove (RE 11.1.4) communities which contain marine plants (all of which are common, widespread species) along a 30m section at KP428.7, two sections totalling 0.11km at KP437 and three sections totalling 0.29km at KP445. These marine plants include:

- *Sporobolus virginicus* – Saltwater couch
- *Enchylaena tomentosa* – Ruby saltbush
- *Avicennia marina* – Grey mangrove
- *Aegiceras corniculatum* – River mangrove
- *Ceriops tagal* – Yellow mangrove
- *Excoecaria agallocha* – Milky mangrove
- *Sarcocornia quinqueflora* – Beaded glasswort
- *Suaeda australis* – Austral seablite
- *Limonium solanderi* – Sea lavender.

Other marine species that have been recorded by the Queensland Herbarium in the 5km buffer which could be recorded in estuarine areas along the pipeline route include:

- *Bruguiera gymnorhiza* – Large-leaved mangrove
- *Suaeda arbusculoides*

- *Tecticornia indica*
- *Tecticornia pergranulata.*

7.4.2 Potential adverse or beneficial impacts of the project activities on the identified environmental values

7.4.2.1 Terrestrial Flora

For terrestrial flora, the key risks relating to the clearing of remnant vegetation include:

- Loss of Endangered brigalow communities (RE 11.4.8 and 11.9.1)
- Loss of Endangered natural grasslands of the Queensland Central Highlands and the northern Fitzroy Basin (RE 11.8.11)
- Loss of Endangered semi-evergreen vine thickets of the Brigalow Belt (RE 11.11.18)
- Loss of 10 Of Concern REs (11.3.2, 11.3.3, 11.3.4, 11.3.7, 11.3.25, 11.3.27, 11.3.36, 11.8.11, 11.9.7, 11.11.16)
- Loss of 17 No Concern at Present REs (11.1.1, 11.1.2, 11.1.4, 11.3.26, 11.5.3, 11.5.8, 11.5.9, 11.5.12, 11.7.2, 11.8.5, 11.9.2, 11.9.9, 11.11.1, 11.11.4, 11.11.15, 11.12.1, 11.12.2)
- Loss of HVR of Endangered and Of Concern REs
- Impacts on four EVNT flora species recorded in or close to the proposed route during the field surveys
- Loss of potential habitat for EVNT flora species (detected and mapped)
- Loss of DIWA wetland communities
- Loss of referable wetlands (including WPAs and WMAs)
- Loss of freshwater wetland ecosystems and associated riparian vegetation
- Loss of marine wetlands and associated marine plants
- Fragmentation of remnant vegetation blocks
- Potential indirect impacts on downstream riparian and wetland communities (including DIWA and referable wetlands).

Potential Impacts on Vegetation Communities and Regional Ecosystems
The pipeline route transects approximately 114.5km of remnant vegetation, or 19.5% of the proposed 587.5km pipeline route (with laterals).

In areas not subject to cropping and grazing, such as remnant and regrowth communities, there is the potential to allow tree and shrub vegetation to naturally re-establish over all but the area immediately over the pipeline. A reduced easement over the constructed pipeline will be required for the ongoing inspection and maintenance. Assuming that a 7m cleared easement is required to protect the pipeline from root damage, the remaining cleared area would be expected to regenerate naturally in the medium term (20 to 50 years).

Regional Ecosystems with Endangered, Of Concern and No Concern at Present biodiversity statuses were recorded within the ROW. These include:

- Three areas of Endangered REs:
  - Up to 1.7ha would be impacted if the entire ROW requires clearing, representing 0.1% of Endangered REs occurring within the 5km study area.
- Ninety-six (96) areas of Of Concern REs:
  - Up to 105.1ha would be impacted if the entire ROW requires clearing, representing 0.21% of Of Concern REs occurring within the 5km study area.
- One-Hundred and Twenty (120) areas of No Concern at Present REs:
  - Up to 351ha would be impacted if the entire ROW requires clearing, representing 0.41% of No Concern at Present REs occurring within the 5km study area.

The indirect impacts of construction and operation on remnant vegetation could include erosion, sediment loss and weed invasion. These impacts are unlikely to be significant provided measures in the Erosion and Sediment Control Plan, Weed Management Plan and Pest Management Plan are implemented.

An overview of the areas of Endangered and Of Concern REs required to be cleared for construction of the pipeline, including KP start and end points and area to be cleared (with the ROW) are included in Appendix I.

Potential Impacts on EPBC Listed Communities

Three EPBC listed communities, Brigalow (RE 11.4.8 and 11.9.1), natural grasslands of the Queensland Central Highlands and the northern Fitzroy Basin (RE 11.8.11), and semi-evergreen vine thickets of the Brigalow Belt (RE 11.11.18) were recorded within the ROW. The route transects five areas of these EECs including:

- RE 11.4.8 from KP185.06 to KP185.30
- RE 11.8.11 from KP35.44 to KP36.90 and KP37.25 to KP37.63
- RE 11.9.1 from KP166.17 to KP166.20
- RE 11.11.18 from KP356.91 to KP357.06.

Additionally, the ROW contains a maximum of 36.51ha of remnant RE 11.3.2 (Poplar Box woodland on alluvial soils). Although Weeping Myall (*Acacia pendula*) woodland EEC can be associated with this regional ecosystem, no Weeping Myall trees were observed on the ROW during field surveys, indicating that the EEC is not present.

The area of vegetation clearance required at each location where EECs occur is provided in Table 7-20. Provided no Weeping Myall is present in RE 11.3.2, up to 9.1ha of EECs would be

impacted if the entire ROW required clearing. This represents 0.13% of the EECs occurring within the 5km wide study area. The area impacted would be greatly reduced by utilising pre-existing clearings and reducing clearing widths in Endangered communities.

Potential Impacts on Bioregional Corridors

The ROW contains 623.7ha of bioregional corridors mapped by EHP, including 474.7ha considered to have state significance and 149ha of regional significance (Table 7-27). Potential impacts on bioregional corridors would be substantially reduced as 50.8% of the area in mapped corridors is cleared with low ecological value in its present condition. Subject to the successful implementation of the mitigation strategies provided in Section 7.4.3, the potential impacts on connectivity are expected to be limited to the direct impact associated with clearing of remnant vegetation within identified corridors in the ROW.

Table 7-27 Estimated Area of Bioregional Corridors within the ROW (Ecosure 2012a)

Corridor Status*	Pipeline	Length in ROW (km)	Area in ROW (ha)
State	Mainline	66.72	266.9
	SGIC	0	0
	Elphinstone	49.26	197.1
	Saraji	1.8	7.2
	Dysart	0.88	3.5
State Total		118.66	474.7
Regional	Mainline	25.22	100.8
	SGIC	0	0
	Elphinstone	0	0
	Saraji	5.74	23
	Dysart	6.29	25.2
Regional Total		37.25	149
Corridor Total		155.91	623.7

* Corridor Status assigned in Brigalow Belt Biodiversity Planning Assessment (DERM, 2008).

Potential Impacts on EVNT Flora Species

Targeted searches for EVNT species during field assessments revealed the presence of four EVNT plant species which were recorded within, or close to the proposed pipeline ROW (refer to Table 7-21).

Potential Impacts on Protected Area Estates

No areas of protected area estate lie adjacent to, or are transected by the ROW, so are unlikely to be impacted by construction or operations activities, provided that mitigation measures are implemented (refer to Section 7.4.3).

7.4.2.2 Terrestrial Fauna

The key fauna issues potentially affected by the project include:

- Disturbance to mature vegetation and hollow-bearing trees and therefore loss of perching, foraging and nesting resources
- Potential disturbance to fauna movement corridors and dry season fauna refuge (predominantly associated with creeks and dams). Such impacts are primarily temporary in nature
- A temporary barrier to fauna movement and potential trap provided by the open pipeline trench (trenchfall)
- Unearthing of burrowing fauna species during construction
- Potential limited disturbance to areas which provide habitat for the Vulnerable Ornamental Snake and from which the species was recorded. These areas include cleared lands and disturbed wetlands, rather than remnant vegetation
- Potential impacts on several EVNT fauna species recorded within or proximate to the proposed route during the field surveys, including the Powerful Owl (*Ninox strenua*), Grey Goshawk (*Accipiter novaehollandiae*) and Grey Snake (*Hemiaspis damelii*)
- Disturbance to potential habitat for EVNT fauna species including the Yellow Chat, Powerful Owl, Grey Snake, Ornamental Snake, Brigalow Scaly-foot, Yakka Skink, Common Death Adder, Little Pied Bat and Grey-headed Flying Fox
- Limited disturbance to riparian vegetation and associated wetland ecosystems providing restricted habitat types for a range of least concern fauna species
- Fragmentation of remnant vegetation blocks, particularly in association with hills and ranges north of Moranbah.

Potential Impacts on Fauna Habitat

The pipeline route transects approximately 114.4km of remnant vegetation, or 19.50% of the 587.4km route (with laterals). Assuming that the entire ROW contained remnant vegetation and was required for construction, the total disturbance area would be approximately 457.9ha of remnant vegetation (578.4ha including HVR) (Ecosure 2012a).

The removal of remnant vegetation has impacts on fauna habitat values through loss of:

- Estuarine habitat which may support species such as Yellow Chat, Estuarine Crocodile and Water Mouse
- Mature trees which provide hollows for fauna, especially nesting birds, microbats and marsupial gliders
- Tree species with abundant decorticating bark which is preferred foraging substrate for a variety of woodland birds and reptiles
- Freshwater wetland habitats which may support species such as Cotton Pygmy Goose
- Woodlands and open forests which may support threatened reptiles including Brigalow Scaly-foot, Dunmall's Snake, Grey Snake and Ornamental snake
- Woodlands on Cainozoic lateritic duricrust which may support species such as Common Death Adder, Yakka Skink and the Inornate Rock Wallaby

- Grasslands on Cainozoic igneous rocks which may support species such as the Grey Snake
- Semi-evergreen vine thicket on old sedimentary rocks that provides high quality habitat for fossorial skinks in addition to smaller passerines and frugivorus birds.

Impacts on Connectivity

The pipeline construction has the potential to create short term barriers to fauna movement, create or increase edge effects and reduce habitat connectivity. The majority of the route is in pasture / grassland, which is the habitat least affected by connectivity or fragmentation impacts. Much of the remainder of the route has been collocated with existing cleared easements where the impacts have already occurred. In these cases, the additional clearing represents a cumulative impact where the gap between habitat patches becomes wider.

Operational impacts on terrestrial fauna are considered to be minimal due to the rehabilitation and revegetation (where appropriate) of the majority of the pipeline easement width. Within structurally complex vegetation such as riparian areas, the construction corridor may present a barrier to some fauna species, although the majority of species present are adapted to dispersal across open woodland habitats and are therefore likely to be tolerant of small canopy gaps. The corridor is a permeable barrier, unlike a physical structure or large water body. Although the corridor will be kept free of vegetation (trees and shrubs) for pipeline maintenance, ground covers will provide shelter for small fauna species crossing the gap.

Impacts Associated With Trenchfall

Construction of the pipeline includes trenching. An open trench will create a temporary barrier to fauna movement with the potential for ground-dwelling fauna to fall into the trench and become trapped. Once trapped in the trench, wildlife could be subject to overheating, dehydration and / or predation.

Impacts on EVNT and Migratory Fauna Species

A review of relevant desktop data and completion of field surveys indicates that 26 EVNT species and 12 migratory species are considered to have a moderate to high likelihood of occurrence within the proposed pipeline corridor or have already been recorded along the route (EcoSM 2012).

Of those EVNT species known from the project area, ten have been identified as having the potential to be adversely impacted by the project as follows:

- Powerful Owl (recorded from Mount Larcom, KP469)
- Yellow Chat (recorded approximately 1km north of KP439)
- Ornamental Snake (recorded in the vicinity of KP176 and south-west of KP203)
- Water Mouse (recorded several hundred metres east of KP430)
- Grey-headed Flying Fox (recorded from Raglan Creek KP446.5)
- Little Pied Bat (recorded from KP50, KP274.4, KP311.5, KP462 and SL16.5)

- Grey Snake (not recorded on project site, but recorded from project area)
- Brigalow Scaly-foot (not recorded but highly likely to be present in project area)
- Common Death Adder (not recorded but highly likely to be present in project area)
- Yakka Skink (not recorded but highly likely to be present in project area).

A number of EVNT species considered likely to occur within the project area are likely to be subject to impacts of such limited duration and intensity that these are considered unlikely to be significant in an ecological or statutory context. Impacts on these species have been carefully considered against statutory guidelines and it is considered that with implementation of appropriate strategies, the pipeline will be unlikely to result in significant impacts on the viability of affected populations.

Vertebrate pests are present throughout the pipeline route. Construction of the pipeline is unlikely to significantly increase the distribution or abundance of vertebrate pests as these species will lose habitat.

7.4.2.3 Aquatic Ecology

Wetlands

The potential impacts to aquatic ecology from construction activities may arise from:

- Injury to aquatic fauna habitat during construction, including EVNT species
- Degradation or loss of riparian and instream habitat
- Increased erosion, run off and sedimentation
- Alteration of instream flow and aquatic habitat
- Alteration of water quality
- Increased introduction and spread of weeds.

During operation, risks to aquatic ecology could arise from sediment mobilisation and erosion from any exposed areas.

Up to 37.5ha of wetland REs would be impacted if the entire ROW required clearing. However, 10.7ha of mapped wetland within the SGIC section are likely to contain non-remnant vegetation dominated by weeds such as para grass and water hyacinth. Management strategies are described in Section 7.4.3.

Marine Flora

Potential impacts from conventional construction are likely to include:

- Direct loss of marine plants
- Loss of marine habitat
- Changes in hydrology

- Transport of sediment and other pollutants
- Aquatic weed invasion.

The pipeline route transects 0.43km of saltmarsh (RE 11.1.1 and 11.1.2) and mangrove (RE 11.1.4) communities, which contain marine plants and bare marine substrate, at KP428.6 to KP428.7, KP436.4 to KP436.5 and KP444.8 to KP445.1. Assuming that the entire ROW contains marine vegetation and / or habitat and requires removal for construction, the maximum total disturbance area would be approximately 1.7ha.

7.4.3 Management strategies

This Section describes the strategies identified to manage potential impacts of the project on flora and fauna. Management strategies are summarised in Table 7-29 and Table 7-30. Section 8 describes the management strategies for the rehabilitation of disturbed areas.

7.4.3.1 Terrestrial Flora and Fauna

Flora – Mitigation
Proposed mitigation measures for flora include:

- Minor re-alignments of the pipeline route to avoid or minimise clearing of areas of high environmental value
- Use of minimum clearing widths in areas of remnant vegetation
- Minimising clearing of large mature trees
- Careful management of clearing and construction works to minimise area of clearing and associated disturbance
- Scheduling of construction during the dry season wherever possible (especially in and adjacent to watercourses and wetlands)
- Effective rehabilitation of disturbance areas following construction, including stockpiling and respreading of topsoil and vegetative wastes, weed control and revegetation where required (refer to Appendix E)
- Effective sediment and erosion control systems to minimise indirect impacts on surrounding areas
- A Weed Management Plan, including effective weed hygiene procedures, regular weed monitoring during and after construction and weed control works as required (refer to Appendix D).
- Investigation into the use of HDD techniques to avoid impacts on major watercourses
- Development of offset strategies (Offset Management Plan) to compensate for any residual impacts on important ecological values.

Offsets

While all practicable efforts will be made to avoid and minimise impacts on flora of high ecological value, it is likely that small areas will be cleared or disturbed. Where residual impacts cannot be avoided, an Offset Management Plan will be prepared and implemented to rehabilitate vegetation similar to that of the impacted vegetation in a nearby location. The goal of any offset program will be to achieve a net conservation gain by enhancing the long-term sustainability of the vegetation in the Bioregion. Offsets will be developed in liaison with relevant Commonwealth and State regulatory agencies. Offsets may be required for:

- 7.4ha of Endangered Ecological Communities under the EPBC Act
- 100.9ha of REs with Of Concern biodiversity status assigned by EHP
- 24ha of HVR of Endangered REs
- 43.9ha of HVR of Of Concern REs
- 0.4ha of Essential Habitat identified by EHP
- 33.4ha of freshwater wetlands identified by EHP
- Any residual impacts to EVNT flora species and their habitats.

It is anticipated that these areas are likely to be reduced by further refinements to the proposed pipeline route and minimising the construction corridor width in sensitive areas.

Fauna – Mitigation Recommendations

Proposed mitigation measures for fauna include:

- Developing and implementing Species Management Plans prior to construction to mitigate impacts on terrestrial fauna
- Developing and implementing a Pest Management Plan
- Monitoring of open trenches by fauna spotter/catchers during the construction period
- Minor re-alignments of the pipeline route to avoid or minimise clearing of areas of high environmental value
- Use of minimum clearing widths in areas of remnant vegetation which supports fauna habitat of the highest quality. These areas have been identified in EcoSM (2012)
- Investigation into the use of trenchless techniques (e.g. HDD) to avoid impacts on major watercourse crossings.

7.4.3.2 Aquatic ecology

Management strategies for aquatic ecology will include the development of:

- An Aquatic Values Management Plan for EVNT species
- An Erosion and Sediment Control Plan
- A Weed Management Plan will effectively manage any aquatic weeds and prevent weeds from spreading to, or impacting on new areas

- A rehabilitation program.

Table 7-28 provides the structure and outline for the proposed Aquatic Values Management Plan. The headings within the report are defined and explanations of report sections are provided.

Table 7-28 Aquatic Values Management Plan – proposed report structure and outline

Section	Contents	Description
Introduction	Project Description	Provides a brief overview of the project
	Purpose of AVMP	Outlines the objective of the plan including description of the policies and conditions, and how these are to be addressed by the plan, for example conditions relating to protection and management of EPBC listed species and places
	Scope of Plan	Defines the areas included in the plan, including a summary of watercourses and wetlands as described in previous reports. Defines limits of the area and any activities associated with the project that are not included
	Definitions	Technical terms, acronyms and abbreviations are defined
Watercourse crossings	Overview of the sites and the location within the plan area	including catchments, variation of types of water courses and hydrology in the project area
	Watercourse construction techniques *(Description of methods proposed for crossing watercourses and which method applied specified for the watercourses)*	Description of techniques e.g. HDD
		Open cut
Methodology *(Description on how information and data were collected and analysed)*	Desktop review and database searches	Including gap analysis of existing information
	Field surveys	Targeted assessments based on gap analysis
Assessment of Aquatic Values	Desktop assessment	EPBC list flora: specify distribution and potential habitat
		EPBC listed fauna: specify distribution and potential habitat
		EPBC listed places: specify location and values
	Field Assessment	Aquatic values of minor watercourses: specify potential habitat for MNES
		Aquatic values of major watercourse: specify potential habitat for MNES
Potential impacts to Aquatic Values *(Aspects of project particularly related to construction phase that could affect potential habitat for MNES)*		

Section	Contents	Description
Mitigation and management strategies of potential impacts to Aquatic Values *(Define approaches to prevent, minimise, and address potential disturbance to potential habitat of MNES)*	Minor watercourses	
	Major Watercourses	
Summary and Conclusions		

Following rehabilitation and successful stabilisation of watercourse bed and banks, the operation of the pipeline is predicted to have a negligible impact on aquatic flora and fauna. Management strategies addressing potential impacts are described in Table 7-29 and Table 7-30.

Table 7-29 Land management: flora and fauna - construction

Element / Issue	Disturbance, degradation or fragmentation of vegetation communities. Loss or harm to flora species and populations. Disturbance and/or degradation of flora habitat areas. Introduction or spread of weed species.

Performance Objectives	Management Strategies	Performance Criteria	Monitoring	Corrective Action
Terrestrial Flora				
Pre-construction planning to avoid or minimise impacts to native vegetation and EVNT flora species.	▪ Pre-construction surveys will be conducted in the Right of Way (ROW) and immediate adjacent areas to mark Endangered, Vulnerable and Near Threatened (EVNT) and regionally significant flora species. (C072). ▪ A pre-construction survey will be undertaken by an appropriately qualified ecologist to clearly identify and mark hollow-bearing trees or other ecologically sensitive areas (C074). ▪ Where the ROW is to be reduced (e.g. sensitive watercourse crossings or sensitive habitat areas) this will be recorded on alignment sheets.	▪ Disturbance of terrestrial flora during construction of the pipeline and associated access tracks. ▪ Disturbance outside designated areas.	▪ Audits of vegetation clearing.	▪ Report to relevant authorities. Revise management strategies to prevent recurrence.
To minimise impacts to, and protect native vegetation and EVNT flora species.	▪ Barriers will be erected around significant vegetation values in order to restrict access and avoid disturbance. ▪ Large trees will be trimmed rather than removed at sensitive watercourse crossings and elsewhere.	▪ Disturbance of terrestrial flora during construction of the pipeline and associated access tracks. ▪ Disturbance outside areas surveyed to be cleared.	▪ Audits of vegetation clearing.	▪ Report to relevant authorities. Revise management strategies to prevent recurrence.
To avoid or minimise impacts to native vegetation and EVNT flora species through retention and reuse of topsoil and cleared vegetation	▪ Pre-stripping and stockpiling of topsoil and bed material will be in accordance with the Soils Management Plan and stored above	▪ Effectiveness of Soil Management Plan to manage topsoil storage.	▪ Audits of vegetation clearing, and use of topsoil and cleared vegetation.	▪ Report to relevant authorities. Revise management strategies to prevent recurrence.

Performance Objectives	Management Strategies	Performance Criteria	Monitoring	Corrective Action
	the bank where it will not be buried or damaged, with topsoil and bed material stockpiled separately (C048). ▪ To assist in erosion control following construction, cleared native vegetation will be re-spread over the ROW (particularly on the banks of creek crossings and in areas with steep slopes) where safety will not be impaired.	▪ Implementation of Erosion and Sediment Control Plan.	▪ Vegetation re-establishment should be monitored during and after construction	
Adherence to legal obligations to protect native vegetation and EVNT flora species.	▪ Protected flora species (including terrestrial and marine species) will only be removed or disturbed if authorised under a relevant permit (EM015). ▪ A Species Management Plan will be implemented to restore the ROW to its pre-existing state in terms of biodiversity values	▪ Compliance with clearing permits.	▪ Inspection of cleared areas and audit of compliance with clearing permits.	▪ Report to relevant authorities. Revise management strategies to prevent recurrence.
To rehabilitate and offset any rare, endangered or vulnerable plants disturbed by construction.	▪ If Endangered, Vulnerable and Near Threatened (EVNT) plants cannot be avoided, an appropriate management plan to offset biodiversity losses will be developed and implemented in liaison with relevant State and Commonwealth regulatory agencies (C073). ▪ Seeds from local tree species will be harvested to assist easement rehabilitation in areas where natural regeneration is not successful. ▪ A targeted Rehabilitation Program will be implemented to restore the ROW to its pre-existing state in terms of biodiversity values. ▪ Specific targeted management measures for rare, endangered or	▪ Effectiveness of rehabilitation of the ROW following pipeline commissioning.	▪ BioCondition reports and assessments of rehabilitated areas.	▪ Review Rehabilitation Program and revise Pest Management Plan and Weed Management Plan.

Performance Objectives	Management Strategies	Performance Criteria	Monitoring	Corrective Action
	vulnerable species will be implemented including: ▪ Offset Management Plan to be developed for the endangered natural grasslands of the Queensland Central Highlands and the northern Fitzroy Basin (KP35.44 - 36.90 and KP37.25-37.63); ▪ No clearing of Brigalow (or Brigalow regrowth) will be conducted outside the ROW (EM018).			
Terrestrial Fauna				
Pre-construction planning to avoid or minimise impacts to native fauna and EVNT fauna species habitat.	▪ Pre-construction survey undertaken to identify any EVNT species and/or breeding places within the construction corridor. Flag location of breeding places within the construction corridor so they may be avoided where practicable during construction. ▪ A pre-construction survey will be undertaken by an appropriately qualified ecologist to clearly identify and mark hollow-bearing trees or other ecologically sensitive areas (C074).	▪ Disturbance of terrestrial fauna during construction of the pipeline and associated access tracks. ▪ Disturbance outside designated areas.	▪ Inspection of cleared areas and audit of compliance with clearing permits. ▪ Compliance with pre-construction survey results. ▪ Records of recovered and released, injured or deaths of fauna.	▪ Report to relevant authorities. Revise spotter catcher procedures and SMP strategies to prevent recurrence.
Targeted species management to minimise impacts to native fauna and EVNT fauna species.	▪ Where threatened fauna species are identified, targeted species-specific management strategies will be incorporated into project documentation (including the EMP and any relevant procedures developed) (EM020). ▪ Species Management Plan will be implemented to restore the ROW to its pre-existing state in terms of biodiversity values.	▪ Disturbance of terrestrial fauna during construction of the pipeline and associated access tracks.	▪ Records of recovered and released, injured or deaths of fauna.	▪ Report to relevant authorities. Revise spotter catcher procedures and SMP strategies to prevent recurrence.
Minimising habitat fragmentation to	▪ Proposed clearing boundaries will be	▪ Disturbance outside	▪ Inspection of cleared	▪ Report to relevant

Performance Objectives	Management Strategies	Performance Criteria	Monitoring	Corrective Action
retain relevant niches of affected fauna species.	clearly shown on alignment sheets. ▪ Clearing of remnant vegetation areas should be minimised for the purposes of siting, laydown areas, vehicle access tracks and other ancillary impact areas (EM016) ▪ Where the ROW is to be reduced (e.g. sensitive watercourse crossings or sensitive habitat areas), this will be recorded on alignment sheets.	designated areas.	areas and audit of compliance with clearing permits.	authorities. Revise management strategies to prevent recurrence.
Protection and supply of habitat to retain relevant niches of affected fauna species.	▪ Where feasible and approved by the landholder, felled timber shall be positioned in small piles along the edge of the ROW to provide habitat for fauna species. Feasibility will depend on the amount of felled timber available, operational and access requirements and the sensitivity of the adjacent vegetation (EM021). ▪ Vehicle tracks along the ROW and designated access areas (turnarounds etc.) shall be clearly marked and well maintained to minimise the potential for vehicles to stray outside of the ROW, particularly during and after wet weather (EM022).	▪ Disturbance outside designated areas. ▪ Loss of habitat associated with clearing of the ROW.	▪ Inspection of cleared areas and audit of compliance with clearing permits. ▪ Compliance with pre-construction survey results. ▪ Presence of habitat shelters associated with the ROW. ▪ Records of habitat creation using cleared vegetation.	▪ Report to relevant authorities. Revise management strategies to prevent recurrence.
Use of an experienced spotter / handler to reduce harm to fauna species.	▪ A suitably qualified and experienced fauna spotter/ handler will be present during vegetation clearing to minimise the potential harm to fauna species and recover any injured fauna (C076). ▪ All fauna captured during the pre-construction survey and spotter/catcher activities should be re-located (C075).	▪ Disturbance of terrestrial fauna during construction of the pipeline and associated access tracks.	▪ Records of fauna recovery of trench fall and translocation. ▪ Records of injury or deaths of fauna.	▪ Report to relevant authorities. Revise management strategies to prevent recurrence.
Protect fauna from trenchfall and	▪ Ramps (with slopes of no greater	▪ Recovered and released	▪ Records of trench	▪ Report to relevant

Performance Objectives	Management Strategies	Performance Criteria	Monitoring	Corrective Action
recover fauna affected by construction activities.	than 50%) will be installed in the trench to allow the easy egress of fauna from the trench at a minimum of 1,000m intervals (C077). ▪ A qualified and experienced fauna spotted / handler should check the trench for captured fauna at least daily, preferably in the morning to remove animals prior to the heat of the day (C078). ▪ Night caps will be placed over the open pipe string ends to prevent the ingress of wildlife into welded pipes (EM023). ▪ All fauna captured during the pre-construction survey and spotter/catcher activities should be re-located (C075). ▪ The length of time that the trench is open shall be minimised through staging of trenching activities to minimise the potential for the pipeline to impact on local populations of fauna (EM024).	fauna. ▪ Recorded injury or deaths of fauna.	monitoring by spotter / handler. ▪ Records of fauna translocations. ▪ Records of injury or deaths of fauna.	authorities. Revise spotter catcher procedures to prevent recurrence.
Pests and Weeds				
To prevent the spread of pests and weeds diseases and animal pests as a result of construction activities.	▪ Develop and implement a Weed Management Plan with reference to Arrow's Pest Management Program, 2012 which adopts principles developed in alliance with the Australian Weeds Strategy (C082).	▪ Distribution of pest or weed species. ▪ Treatment of declared plants within the ROW promptly following their discovery.	▪ Monitoring of weed infestations within disturbed areas should occur twice during construction and then biannually for a period of two years following construction. ▪ Following the two year period, the frequency of monitoring should be reconsidered dependent on the success of control	▪ Implement measures (e.g. controlled spraying or pulling) to remove invasive species, should weed or pest species associated with Project activities be detected.

Performance Objectives	Management Strategies	Performance Criteria	Monitoring	Corrective Action
			measures and the level of infestations.	
Vehicles/plant and equipment				
To prevent the spread of pests and weeds through contaminated vehicles and plant.	▪ All vehicles and plant must be washed down by trained personnel and certified weed free, consistent with the Queensland Checklist for Cleandown Procedures, 2000. (EM025) ▪ Trained personnel will assess vehicles, plant and equipment following cleaning and issue certification. A register will be maintained of vehicles, plant and equipment cleaned (EM026). ▪ Locations for washdown facilities will be identified prior to construction. ▪ Washdown facilities will be constructed in accordance with Queensland Guidelines for the Construction of Vehicle and Machinery Wash-down Facilities, 2000. (EM027).	▪ Distribution of pests and weeds across the pipeline route or adjacent landholdings. ▪ Treatment of declared plants within the ROW promptly following their discovery.	▪ Monitor certification of vehicles, plant and equipment cleaned. ▪ Identification of weeds previously unrecorded in the area.	▪ Vehicles, plant and equipment failing an inspection will be washed down and re-inspected. ▪ New populations of weed or pest species will be eradicated.
Prevent distribution of weeds	▪ Boundary fence lines will be marked on Alignment Sheets and in the field to prevent soil transfer across landholdings.	▪ Distribution or spread of weed species across landholdings.	▪ Monitor certification of vehicles, plant and equipment cleaned. ▪ Identification of weeds previously unrecorded in the area.	▪ Vehicles, plant and equipment failing an inspection will be washed down and re-inspected. ▪ Treatment of emergent weeds
Clear and grade				
To prevent the spread of weeds.	▪ Weed Management Plan implemented. ▪ Preclearance survey conducted for weeds. ▪ Any declared weeds sprayed, destroyed or removed prior to clear	▪ Distribution of weeds associated with construction activities.	▪ Monitor certification of vehicles, plant and equipment cleaned. ▪ Identification of weeds previously unrecorded in the area.	▪ Vehicles, plant and equipment failing an inspection will be washed down and re-inspected. ▪ Treatment of emergent weeds

Performance Objectives	Management Strategies	Performance Criteria	Monitoring	Corrective Action
	and grade. ▪ Stockpiled topsoil and subsoil will be reused in the same locality from which they were extracted to avoid the spread of pests or weeds (EM028).			
Aquatic ecology				
To protect native aquatic flora and fauna.	▪ A pre-construction survey should be conducted to identify potential turtle nests and platypus borrows within the known distribution ranges of these species (C079). ▪ In watercourses that are potential Fitzroy River Turtle habitat, disturbance to the sandy substrate areas of these watercourse beds and banks will not occur during the breeding and nesting season (September and October) (C080). ▪ Construction of watercourse crossings will be scheduled during the dry season wherever practicable when the intermittent rivers and streams traversed by the pipeline are generally not in flow (C038).	▪ Crossing in accordance with the methodology described in the Aquatic Values Management Plan.	▪ Audit Species Specific Management Plan and Aquatic Values Management Plan.	▪ Restricting construction within and around the creek channel to the dry season where possible. ▪ Where surface water is present during construction to account for the movement of aquatic fauna, design and construct temporary barriers in waterways in accordance with temporary waterway barrier works self assessable code (DEEDI 2010). ▪ Record, investigate and respond should works occur outside the construction corridor.
To protect potential Fitzroy River Turtle habitats within watercourses	▪ Crossings will be constructed in winter months during periods of no, or very low flows, where possible.	▪ Crossing in accordance with Species Specific Management Plan for Fitzroy River Turtle habitat.	▪ Audit Species Specific Management Plan and Aquatic Values Management Plan.	▪ Record, investigate and respond should works occur outside the construction corridor. ▪ Construction activities will cease where a major rainfall event is forecast that will create heavy flows in the watercourse.
To protect native aquatic flora and fauna.	▪ The ROW will be 30m with 10m additional working space. The additional working space will not be cleared in environmentally sensitive	▪ Compliance with permits (including waterway barrier permits) in accordance with the SP	▪ Monitoring and maintaining water quality (before, during and after construction)	▪ Report to relevant authorities. Revise management strategies to prevent recurrence.

Performance Objectives	Management Strategies	Performance Criteria	Monitoring	Corrective Action
	areas (C045). ▪ Flows will be reinstated at each flowing watercourse crossing site as soon as trenching is completed (C081). ▪ Preparing and implementing an Erosion and Sediment Control Plan including installing and maintaining sediment control devices to be installed around exposed areas and earthworks adjacent to aquatic habitats. ▪ Developing a Weed Management Plan for implementation during the construction phase. Where appropriate the plan will include required vehicle washdown, monitoring of pests and weeds, and application of appropriate control measures.	Act and the Fisheries Act. ▪ Distribution of weeds associated with construction activities.	in accordance with Queensland Water Quality Guidelines (DERM 2009), and, Water Quality Objectives for Coomera River Environmental Values and Water Quality Objectives Plan (DERM, 2009). ▪ Monitoring of weed infestations within disturbed areas should occur twice during construction and then biannually for a period of two years following construction. Following the two year period, the frequency of monitoring should be reconsidered dependent on the success of control measures and the level of infestations.	▪

Auditing	▪ Audits to be conducted in accordance with Section 4 of this EM Plan.
Reporting	▪ Submission of checklists to record the effectiveness of flora and fauna protection measures – completed and reviewed by manager / supervisor. ▪ Maintain a Washdown Register of vehicle, plant and equipment declared freed of weeds and copies of all washdown certificates. ▪ Maintain records of clearing activities. ▪ Maintain records of weed spraying and or removal. ▪ Maintain records of weed inspections. ▪ Maintain records of species and number of fauna removed from the pipeline trench. ▪ Maintain records of complaints in Complaints Register. Address complaints and close out. Refer to Section 4 of this EM Plan. ▪ Maintain records of any non-compliances, incidents or accidents. Address and close out in accordance with Section 4 of this EM Plan.
Responsible person (s)	▪ Construction Manager

	▪ EPC Construction Manager ▪ Environmental Officer.
Associated Documentation	▪ Queensland Guidelines for the Construction of Vehicle and Machinery Washdown Facilities, 2000. ▪ Weed Management Plan. ▪ Pest Management Plan. ▪ Arrow Pest Management Program, 2012. ▪ Corrective Action Procedure Action Procedure in the HSEMS. ▪ Environmental Incident Reporting Procedure as outlined in the HSEMS. ▪ Queensland Checklist for Cleandown Procedures, 2000. ▪ Queensland Guidelines for the Construction of Vehicle and Machinery Washdown Facilities, 2000. ▪ Weed information sheets

Table 7-30 Ecological management strategies - operation

Element / Issue	Offset management. Introduction or spread of weed species.

Performance Objectives	Management Strategies	Performance Criteria	Monitoring	Corrective Action
Protecting specific flora and fauna species native to the site.	▪ Areas utilised for offsets will be secured. These areas will be monitored in accordance with the Offset Management Plan.	▪ Changes in biodiversity indicators following completion of rehabilitation of the ROW.	▪ Ongoing monitoring programs will be conducted to document the success of offset mitigation measures.	▪ Corrective action measures will be developed and implemented.
To prevent the spread of weeds along the pipeline easement.	▪ Implement annual weed treatment program along the ROW where weed infestations are identified. Typically, this is implemented in conjunction with landholder spraying and weed control programs (EM029). ▪ Ensure equipment and vehicles are cleaned in designated wash-down sites before leaving weed-infested areas or entering weed-free areas.	▪ Change in weed infestation in or adjacent to the operational ROW or working areas.	▪ Annual monitoring of the pipeline easement to confirm the effectiveness of weed control measures.	▪ Implement measures (e.g. controlled spraying or pulling) to remove invasive species, should weed species be detected.

Auditing	▪ Audits to be conducted in accordance with Section 4 of this EM Plan. ▪ Independent audit every two years.
Reporting	▪ Complete easement inspection checklists to monitor control of weeds along the pipeline easement. ▪ Maintain a Washdown Register of vehicle, plant and equipment declared freed of weeds and copies of all washdown certificates. ▪ Maintain records of any non-compliances, incidents or accidents. Address and close out in accordance with Section 4 of this EM Plan. ▪ Annual Return.
Responsible person (s)	▪ Environmental Officer. ▪ Operations Manager.

Associated Documentation	▪ As required for operations activities, e.g.: - *Land Protection (Pest and Stock Route Management) Act, 2002.* - Arrow Pest Management Program, 2012. - Queensland Checklist for Cleandown Procedures, 2000. - Weed information sheets - Queensland Guidelines for the Construction of Vehicle and Machinery Washdown Facilities, 2000.

7.5 Noise

7.5.1 Description of the existing environment and environmental values

Major existing noise sources along the proposed pipeline route consist of the Main North Coast Railway Line and the Bruce Highway. Other typical rural noise sources include occasional light aircraft, tractors and light vehicles. Several mining companies who own tenements within 200m of the proposed pipeline route include Xstrata Coal Queensland Pty Ltd, Peabody (Burton Coal) Pty Ltd, Vale Australia Pty Ltd, Coppabella Coal Pty Ltd, Marlborough Nickel Pty Ltd and Cement Australia. In some areas, mining activities from these mines are audible at the sensitive receptors.

Ambient noise levels were measured at five representative locations along the proposed pipeline route and typical noise sources were observed to provide information on the current noise environment for the project. These locations were selected to indicate existing noise levels at a variety of environments along the proposed pipeline route. Monitoring period results are presented in Table 7-31.

Table 7-31 Summary of unattended environmental noise monitoring descriptors

Location	Day			Evening			Night		
	LA10 15 min dB(A)	LAeq 15 min dB(A)	LA90 15 min dB(A)	LA10 15 min dB(A)	LAeq 15 min dB(A)	LA90 15 min dB(A)	LA10 15 min dB(A)	LAeq 15 min dB(A)	LA90 15 min dB(A)
Location 5 (KP78.5) (rural residential site located approximately 10km northeast of the Millenium and Poitrel mines and 5km west of the Millenium coal loading facility near Goonyella branch railway line)	51	49	35	40	38	28	41	39	29
Location 5 (KP78.5) (rural residential site located approximately 10km northeast of the Millenium and Poitrel mines and 5km west of the Millenium coal loading facility near Goonyella branch railway line)	51	49	35	40	38	28	41	39	29
Location 4 (KP224.6) (an isolated rural residence)	42	41	28	28	30	22	26	27	20
Location 3 (KP13.2) (semi-rural area on Boongary Road, in the vicinity of Gracemere, southwest of Rockhampton)	51	49	35	46	47	38	39	39	27

Location	Day			Evening			Night		
	LA10 15 min dB(A)	LAeq 15 min dB(A)	LA90 15 min dB(A)	LA10 15 min dB(A)	LAeq 15 min dB(A)	LA90 15 min dB(A)	LA10 15 min dB(A)	LAeq 15 min dB(A)	LA90 15 min dB(A)
Location 2 (KP417.9) (site adjacent to Bruce Highway, 9km north of the village of Bajool, and is located close to the Main North Coast Line)	56	53	43	60	56	39	59	55	33
Location 1 (KP460.2) (a rural residence located on Raglan Station Road north of Ambrose township)	50	47	39	45	42	34	49	45	33

The environment at isolated rural residences has very low background noise levels, with attended monitoring showing L_{A90} noise levels below 30 dB(A) during daytime hours.

Vibration sources including roads, railway line and mining activities identified along the proposed pipeline route are not likely to cause perceivable vibration levels at sensitive receptors, therefore no baseline vibration monitoring was carried out for the project.

Within a 1km buffer either side of the proposed pipeline route, 137 residential dwellings have been identified.

In addition, the following facilities have been identified within 1km either side of the proposed pipeline route near KP466.9 (pipeline is located within the SGIC in this area):

- One police station
- One library
- Mount Larcom Ambulance Station
- Mount Larcom State School.

Sensitive receptors are shown on Map Series 7 in Appendix A.

7.5.1.1 Noise criteria

The *Environmental Protection (Noise) Policy* (EPP (Noise)) defines the environmental values to be protected as the qualities of the acoustic environment that are conducive to:

a) Protecting the health and biodiversity of ecosystems.
b) Human health and wellbeing, including by ensuring a suitable acoustic environment for individuals to do any of the following:
   - sleep
   - study or learn

- be involved in recreation, including relaxation and conversation

c) Protecting the amenity of the community.

Schedule 1 of the EPP (Noise) establishes long term acoustic quality objectives for enhancing or protecting environmental values, as described in Table 7-32.

Table 7-32 Schedule 1 Acoustic quality objectives

Sensitive receptor	Time of day	Acoustic quality objective (measured at the receptor) dB(A)			Environmental value
		$L_{Aeq,adj,1hr}$	$L_{A10,adj,1hr}$	$L_{A1,adj,1hr}$	
Dwelling (for outdoors)	daytime and evening	50	55	65	health and wellbeing
Dwelling (for indoors)	daytime and evening	35	40	45	health and wellbeing
Dwelling (for indoors)	night-time	30	35	40	health and wellbeing, in relation to the ability to sleep
Park or garden that is open to the public for use other than for sport or organised entertainment	anytime	The level of noise that preserves the amenity of the existing park or garden			community amenity

7.5.1.2 Vibration criteria

For the project, the continuous vibration limits for human discomfort and structural damage, drawn from British Standard (BS) 6472 and BS7385 are proposed and shown in Table 7-33.

Table 7-33 Continuous vibration thresholds for human discomfort at different locations

Location	Peak Particle Velocity threshold (mm/s)
Critical working areas	0.4mm/s
Residential dwellings	1.6mm/s for Daytime, 1.2mm/s Night time
Commercial premises	3.2mm/s

Levels for assessing the effects of vibration on structures are provided in the vibration velocity guideline BS7385- Part 2:1993. These are summarised in Table 7-34.

Table 7-34 BS 7385 - Transient vibration guide values for cosmetic damage

Type of building	Vibration Velocity in mm/s (Peak) Measured at the Foundation	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed	50mm/s	
Unreinforced	15mm/s at 4 Hz increasing to 20mm/s at 15 Hz	20mm/s at 15 Hz increasing to 50mm/s at 40 Hz and above

Note: Values applicable at building foundation

7.5.1.3 Blasting criteria

The assessment of noise and vibration impacts associated with blasting during the construction phase has used EHP's Ecoaccess guideline, *Noise and Vibration from Blasting* (2006). These guidelines provide assessment criteria for blasting noise and vibration, as shown in Table 7-35.

Table 7-35 Summary of noise and vibration blasting criteria

Topic	Criteria for noise and vibration assessment
Noise Blasting	Air blast overpressure: • must be not more than 115 dB (linear) peak for nine out of any ten consecutive blasts initiated, regardless of the interval between blasts; and • must not exceed 120 dB (linear) peak for any blast. Blasting operations must be carried out in such a manner that if ground vibration should propagate to a noise sensitive place, the ground borne vibration: • must not exceed a peak particle velocity of 5mm per second for nine out of any ten consecutive blasts initiated, regardless of the interval between blasts; and • must not exceed a peak particle velocity of 10mm per second for any blast.
Times of blasting	Blasting should generally only be permitted during the hours of 9.00am to 3.00pm, Monday to Friday, and from 9.00am to 1.00pm on Saturdays. Blasting should not generally take place on Sundays or public holidays. Blasting outside these recommended times should be approved only where: • blasting during the preferred times is clearly impracticable (in such situations blasts should be limited in number and stricter airblast overpressure and ground vibration limits should apply); or • there is no likelihood of persons in a noise-sensitive place being affected because of the remote location of the blast site.

Source: Ecoaccess Guideline Noise and Vibration from Blasting (EHP 2006)

7.5.2 Potential adverse or beneficial impacts of the project activities on the identified environmental values

7.5.2.1 Noise

Construction noise is expected to exceed the project noise goals at approximately seven noise sensitive receptors within 200m of the pipeline route, although construction activities are scheduled to occur during the daytime, between 6.00am to 6.00pm, for the majority of the works, and will be

short term at any one location as the construction activity moves progressively along the proposed pipeline route. This will remove the potential for sleep disturbance.

Noise generated from construction machinery is expected to range up to 100dB(A) at the source, but the total noise generated during construction will depend on the combination of machinery in use and the location and duration of construction activities.

It is possible that in hard rock terrain blasting may be necessary. The extent of the nuisance caused by the noise from such works depends largely upon the quantity of blasting required, the depth of drilling, the character of the rock, the blasting techniques employed and proximity to sensitive receptors. Any blasting will be undertaken during the day with notification given in advance to any residents in the vicinity.

It is unlikely that noise from the construction of the pipeline or subsequent operational activities will have a lasting or major impact on native fauna.

Noise will not be generated from normal operation of the project. However, when venting of the pipeline is required (e.g. emergency release), a very loud, high-pitched noise at vent valves. This would only occur in an emergency. If for any reason venting was required at any other time such as during maintenance, local residents, landholders and affected industries will be notified in advance.

7.5.2.2 Vibration

The use of heavy plant and equipment during construction may generate discernible vibrations in proximity to particular activities, especially within 100m of blasting activities on rocky terrain. The level of vibrations generated as a result of these activities will vary in intensity and character depending on the combination of plant in operation at any one time and the location and duration of the individual activities.

The extent of vibration nuisance caused by any blasting works depends largely upon the volume of blasting required, the depth of drilling, the character of the rock, the blasting techniques employed and proximity to sensitive receptors. Blasting activities, if required, are not likely to cause perceivable vibration levels at the sensitive receptors and will not exceed the airblast overpressure and ground vibration criteria.

7.5.3 Management strategies

This Section describes measures to manage potential impacts from noise and/or vibration generated by the project. Management strategies are summarised in Table 7-36 and Table 7-37.

A Noise and Vibration Management Plan (NVMP) will be developed for activities where noise and/or vibration must be controlled and mitigated.

An analysis of where rock blasting may occur will be confirmed during detailed design and appropriate mitigation measures identified. The blasting levels and times provided within the Ecoaccess Guideline Noise and Vibration from Blasting (EHP 2006) will need to be considered for any

blasting undertaken as part of construction activities. If blasting is required, a Blast Management Plan will be prepared as part of the NVMP. An outline of the NVMP and Blast Management Plan is presented in Appendix G.

Table 7-36 Noise and vibration management procedures – construction

Element / Issue	Noise nuisance on sensitive receptors. Vibration from construction activities.

Performance Objectives	Implementation / Management Strategies	Performance Criteria	Monitoring	Corrective Action
To avoid noise nuisance generated by construction activities.	▪ Develop and implement a NVMP for construction activities (EM030). ▪ With the exception of Horizontal Directional Drilling (HDD) and hydrostatic testing, construction activities will be scheduled to occur between the hours of 6.00 am and 6.00 pm (C069).	▪ Complaints of excessive noise received during construction.	▪ In the event of complaint, implement noise monitoring and corrective action. ▪	▪ Implement management measures as outlined in the NVMP.
	▪ The Project will liaise with landholders to advise on the construction schedule and construction works through their respective landholdings and the likely duration of potentially noisy activities (C067). ▪ A complaints register will be maintained and complaints will be addressed in a timely manner (C068). ▪ Vehicles and equipment will be fitted with noise-reduction devices (EM031).	▪ Noise related complaints received from residents/ sensitive receptors during construction.	▪ Evidence of notification to nearby residents. ▪ Noise monitoring will be conducted if directed by the administering authority in response to a noise complaint.	▪ Investigate construction noise sources. Implement a hierarchy of mitigation focusing on source control, changes to construction methods or programming. ▪ Conduct attended noise monitoring (refer to Appendix G).
	▪ Vehicles, plant and equipment will be maintained in accordance with manufacturers' requirements (C065). ▪ Limiting vehicle speeds on the Right of Way (ROW) to reduce	▪ Compliance with manufacturer specifications with respect to noise emissions.	▪ In the event of a complaint made in relation to a specific vehicle or piece of equipment monitor to determine noise emissions from that item.	▪ Recommendations and corrective actions implemented may include increased servicing of vehicles. ▪ Evidence of prompt repair and replacement of faulty

Performance Objectives	Implementation / Management Strategies	Performance Criteria	Monitoring	Corrective Action
	impacts (such as wheel-generated dust or noise) (C064).			equipment generating excess noise.
To avoid vibration nuisance to sensitive receptors.	▪ Should blasting be required, a condition survey will be conducted on any landholders properties within 100m of where blasting is to occur. (C071). ▪ Provide advance notice of any scheduled atypical noise events to nearby residents (EM032). ▪ Any blasting will be carried out in accordance with current practice standards with particular reference to Australian Standard AS 2187:1998 'Explosives - Storage, Transport and Use'. (C070).	▪ Vibration related disturbance at residents/ sensitive receptors during construction. ▪ Blasting will meet the criteria in Ecoaccess guideline: Noise and Vibration from Blasting (2006) and the Australian Standard AS 2187:1998 Explosives - Storage, Transport and Use.	▪ A pre-construction condition survey on properties within 100m of a proposed blasting location will be conducted. ▪ Vibration monitoring should be carried out at sensitive receivers if blasting occurs within 200m from a sensitive receiver. ▪ Noise monitoring will be conducted if directed by the administering authority in response to a noise complaint. ▪ Vibration monitoring (refer to Appendix G).	▪ Amend blasting requirements to comply with vibration criteria.

Auditing	▪ Audits and reviews (non-compliance and incident reporting) undertaken in accordance with Section 4 of this EM Plan.
Reporting	▪ Complete check sheets to record atypical noise or vibration generating activities. ▪ Maintain records of pre-construction property condition surveys. ▪ Maintain records on noise testing of vehicles and equipment. ▪ Maintain vibration monitoring records. ▪ Maintain records of complaints in Complaints Register. Address complaints and close out. Refer to Section 4 of this EM Plan. ▪ Maintain records of any non-compliances, incidents or accidents. Address and close out in accordance with Section 4 of this EM Plan.
Responsible Person(s)	▪ Construction Superintendent. ▪ EPC Contractor Construction Manager. ▪ Environmental Officer.
Associated Documentation	▪ Ecoaccess guideline: Noise and Vibration from Blasting (2006). ▪ Environmental Protection (Noise) Policy 2008. ▪ AS 2436:1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites. ▪ British Standard 7385-1993 - Assessing the effects of vibration on structures. ▪ Noise and Vibration Standard Operating Procedure.

Table 7-37 Noise and vibration management strategies – operation

Element / Issue	Noise nuisance at sensitive receptors from operations activities.

Performance Objectives	Management Strategies	Performance Criteria	Monitoring	Corrective Action
To avoid noise nuisance generated by pipeline maintenance activities.	▪ A complaints register will be maintained and complaints will be addressed in a timely manner (C068).	▪ Noise complaints received regarding scheduled maintenance activities.	▪ Maintenance activities hours recorded.	▪ Revise scheduling and performance characteristics of maintenance activities.
	▪ Provide advance notice of any scheduled maintenance activities creating excess noise along the ROW, including venting, to nearby residents (EM033). ▪ A complaints register will be maintained and complaints will be addressed in a timely manner (C068)	▪ Noise complaints from sensitive receptors.	▪ Evidence of notification to nearby residents.	▪ Undertake monitoring of noise complaint and undertake corrective actions based on monitoring results.
	▪ Vehicles, plant and equipment will be maintained in accordance with manufacturers' requirements (C065).	▪ Compliance with manufacturer specifications with respect to noise emissions.	▪ In the event of a complaint made in relation to a specific vehicle or piece of equipment monitor to determine noise emissions from that item.	▪ Recommendations and corrective actions implemented may include increased servicing of vehicles. ▪ Evidence of prompt repair and replacement of faulty equipment generating excess noise.

Auditing	▪ Independent audit every two years.
Reporting	▪ Works deviating from normal operating conditions will be reported and action initiated to prevent a recurrence of the incident. ▪ Maintain records of complaints in Complaints Register. Address complaints and close out. Refer to Section 4 of this EM Plan. ▪ Maintain records of any non-compliances, incidents or accidents. Address and close out in accordance with Section 4 of this EM Plan. ▪ Annual Return.
Responsible Person(s)	▪ Environmental Officer. ▪ Operations Manager.
Associated Documentation	▪ EMS Operations.

7.6 Social

This Section provides a description of the existing social environment in the project area.

7.6.1 Description of the existing environment and environmental values

7.6.1.1 Community Characteristics

The project area encompass a number of main centres and townships located along the proposed pipeline route, including Moranbah, Glenden, Nebo, Dysart, Gracemere and Calliope. The overall population of the project area was 104,801 people in 2010, with an expected increase to approximately 180,000 people by 2031. Key characteristics of the project area include:

- A slightly more transient population compared to Queensland with higher proportions of people living elsewhere five years prior to the 2006 Census
- Approximately 3.5% of the project area population, or 3,126 people, identified as being Indigenous at the 2006 Census. The Indigenous people of the project area generally had lower levels unemployment compared to Indigenous people in Queensland as a whole, but much higher levels compared to Queensland's total population
- A generally young population, with a slightly higher proportion of children and a lower proportion of older people aged 65 years and older compared to Queensland
- In 2006, the project area has relatively low levels of cultural diversity compared to Queensland with lower proportions of people born overseas and people who spoke a language other than English
- The project area had a slightly larger average household size compared to Queensland as a whole, with the majority of households in the project area family households.

7.6.1.2 Employment and the economy

Overall, the project area had a relatively low rate of unemployment compared to Queensland as a whole, with approximately 42,000 people in the project area aged 15 years or over that were either employed or looking for work in 2006. Mining was a key employer in the project area, with approximately 22% of the workforce employed in mining, compared to approximately 2.8% in Queensland overall.

In 2006, households in the project area had relatively high household and individual incomes equal to or above those for Queensland as a whole. However, there were pockets of relative socio-economic disadvantage and low levels of economic resources throughout the project area, and these areas are likely to be more vulnerable to the impacts of large infrastructure projects than those that display levels of relative advantage.

7.6.1.3 Housing and accommodation

The project area generally had a significantly higher rate of separate houses compared to Queensland as a whole. However, the project area also had relatively high proportions of other dwellings, which may reflect the presence of temporary workers' accommodation camps associated

with mining activity. The project area generally had rates of rental housing similar to Queensland, with some townships experiencing very high rates of rental housing. This is likely to be attributed to the high proportions of company provided housing in some of the key townships in the project area. Median house sale prices across the project area have increased considerably over recent years, largely due to the increased demand for housing from workers in the mining and resources industries.

7.6.1.4 Amenity and public safety

Many of the small towns throughout the project area were generally considered to be safe communities with low crime rates (Isaac Regional Council Community Plan, 2009). However, the project area had slightly higher rate of reported assault, offences against the person, and other property damage compared to Queensland (Queensland Police Service, 2006).

7.6.1.5 Local community and environmental values

Community and environmental values in the project area generally relate to:

- Access and connectivity, with the community valuing safe road networks to improve community connectivity and accessibility to services, larger centres and friends and family
- Rural amenity and lifestyle, as the area is generally characterised by rural and agricultural landscapes, and its associated laid back rural lifestyle
- Community safety, with the populations in the project area valuing the region as a relatively safe area, with opportunities for their children to grow up safely
- Social infrastructure, services and facilities, such as hospitals, schools, libraries, churches and open space/recreation grounds are highly valued in local communities. Continued accessibility to these services and facilities, particularly medical services, is important to communities where high levels of resource project workforces have increased demand for such services
- Housing, with the availability of affordable and appropriate housing is valued by the community
- Local employment opportunities, particularly the equitable recruitment and training of local workers, with an emphasis on vulnerable groups who experience disadvantage in the labour market including Indigenous persons, women, young people, the unemployed and persons with a disability.

7.6.2 Potential adverse or beneficial impacts of the project activities on the identified communities and environmental values

Potential beneficial impacts of the project include:

- Employment and training opportunities
- Demand for local goods and services, including catering, transportation, sub-contractors and accommodation services, benefiting local and regional communities

- Economic benefits through increased output, contribution to household incomes, employment, and indirect contribution to energy self-sufficiency and security of supply in Australia.

The construction of the project may result in short-term disruption to community with limited long-term impacts likely to occur once the project is commissioned and operating. Potential adverse impacts associated with the project during construction include:

- Temporary disruption to land use
- Short-term disruption to accessing property and/or social infrastructure
- Increased demand for constrained short-term accommodation facilities
- Impacts on existing skill shortages
- Increased traffic on the regional road network.

The proposed pipeline route is within 1km of 137 residential lots (refer to infrastructure map series for locations of residential dwellings, Map Series 7, in Appendix A.

The construction of the project, including the stockpile of materials, noise, dust and traffic may temporarily affect the amenity of a small number of residents located close to the proposed works for a few weeks. Additionally, potential impacts to public safety may result from construction traffic, including the delivery and collection of materials, and the movement of the construction workforce, as well as changes to access or road works where the proposed pipeline is near a road reserve. As such, there may be some potential safety issues for pedestrians at bus stops and waiting for the school bus along the proposed haul routes or roads used by the workforce.

7.6.2.1 Complaints and dispute resolution

The Social Impact Management Plan (SIMP) provides mechanisms to report incidents and respond to complaints related to the social environment. Arrow will implement a Complaints Management System, consistent with *AS ISO10002-2006 'Customer satisfaction – Guidelines for complaints handling in organisations',* through which disputes and complaints can be resolved (refer to Section 4.9).

7.6.3 Management strategies

Management strategies identified to mitigate potential impacts of the project on community values are provided in Table 7-38 and Table 7-39. Mitigation measures to address social issues will be presented in the SIMP. An SCP will be developed to ensure ongoing community and government consultation, and any social impacts will be mitigated and managed in accordance with these plans. This will ensure that any social and community impacts on existing communities as a result of the project are minimised.

A number of strategies will be implemented to enhance the potential beneficial impacts associated with the project, including early and ongoing consultation with stakeholders, the provision of suitable employment opportunities and training and supporting local procurement opportunities.

Table 7-38 Community management strategies – construction

Element / Issue	Construction activities (disruption / disturbance) impacting on local communities and landholders.

Performance Objectives	Management Strategies	Performance Criteria	Monitoring	Corrective Action
To protect the social and environmental values of local landholders and communities.	▪ Communication and consultation with landholders to reduce uncertainty for property owners about the use of the Right of Way (ROW) and easement (including conversion of the Right of Way (ROW) to an easement option) will be ongoing during construction and operation respectively (C086). ▪ Worker behaviour protocols will be implemented throughout construction (C087). ▪ The capacity of health services, in particular General Practitioner (GP) services, will be identified to minimise impact to local health services (C088).	▪ Complaints from local communities and landholders.	▪ Monitoring of complaints received and the time taken to resolve the issue.	▪ Investigate and respond on receipt of a complaint from local communities or landholders.
To minimise disruption to landholder activities and third parties.	▪ Engage early and often with landholders where access may be affected. ▪ Install gates, cattle grids and/or temporary fencing to control livestock, where agreed (EM034). ▪ Ensure vehicles and personnel remain on the construction ROW and designated access tracks, unless at designated work and turnaround areas within the expanded 40m width (EM035).	▪ Level of unscheduled disruption to landholder activities or to third parties.	▪ Evidence of timely consultation with landholders and third parties. ▪ Monitor feedback from landholder and third parties.	▪ Investigate and respond on receipt of a complaint from local communities or landholders.
Construction activities are managed to maintain public safety near construction works.	▪ Any potential health and safety impacts will be managed through appropriate health and safety policies as part of the Safety Management Plan - Construction (C089). ▪ Health and Safety Officers will be present on the construction site (C090). ▪ Public access along the ROW will be temporarily suspended during construction.	▪ Impacts on public health and safety.	▪ Monitor provision of signage at road crossings and entry points to prevent public access to the ROW.	▪ Repair/reinstate signage if found damaged or removed.
To minimise impact on	▪ An updated list of health services available	▪ Impacts on existing medical and	▪ Monitor provision of	▪ Corrective actions to be

Performance Objectives	Management Strategies	Performance Criteria	Monitoring	Corrective Action
medical and health services.	along the pipeline route, including contact details, will be compiled (C091). ▪ Local health authorities will be advised of the project timetable and made aware of the possible need for their services during the construction phase. The authorities will be updated as the project progresses down the pipeline route (C092). ▪ Employees will be warned about the possibility of wildlife hazards during induction (C093).	health services.	workforce medical and health services.	developed from monitoring strategies.
To minimise health and safety impacts on local communities.	▪ A detailed Pipeline Safety Management Study (SMS) will be undertaken for the project in accordance with Australian Standard AS 2885.1:2012 'Pipelines-Gas and Liquid Petroleum'. The PSMS will ensure that all possible threats at each location are identified, evaluated and appropriately planned for and managed during pipeline construction and operation (C094). ▪ The Safety Management Plan - Construction will be developed in consultation with emergency response agencies (C095). ▪ An Emergency Response Plan (ERP) will be prepared for all likely emergency situations and incidents that could occur as a result of project construction or operations by natural hazards, systems and equipment failure or by human error (C096). ▪ Chemical storage will comply with Australian Standards and Material Safety Data Sheets (MSDS) requirements and Dangerous Goods Storage and Handling Guidelines 2010 (C010).	▪ Impacts on public health and safety.	▪ Monitor pipeline construction in accordance with AS 2885.	▪ Corrective actions to be developed from monitoring strategies.

Auditing	▪ Audits to be conducted in accordance with Section 4 of this EM Plan.
Reporting	▪ Report on social impacts in accordance with the SIMP. ▪ Maintain records of complaints in Complaints Register. Address complaints and close out. Refer to Section 4 of this EM Plan. ▪ Maintain records of any non-compliances, incidents or accidents. Address and close out in accordance with Section 4 of this EM Plan.
Responsible Person(s)	▪ Construction Superintendent. ▪ EPC Construction Manager. ▪ Environmental Officer.
Associated Documentation	▪ SIMP. ▪ SCP. ▪ Alignment Sheets. ▪ Environmental Line List. ▪ Corrective Action Procedure. ▪ Environmental Incident Reporting Procedure.

Table 7-39 Community management strategies – operation

Element / Issue	Landholder liaison maintained.

Performance Objectives	Management Strategies	Performance Criteria	Monitoring	Corrective Action
Operation activities do not adversely impact on landholder activities	▪ Landholder liaison regularly maintained. ▪ Landholders advised in advance of any maintenance activities.	▪ Change in public risk levels from pipeline operations.	▪ Any landholder concerns addressed in a timely manner and closed out.	▪ Operations Manager to implement corrective action where necessary.

Auditing	▪ Independent audit every two years.
Reporting	▪ Reporting on complaints received, responses provided, timeliness of responses and corrective actions taken. ▪ Maintain records of complaints in Complaints Register. Address complaints and close out. Refer to Section 4 of this EM Plan. ▪ Maintain records of any non-compliances, incidents or accidents. Address and close out in accordance with Section 4 of this EM Plan. ▪ Annual Return.
Responsible person(s)	▪ Operations Manager.
Associated Documentation	▪ SIMP ▪ SCP

7.6.4 Heritage

This section provides a description of the existing environment, environmental values, potential impacts and mitigation measures for:

- Indigenous cultural heritage
- Non-Indigenous cultural heritage.

7.6.4.1 Description of the existing environment and environmental values

7.6.4.2 Indigenous cultural heritage

A desktop assessment was undertaken for the project which identified Indigenous cultural heritage values within the project area as follows:

- Known Indigenous cultural heritage values (register searches and literature review)
- Potential Indigenous cultural heritage values (predictive statement and literature review)
- Relevant Aboriginal Parties
- Existing management agreements (ILUAs or CHMPs)
- Potential impacts on heritage and mitigation measures to be implemented.

Indigenous cultural heritage values Commonwealth, State and local government registers were searched. The results of the database searches were as follows:

- Commonwealth registers (World Heritage List, Commonwealth Heritage List, National Heritage List and the Register of the National Estate) – No sites within 1km of the project area
- State Register (Indigenous and Torres Strait Islander Cultural Heritage register and Database (DATSIMA)) – 345 sites within a 5km buffer of the project area
- Local Government Planning Schemes (Calliope Shire Planning Scheme and The Gladstone Plan) – No sites within the project area.

Of the sites identified in the register searches none were within the project area, however, six sites (one quarry, three scarred trees and two stone artefact scatters) were located within 100m of the project area. Four of these sites were located within 50m of the project area and require confirmation of their location through cultural heritage surveys as they may potentially extend or be located within the study area (allowing for error within the original co-ordinates recorded).

In addition available Indigenous cultural heritage studies were reviewed. These studies were located within the general region as well as adjacent to the project area in order to predict the type of sites that may be located within the project area. The most common site types identified were stone artefact scatters and scarred trees. Based on the results of the desktop assessment it is highly likely

that Indigenous cultural heritage values are located within the project area. These will be identified during cultural heritage surveys.

7.6.4.2.1 Identification of Aboriginal parties

The following currently registered native title claims searched through the National Native Title Tribunal (NNTT) have standing as exclusive Aboriginal parties for that portion of the project that falls within their claim boundaries (refer to Figure 7-1). Approximately 87% of the proposed pipeline route falls into this category.

- Barada Barna (QC08/11, QUD380/08)
- Birri (QC98/12, QUD6244/98)
- Darumbal People (QC97/21, QUD6131/98)
- Darumbal #2 (QC99/1, QUD6001/99)
- Jangga (QC98/10, QG6230/98)
- Port Curtis Coral Coast (QC01/29, QUD6026/01)
- Wiri People Core Country Claim (QC06/14, QUD372/06).

The following also have the status of exclusive Aboriginal parties that lie within an unregistered claim, but do not overlap with any currently registered claim. Approximately 3% of the proposed pipeline route falls into this category:

- Southern Barada & Kabalbara (QC00/4, Q60004/00)
- Wiri #2 (QC98/11, QG6251/98)
- Barada Barna Kabalbara &Yetimarla People (QC01/13, QUD6011/01).

The Barada Barna Kabalbara and Yetimarla People claim overlaps with a section of the Wiri #2 claim.

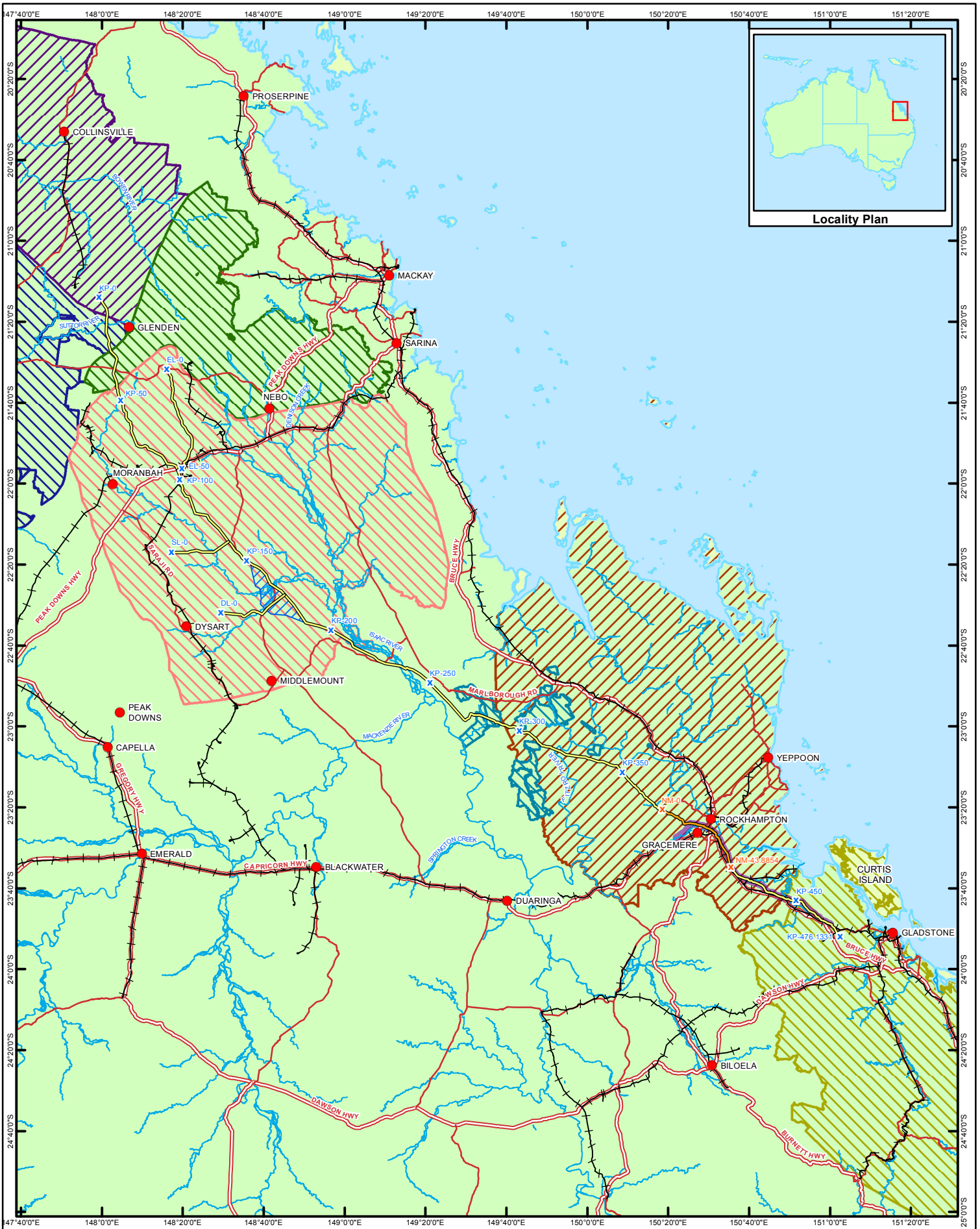


Figure 7 - 1: Native Title Determination Areas within the project area

Legend

- Major Towns
- Kilometre Point - ABP Route
- Kilometre Point - ABP Route SGIC Nine Mile
- ABP Route - Revision SR
- ABP Route - Revision SR SGIC Nine Mile
- Railways
- Highways
- Major Roads
- Major Watercourses
- Upper Isaac River Corridor
- Stanwell-Gladstone Infrastructure Corridor

NTDA Register (QLD)

- Barada Barna People
- Birri People
- Darumbal People
- Darumbal People 2
- Jangga People
- Port Curtis Coral Coast
- Wiri People Core Country Claim

Data Sources:
StreetPro: Major Towns, Roads, Railways; DEHP: Major Watercourses; National Native Title Tribunal: NTDA register (QLD);
Data Supplied by Arrow Energy: ABP Routes, Kilometre Points, Upper Isaac River Corridor, Stanwell-Gladstone Infrastructure Corridor.

N

arrow energy go further

0 25 50
Kilometres

Scale: 1:2,250,000 @ A4
Coordinate System: GCS GDA 1994

Document: I:\QENV2\Projects\QE06591\EN0286\2.500 - Spatial\ArcGIS\EMP\Figure7_1_Native_Title_Determination_AreasWithinTheProjectArea_A4.mxd Date: 27/11/2012

No native title claim has been registered on three sections of the proposed pipeline route. The areas extend for a distance of 63km, or just over 10% of the project area. The areas with no native title claim are located between the following registered claim areas:

- Barada Barna and Darumbal People
- Darumbal and Darumbal People #2
- Darumbal and Port Curtis Coral Coast People.

In addition, there are several cultural heritage bodies identified under the ACH Act 2003 who may have an interest in the project area:

- Woora Consulting Pty Ltd
- Darumbal Enterprises Pty Ltd
- Gidarjil Cultural Heritage Corporation.

7.6.4.3 Non-Indigenous cultural heritage

A desk-top assessment was undertaken to identify Indigenous cultural heritage values within the project area and includes:

- Known non-Indigenous cultural heritage values (register searches and literature review)
- Potential non-Indigenous cultural heritage values (predictive statement and literature review)
- Potential impacts on heritage and mitigation measures to be implemented.

In order to identify known non-Indigenous cultural heritage values within the project area Commonwealth, State and local government registers were searched. The results of the database searches were as follows:

- Commonwealth registers (World Heritage List, Commonwealth Heritage List, National Heritage List and the Register of the National Estate) – No sites within 1km of the project area
- State Register (Queensland Heritage Register and Historical Inventory (Cultural Heritage Information Management System) (EHP)) – Only one place within 1km of the project area
- Local Government Planning Schemes (Calliope Shire Planning Scheme and The Gladstone Plan) – No sites within the project area

The only registered site identified within 1km of the project area was Raglan Homestead (QHR ID: 600389) which is approximately 160m to the southwest of the AB mainline. This was located on the Queensland Heritage Register.

A desktop assessment (literature review) of historic sources was undertaken for the project. This included historical accounts of the region, local area histories, and numerous unpublished manuscripts held in the Capricornia Collection at the Central Queensland University. Places of potential historic significance identified in the literature reviews included property homesteads, camping and water reserves, creek crossings, stock yards (including some associated with the short-lived sheep industry), gate posts of properties, historic roads and sundry buildings. It was noted that most of the potential historic sites would be of local significance rather than of state or national significance.

7.6.4.4 Potential adverse or beneficial impacts of the project activities on the identified environmental values

7.6.4.5 Indigenous cultural heritage

The desktop analysis identified Aboriginal sites within close proximity (50m) of the project area The sites identified within close proximity were a quarry, two artefact scatters and four scarred trees. The assessment also identified a high potential for additional Indigenous cultural heritage to be located within the project area.

Cultural heritage field survey and direct engagement with the relevant Aboriginal parties is required to identify the Indigenous cultural heritage values within the project area. As part of their duty of care Arrow is required to engage with Aboriginal parties to identify the Indigenous cultural significance of the area. The scientific significance of the Aboriginal sites will be variable but may provide information regarding settlement patterns, site types and resource procurement.

Arrow is currently undertaking pre-construction cultural heritage surveys of the project area however the results of these are currently unavailable for the EM Plan. These results will be incorporated into any CHMP and ILUA planned for the project area so that significant cultural heritage sites can be avoided and values mitigated.

7.6.4.6 Non-Indigenous cultural heritage

The desktop analysis identified one Non-Indigenous site within close proximity (160m) of the project area. Raglan Homestead (QHR ID:600389) would not be impacted directly by the project, however, the historic values and potentially associated values would also need to be assessed.

Pre-construction cultural heritage surveys of the project area are currently being undertaken by Arrow, however the results of these are currently unavailable for the EM Plan. These results would be incorporated into a historical heritage management plan (HHMP).

7.6.5 Management strategies

A native title and cultural heritage compliance strategy has been initiated by Arrow to resolve native title interests. Arrow is currently in the process of registering ILUAs with all Native Title groups along the proposed pipeline route. These ILUAs contain management arrangements for aboriginal cultural heritage. Arrow will comply with the ILUAs containing the relevant cultural heritage management

arrangements which will constitute Arrow's compliance with the ACH Act 2003 Duty of Care guidelines.

To mitigate potential impacts on non-Indigenous cultural heritage values, Arrow is currently developing a HHMP and will be implemented as part of the project EM Plan. The HHMP has been developed during field survey within the project area. With the implementation of appropriate mitigation, it is anticipated that the residual impacts on non-Indigenous cultural heritage will be minor and manageable.

Management strategies to protect Indigenous and non-Indigenous cultural heritage during construction are summarised in Table 7-40.

Table 7-40 Heritage management strategies – construction

Element / Issue	Encroachment, accidental damage or disturbance to Indigenous and non-Indigenous cultural heritage places, sites or artefacts.

Performance Objectives	Management Strategies	Performance Criteria	Monitoring	Corrective Action
Indigenous Heritage				
Indigenous cultural heritage values, sites or places are either avoided, harm minimised or harm managed.	▪ As the management arrangements contained in the registered ILUAs. ▪ Compliance with the provisions of the ILUAs developed in conjunction with the respective NT parties (C083). ▪ Compliance with the CHMP developed in conjunction with the respective NT parties (C084).	▪ Compliance with the provisions of the ILUA. ▪ Compliance with Cultural Heritage Duty of Care to Indigenous cultural heritage.	▪ Monitor for compliance with the management arrangements outlined in the ILUA.	▪ Undertake corrective actions in accordance with the ILUA.
To prevent accidental destruction, damage or disturbance of Indigenous cultural heritage values, sites or places.	▪ Conduct formal inductions/briefings to pipeline construction personnel on Indigenous cultural heritage values, sites or places and the appropriate measures to be undertaken in the event of new finds (EM036). ▪ If a new cultural heritage sites or places are uncovered ▪ The Indigenous representatives, of the party responsible as outlined in the relevant ILUA shall be contacted and management measures as outlined in the ILUA shall be applied. (EM037).	▪ Identification and compliance with the management measures as outlined in the ILUA.	▪ Monitor for compliance with the management measures outlined in the ILUA.	▪ Undertake corrective actions in accordance with the ILUA.
Non-Indigenous Heritage				
Cultural heritage values for historical heritage sites, places or structures are maintained.	▪ Implement the Historic Heritage Management Plan (HHMP) as part of the project Environmental Management Plan (EM Plan) (C085). ▪ Incorporate historical heritage awareness into site induction procedures, including information on heritage values, (EM038)	▪ Preservation of historical heritage values, sites or places as outlined in the Historical Heritage Management Plan.	▪ Monitor for compliance with the management measures outlined in the HHMP.	▪ Undertake corrective actions in accordance with the HHMP.

Auditing	▪ Audits to be conducted in accordance with Section 4 of this EMP.
Reporting	▪ Maintain records of compliance with the management measures outlined in the ILUA. Maintain records of complaints in Complaints Register. Address complaints and close out, as outlined in the ILUA or HHMP.
Responsible Person(s)	▪ Construction Manager. ▪ Cultural Heritage / Historical Heritage Officer.
Associated Documentation	▪ ILUAs. ▪ HHMP.

7.7 Waste

This Section describes the wastes generated by the project and the methods by which project wastes will be managed during the construction and operations phases of the project. An inventory of likely waste products is provided and proposed management strategies identified in accordance with the *Environmental Protection (Waste Management) Policy 2000* (EPP (Waste)) and the *Environmental Protection (Waste Management) Regulation 2000.*

7.7.1 Activities

The majority of wastes generated will occur during the construction phase. Relatively low volumes of non-reusable or non-recyclable wastes will be generated.

Hydrostatic testing will be undertaken to establish the strength and leak tightness of the test section and to confirm the strength of the pipeline. The use of additives in hydrotest water will be minimised. Where feasible, test water will be reused to reduce the amount of waste water to be managed.

It is anticipated that low volumes of waste will be produced during operation and maintenance, in the form of liquid waste from pigging and pipe cleaning activities. Waste oils and greases will be generated during inspection and maintenance activities. These wastes will be transported off-site to a suitable recycling facility or licensed landfill. Scheduled maintenance activities, include pigging may result in the generation of sludge. This material is classified as regulated waste and will be transported to a licensed regulated waste landfill.

When the pipeline is no longer required, it will be decommissioned in accordance with the regulatory requirements and accepted environmental best practices of the day. Provided that the pipeline is purged of gas and left in-situ, low volumes of waste are expected to be generated during the decommissioning phase.

The sources of waste, nature and typical volumes that are likely to be generated by the project are provided in Table 7-41.

Table 7-41 Waste items and volumes

Waste item	Volume	
Construction Waste		
Excavated waste		
Estimated volumes of excess materials excavated along the pipeline route (volumes estimated to the nearest 1000 m^3).	▪ Sand and loam topsoil ▪ Clay topsoil ▪ Topsoil ▪ Dispersive clay subsoil ▪ Non-dispersive sand and loam subsoil ▪ Non-dispersive clay subsoil Total	0m^3 0m^3 0m^3 373,000m^3 0m^3 0m^3 373,000m^3
Air emissions		
Excess dust during the excavation of the trench	Minimal – generally windblown dust	
Solid Waste		
Packaging, recyclable and reusable wastes including timber skids, pallets, drums, scrap metals and fibre/nylon ropes and drums.	All pipe-delivery packaging (e.g. ropes, straps) will be removed from the ROW	
Scrap – welding rods (stub ends) / grinding discs	5.5m^3 skip per week	
HDD cuttings / tailings (no additives other than bentonite)	200m^3 per 400m drill string	
Cleared vegetation (felled timber)	Minimal	
Liquid Waste		
Used chemicals and oils – e.g. lube oil, spent x-ray film developer chemicals (if automatic ultrasonic inspection system not used), used tins from solvents	200 litre drums (or similar sealed container)	
Commissioning Waste		
Liquid Waste		
Hydrotest water (first flush 'slug')	1ML/25km long test section	
Hydrotest water	up to 25ML/25km long test section	
Cleaning and drying pigs	As required	
Operational wastes		
Liquid Waste		
Sludge (pigging)	Small	
Decommissioning wastes		
Solid waste		
Scrap metal	2 x 12m shipping containers per scraper station	

Note 1: Volume of excess soil material estimated to the nearest 1000m^3. Total volume of excess soil material does not allow for the compaction of the soil materials during the padding operations and compaction of soil materials on top of the pipe during back fill activities.

7.7.2 Description of environmental values

The EPP (Waste) describes the environmental values to be enhanced or protected under the Policy as:

- The life, health and wellbeing of people
- The diversity of ecological processes and associated ecosystems
- Land use capability, having regard to economic considerations.

Accordingly, the key environmental values in the project area which have the potential to be impacted by waste are:

- Agricultural land
- Air – residential dwellings located within the project area
- Ecology – identified flora and fauna and associated habitats traversed by the proposed pipeline route
- Water resources
- Social – aesthetic values of the project area, health and wellbeing of local communities and the project workforce.

The EPP (Waste) outlines the waste management hierarchy as an optimal waste management tool, in order from most preferred to least preferred:

- Waste avoidance
- Waste reuse
- Waste recycling
- Energy recovery
- Waste disposal.

The management of waste generated by the project will ensure the protection of the environmental values during the construction, operation and decommissioning phases.

7.7.3 Potential adverse or beneficial impacts of the project activities on the identified environmental values

7.7.3.1 General and Hazardous Wastes

Potential impacts on environmental values associated with incorrect waste management procedures include:

- Contamination of land, soil and water (including groundwater) from:
  - spills and/or seepage of either solid or liquid waste, or

  - the inappropriate storage or disposal of solid or liquid waste
- Health risks to the community and the workforce through the inappropriate storage or disposal of hazardous waste material
- Reduced visual amenity from poor site maintenance and the inappropriate storage of general rubbish or other waste materials
- Air quality impacts on human health from hazardous volatile waste streams
- Odours caused by inappropriate waste management and disposal
- Potential contamination of ecosystems / habitats or mortality to fauna caused by soil and water contamination resulting from poor waste disposal practices and/or the inappropriate storage of hazardous wastes.

Hydrostatic testing will be conducted to pressure test a section of completed pipeline (refer to Section 7.8). Potential impacts to environmental values arising from the improper discharge of hydrostatic test water relate to effects on:

- Surface water or groundwater resources
- Terrestrial/aquatic ecology
- Temporary loss of agricultural land
- Soil erosion.

7.7.4 Proposed environmental protection commitments, objectives and control strategies

This Section describes measures to manage potential impacts of the project with respect to waste. Management strategies are summarised in Table 7-43 and Table 7-44

Waste management will be based on a hierarchy beginning with waste avoidance, minimisation and recycling before disposal via existing onsite licensed facilities or off-site disposal using an appropriately licensed contractor.

7.7.4.1 Excavated Material

The maximum volume of dispersive clay subsoil materials will be backfilled into the trench and these materials will be compacted to a bulk density similar to the adjacent undisturbed subsoil materials. However, an excess of 373,000m^3 of sodic (potentially dispersive) subsoil materials will remain. The topsoils overlying sodic subsoils (not recommended for stripping), should be placed over these sodic subsoil materials. Options for handling the excess of sodic (potentially dispersive) subsoil materials shown in Table 7-41 include treatment with a soil conditioner, use in dam construction or burial. These options will be explored as part of the Soil Management Plan (refer to Section 7.3.3.2).

7.7.4.2 General Wastes

All waste materials, including hazardous and regulated substances will be managed and disposed of in strict accordance with relevant legislation and standards, including EPP (Waste) and the Waste Reduction and Recycling Act 2011. The Queensland Waste Reduction and Recycling Strategy 2010-2020 outlines the preferred waste management hierarchy and principles for achieving good waste management for all construction and operational activities. The waste hierarchy moves from the most preferred to the least preferred options for waste disposal, as shown in Figure 7-2 .

Figure 7-2 Waste and resource management hierarchy

Source: *Queensland's Waste Reduction and Recycling Strategy 2010–2020 (EHP 2010).*

Arrow's Waste Management Strategy (refer to Section 7.7) incorporates the principles of EPP (Waste) and the *Queensland Waste Reduction and Recycling Strategy* to minimise the amount of wastes generated. Waste minimisation will be achieved by:

a) Source Reduction

Source reduction is an important step in the waste hierarchy as it stops wastes before they are generated. One of the ways in which this can be achieved is by conducting a material use audit to trace its lifecycle as it passes through the various processes. This will quantify the proportion of the material ending up being discharged into the environment as waste, or being incorporated within a product. The audit findings provide an overview of the areas where materials usage, such as chemicals, can be optimised or reduced through process modification and material substitution.

b) Reuse

Reuse generally means that a discarded item is used again for a similar function. Reuse measures that will be adopted on the project include:

- Returning materials that are in excess or no longer required to the supplier

- Reusing containers to store wastes
- Returning cleaned containers, packaging materials, wooden pallets or drums to the vendor for reuse.

Materials will be segregated within designated waste storage areas to maximise opportunities for reusing waste.

c) *Recycle*

Recycling is the process where used materials are converted into new products avoiding disposal into a landfill. It reduces the consumption of fresh raw materials which would alternatively accelerate the depletion of natural resources.

Recyclable materials include scrap metals and circumferential fibre / nylon rope spacers used in pipe transport. Pipe delivery packaging, including ropes and straps will also be removed from the ROW for recycling. Cleared vegetation will be re-spread as windrow or chipped and re-spread along the ROW during rehabilitation.

d) *Treatment and Disposal*

Treatment and disposal involves the rendering of wastes safe by neutralisation or other treatment methods and finally deposing of the waste products which can no longer be reused or recycled.

Waste unable to be reused, recycled or recovered will be disposed of in appropriately licensed commercial landfill site/s with appropriate regulatory approvals.

The project will aim to achieve positive outcomes by adopting the resource management hierarchy. Table 7-42 outlines potential opportunities for implementing the waste management hierarchy in the project.

Table 7-42 Waste management hierarchy – opportunities

Waste hierarchy	Waste Item	Opportunity
Construction		
Avoid / reduce	Excess spoil removed from the trench.	Excavated material managed in accordance with Waste Management Plan and Soils Management Plan (topsoil will be stored separately and will not be mixed with subsoil).
Reuse	▪ General packaging e.g. waste paper and cardboard. ▪ Timber skids. ▪ Pallets, drums. ▪ Scrap metals. ▪ Fibre/nylon ropes. ▪ Drums. ▪ Cleared vegetation along the ROW.	Timber skids used during pipe stringing will be collected and transferred along the ROW for reuse in pipe stringing further along the corridor. Organic material to be reused onsite during rehabilitation. Weeds will be managed in accordance with a Weed Management Plan. Develop and implement arrangements with suppliers to return unused construction materials to the supplier.
Recycle	Welding rods (stub ends) / grinding discs. Used chemicals and oils, e.g.: ▪ Lube oil and hydrocarbons ▪ Spent x-ray film developer chemicals (if automatic ultrasonic inspection system	Recycle waste metals using a steel and metal merchant. Recycle waste oils and chemicals using licensed waste contractors. Hydrostatic test water will be recycled for secondary uses where water quality meets

Waste hierarchy	Waste Item	Opportunity
	not used) ▪ Paint and paint tins ▪ Used tins from solvents. Hydrotest water.	discharge criteria.
Treat / dispose	Hydrotest water (first flush 'slug') - contains residual dirt and welding dross.	Disposal by waste contractor to a local government waste disposal facility.
▪ Operation		
Treat / dispose	Sludge generated from pigging activities.	Disposal by licensed waste contractor to a regulated waste disposal facility.

7.7.4.3 Hydrostatic Test Water

The disposal of hydrostatic test water will be managed in accordance with a Hydrostatic Test Water Management Plan (refer to Section 7.8).

Test water will be reused to minimise the amount of water required for testing. Hydrotest management procedures will aim to maximise the efficiency of testing, taking into consideration the timing of construction. Disposal to land will only take place where an assessment of water quality meets relevant criteria and relevant approvals have been obtained.

7.7.4.4 Waste Management Plan

A Waste Management Plan will be developed for the project's construction and operations phases to mitigate waste impacts. The Waste Management Plan will provide management processes for key waste streams and guidance on the adoption of the waste hierarchy. The Plan will cover:

- A program for safe recycling, reuse or disposal of all wastes
- A disposal procedure for hazardous wastes
- A staff awareness and induction program that encourages re-use and recycling.

Table 7-43 Waste management strategies – construction

Element / Issue	Regulated and non-regulated wastes generated by project activities.

Performance Objectives	Implementation / Management Strategies	Performance Criteria	Monitoring	Corrective Action
Impacts to the environment and surrounding communities from the handling and disposal of construction waste are minimised.	▪ A Waste Management Plan (WMP) will be prepared prior to the start of the construction of the pipeline in accordance with the Environmental Protection (Waste Management) Policy 2000 and all applicable legislative requirements (C017). ▪ Construction workers will be made aware of the Waste Management Plan (WMP) through the inductions process and tool box talks (C025). ▪ Waste management will be based on the waste hierarchy - waste avoidance, waste re-use, waste recycling, and waste disposal (C018). ▪ Waste management will be in accordance with all relevant regulatory requirements (C019).	▪ Proportion of waste being returned for reuse, recycle or going to disposal.	▪ Quarterly reviews of the waste management register to monitor implementation of the waste management hierarchy.	▪ Rectify causes of non-conformance with the WMP performance requirements.
To minimise resource utilisation by avoiding or reducing construction waste.	▪ Develop and implement arrangements with suppliers to return unused construction materials to the supplier (EM039).	▪ Proportion of waste managed in accordance with the Waste Management hierarchy presented in the WMP.	▪ Monitor waste streams on a quarterly basis, to include: resource use, waste recovered and waste reduced. Collect waste data.	▪ Where trends indicate failure to achieve targets, initiate investigations and identify corrective actions to enable targets to be achieved.
To minimise resource utilisation by reusing or recycling construction waste.	▪ Reusable and recyclable wastes, such as timber skids, pallets, drums, scrap metals and circumferential fibre/nylon to spacers used in pipe transport shall be collected and stockpiled for recycling (C021). ▪ All pipeline packaging waste material (e.g. ropes and straps) will be removed	▪ Proportion of waste reused or recycled in accordance with the with the waste management hierarchy presented in the WMP.	▪ Monitor waste streams on a quarterly basis, include: waste recycled and waste re-used. Collect waste data.	▪ Where trends indicate failure to achieve targets, initiate investigations and identify corrective actions to enable targets to be achieved.

Performance Objectives	Implementation / Management Strategies	Performance Criteria	Monitoring	Corrective Action
	from the Right of Way (ROW) and disposed in accordance with local government requirements. (C020). ▪ All binding material and dunnage from transport vehicles and unloading areas is to be collected and transported off the Right of Way (ROW) to designated disposal areas. (C022). ▪ Any vegetation wastes created through clearing activities will be either chipped for re-use or stockpiled and used as windrows along the Right of Way (ROW) or left for use by the landholder (C026). ▪ Provide bins for different waste streams to separate solid waste. Provide general domestic waste and food waste disposal facilities to assist with waste segregation (EM040). ▪ All suitable material extracted during trenching will be re-used in the trench as padding and backfill for the pipeline. (C029). ▪ Drilling mud will be screened and recycled if practicable or buried in the proposed pipeline trench or pit within the Right of Way (ROW). (C030).			
Impacts to the environment and surrounding communities from general wastes are minimised through on-site waste storage.	▪ Wastes will be appropriately contained and / or covered to prevent access by stock or wildlife (EM041). ▪ Lidded refuse containers will be located at each worksite. (C024). ▪ Licensed waste disposal facilities will be identified and used for disposal of putrescibles and non-putrescibles solid wastes. (C028). ▪ Chemical wastes will be appropriately labelled and contained in sealed	▪ Disposal of general wastes.	▪ Inspections of waste storage locations in accordance with monitoring and inspection schedule.	▪ In the event of any accidental spillage of waste, an incident report will be raised corrective actions undertaken in accordance with the outcomes of incident investigations, audits, monitoring results or advice given by the

Performance Objectives	Implementation / Management Strategies	Performance Criteria	Monitoring	Corrective Action
	containers for safe transport to an approved chemical waste receivable/disposal depot or collection by a liquid waste treatment service (C032).			relevant regulatory authority.
Impacts to the environment and surrounding communities from the handling, storage, transport and disposal of hazardous wastes are minimised.	▪ Undertake the handling, storage, transport and disposal of hazardous wastes in accordance with relevant Australian Standards and legislation (EM042). ▪ Chemical wastes (e.g. spent pipeline x-ray film developer chemicals if used) shall be collected in 200 litre drums (or similar sealed container), appropriately labelled, for safe transport to an approved chemical waste depot or collection by a liquid waste treatment service (C032). ▪ Declared plants detected on the Right of Way (ROW) will be managed in accordance with the Weed Management Plan (C027). ▪ Waste oil and solvents shall be collected by approved contractors for recycling, re-use or disposal at approved locations (C031). ▪ Any diesel or oil spills that may occur during construction activities will be contained and managed in accordance with the Emergency Response Plan (C005).	▪ Disposal of hazardous wastes.	▪ Monitor and track controlled waste to prevent unauthorised discharge into the environment.	▪ Initiate investigations and identify corrective actions for hazardous waste incidents that deviate from normal operating procedures.
Impacts to the environment from the disposal of hydrostatic test water are minimised.	▪ Develop and implement a Hydrostatic Test Water Management Plan, incorporating environmental protection measures (C033). ▪ Pipeline decommissioning will be undertaken in accordance with relevant	▪ Method of disposal of hydrostatic test water.	▪ Testing of hydrostatic test water quality prior to release, to ensure compliance with regulatory limits, in accordance with the EA.	▪ Rectify work procedures to ensure compliance with regulatory limits.

Performance Objectives	Implementation / Management Strategies	Performance Criteria	Monitoring	Corrective Action
	regulatory standards at the time (EM052).			

Auditing	▪ Audits to be conducted in accordance with Section 4 of this EM Plan. Waste streams, quantities and management practices will be audited during construction. Waste audits will: - Assess actual wastes generated v. predicted waste streams and quantities; - Review potential risks from wastes; - Review waste records; - Review implementation of the waste management hierarchy.
Reporting	▪ Report immediately to the Environmental Officer and relevant authorities any incident where harmful waste material is accidentally released to the environment. ▪ Complete checklists to ensure wastes are being handled and stored correctly. ▪ Maintain records of waste stream monitoring and targets achieved, in accordance with the Waste Management hierarchy. ▪ Maintain records and report on tracking of trade and regulated wastes. ▪ Maintain records of complaints in Complaints Register. Address complaints and close out. Refer to Section 4 of this EM Plan. ▪ Maintain records of any non-compliances, incidents or accidents. Address and close out in accordance with Section 4 of this EM Plan.
Responsible Person(s)	▪ Construction Superintendent ▪ Environmental Officer.
Associated Documentation	▪ Queensland Waste Reduction and Recycling Strategy 2010 – 2020. ▪ AS 1940: The Storage and Handling of Flammable and Combustible Liquids. ▪ AS 3780: The Storage and Handling of Corrosive Substances. ▪ AS 2931: Selection of Use of Emergency Procedure Guides for Transport of Dangerous Goods. ▪ *Dangerous Goods Safety Management Act 2001.* ▪ Waste tracking certificates for regulated wastes transported off-site. ▪ Waste Management Plan. ▪ Corrective Action Procedure. ▪ Environmental Incident Reporting Procedure.

Table 7-44 Waste management strategies – operation

Element / Issue	Regulated and non-regulated wastes generated by project activities.

Performance Objectives	Management Strategies	Performance Criteria	Monitoring	Corrective Action
Manage waste generated from pipeline cleaning - pigging.	▪ Collection of pipe cleaning waste from centralised locations by an approved contractor to transport regulated waste to a licensed waste landfill.	▪ Cleanliness of the site following maintenance activities.	▪ Review waste disposal records/transport receipts to confirm use of licensed waste management facilities.	▪ In the event of any accidental spillage of waste, an incident report will be raised. Corrective actions will be undertaken in accordance with the outcomes of incident investigations, audits, monitoring results or advice given by the relevant regulatory authority.

Auditing	▪ Independent audit every two years.
Reporting	▪ Complete easement inspection checklists to record the effectiveness of waste management measures and observations from pipeline inspections. ▪ Maintain records of all regulated wastes removed from site. ▪ Maintain records of any non-compliances, incidents or accidents. Address and close out in accordance with Section 4 of this EM Plan. ▪ Annual Return.
Responsible person(s)	▪ Environmental Officer. ▪ Operations Manager.
Associated Documentation	▪ *Environmental Protection Act 1994.* ▪ Environmental Protection (Waste Management) Policy 2000. ▪ Environmental Protection (Waste Management) Regulation 2000. ▪ Environmental Protection Regulation 2008. ▪ *Waste Reduction and Recycling Act 2011.*

7.7.5 Coal Seam Gas (CSG) Water

No CSG water will be produced as a result of the project, and as such, has not been considered or assessed as part of this EM Plan.

7.8 Water

7.8.1 Description of the existing environment and environmental values

This Section summarises the existing environment and environmental values for surface water. Aquatic communities are described in Section 7.4.

7.8.1.1 River Basins and Watercourses

The locations of the main watercourses in the project area are provided in Map Series 9 in Appendix A. The proposed pipeline route traverses three river basins as follows:

- Burdekin Basin, from KP0 to KP37.2
- Calliope River Basin, from KP37.2 to KP467.9
- Fitzroy Basin from KP467.9 to KP476.1.

From the Burdekin Basin, the AB mainline crosses Suttor Creek before crossing into the Fitzroy Basin. Here, the AB mainline crosses three major river catchments, namely the Mackenzie, Isaac and Fitzroy. The Fitzroy River is the largest river system crossed by the proposed pipeline route with a catchment area of 133,545km^2 at the proposed crossing location. The Fitzroy River is a large watercourse with a 50m wide flowing channel at the crossing point (KP318.9). From the Fitzroy Basin (where all three laterals are located) the AB mainline extends 9km within the Calliope River Basin and crosses Larcom Creek and Raglan Creek.

A total of 49 watercourse crossings were investigated along the proposed pipeline route (main pipeline and laterals) during the early to mid-dry season surveys (Ecosure 2012b). Many of the watercourses are typical of Australian dryland river systems, being intermittent with little to no flow during the drier months. The assessed watercourses and their stream order (using the Strahler (1952) method for stream classification) are listed in Appendix H.

Permanent and semi-permanent waterholes are present at a number of watercourse crossings including:

- Endrick Creek (KP285.6)
- Black Gin Creek (NM2.1)
- Larcom Creek (KP474.9)
- Isaac River (SL19.3).

The nearest Ramsar Wetland is the Shoalwater and Corio Basin area located 60km northeast of the proposed pipeline route.

The proposed pipeline route transects five REs that are classified and mapped as wetlands according to the Queensland Wetland Mapping and Classification Methodology (EPA, 2005). In clearing the ROW, up to 37.45ha of wetlands will be impacted, including 26.73ha of remnant wetland REs and 10.72ha of non-remnant wetlands. The majority of wetlands observed as being traversed by the proposed pipeline route were narrow bands of fringing riparian vegetation containing limited habitat for aquatic species. Non-riverine freshwater wetlands (RE 11.3.27) appeared to be ephemeral with low abundance and diversity of aquatic vegetation.

7.8.1.2 Existing water users

There are a wide range of water users within the Burdekin, Fitzroy and Calliope river basins, with end use varying from stock and domestic agricultural, industrial and mining and domestic water supply.

The proposed pipeline route traverses the Fitzroy River in the upper reach of the Fitzroy Water Management Area. The Fitzroy River is a heavily regulated system with users extracting supplemented water in the area immediately downstream of the pipeline crossing.

The AB mainline and SL both cross the Isaac River. Water use along the Isaac River is generally by un-supplemented water harvesters, such as broad acre irrigators. These users are licensed to extract water from the river in times of high flows.

SunWater operates a number of water supply schemes providing water to mines, towns and rural consumers throughout Central Queensland.

Potable and non-potable water demands during the construction phase are identified in Table 7-45.

Table 7-45 Water demand – pipeline construction

Activity	Allowance	Description/Assumptions
Non-potable water		
Construction Water Demand	500kL/day	Daily volume to provide dust suppression, vehicular washing and miscellaneous water use during construction
Total Construction Water Usage	150ML	Total construction allowances
Hydrostatic Pressure Testing	100ML	Based on testing the entire length of the pipeline
Total Non-Potable Water Usage	250ML	For total construction duration

7.8.1.3 Existing flooding characteristics

Watercourse crossings will be required for pipe laying and the movement of construction equipment and may be vulnerable to flooding, erosion, scour or landslip. Flooding is considered a risk during construction and operation of the pipeline.

Eleven locations along the proposed pipeline route where significant lengths of the pipeline may be subject to flood inundation have been identified (GHD, 2011). Only an overview assessment of flood levels was undertaken at this early stage of design. While this flood study was focussed only on identifying locations where significant lengths of the pipeline may be inundated, there are numerous

other locations where shorter lengths are likely to be flooded. Further detailed flooding investigations will be undertaken as part of detailed design.

7.8.1.4 Existing water quality and environmental values

Existing water quality within the Fitzroy Basin is highly variable, ranging from excellent in undisturbed national parks at the top of some catchments through to impacted in lower areas where a range of land uses are present including grazing, cropping, mining and development. Temporal variation in water quality is also high, with rainfall causing pulses of fresh water, pollutants and sediments to be washed into watercourses and influencing water quality characteristics (EHP, 2010).

The majority of watercourses within the project area are highly modified as a result of extensive clearing and existing land use practices, with water generally high in turbidity, metals, nutrients and pesticides. Water quality within the project area is also greatly influenced by rainfall events, with many waterways having an absence of flow for extended periods during the dry season.

Studies of water quality within the Fitzroy Basin have shown that electrical conductivity can be high during the prolonged dry season, decreasing following the arrival of summer rainfall. There is also evidence that background metal concentrations regularly exceed the aquatic ecosystem trigger values outlined in ANZECC (2000), most likely as result of the highly mineralised waters of the Fitzroy River system (DERM presentation to Central Queensland mining Rehabilitation Group (http://www.cqmrg.org.au)).

A field assessment of water quality was conducted from 12 to 24 September 2011 to expand on existing information and further describe the water quality of sites to be disturbed by pipeline construction activities. A total of 25 water crossing sites were selected for water quality assessment along the proposed pipeline. Sites that had a higher probability of surface water present and with available access were selected for the assessment.

At each accessible site where water was present, physico-chemical water quality parameters were measured and recorded using a calibrated water quality meter. Parameters included temperature (^{o}C), electrical conductivity (µS/cm), dissolved oxygen (mg/L and %sat) and turbidity (NTU). General observations were also made of water quality conditions at each sampling site. Results were compared with the local water quality objectives for sub-basins of the Fitzroy River catchment from the EPP(Water), which support the environmental values (EV's) that apply to the watercourses.

The EV's (defined on Table 7-46) that apply to each EPP(Water) area are identified in Table 7-47). The water quality data was evaluated against values set to protect the aquatic ecosystem environmental values with management intent of lightly to moderately disturbed. The aquatic ecosystem EV was adopted as it sets the most stringent objectives for the water quality indictors measured, with the exception of electrical conductivity for waters intended for drinking water supply, as discussed below.

Table 7-46 Description of environmental values (EV's) from the Environmental Protection (Water) Policy (2011)

Environmental Value		Description
	Aquatic Ecosystems	A community of organisms living within or adjacent to water, including riparian or foreshore area. Levels of protection for aquatic ecosystems: ■ High ecological/conservation value waters (HEV). Waters in which the biological integrity is unmodified or highly valued ■ Slightly to moderately disturbed (SMD): waters that retain biological integrity but are affected by human activity. ■ Highly disturbed (HD): waters that are significantly degraded by human activity and have lower ecological value
	Irrigation	Suitability of water supply for irrigation-for example, irrigation of crops, pastures, parks, gardens and recreational areas.
	Farm Water Supply	Suitability of domestic farm water supply, other than drinking water. For example, water used for laundry and produce preparation.
	Stock Watering	Suitability of water supply for production of healthy livestock.
	Aquaculture	Health of aquaculture species and humans consuming aquatic foods (such as fish, molluscs and crustaceans) from commercial ventures.
	Human Consumers of Aquatic Foods	Health of humans consuming aquatic foods-such as fish, crustaceans and shellfish (other than oysters) from natural waterways.
	Primary Recreation	Health of humans during recreation which involves direct contact and a high probability of water being swallowed-for example, swimming, windsurfing.
	Secondary Recreation	Health of humans during recreation which involves indirect contact and a low probability of water being swallowed-for example, wading, boating, rowing.
	Visual Recreation	Amenity of waterways for recreation which does not involve any contact with water-for example, walking and picnicking adjacent to a waterway.
	Drinking Water	Suitability of raw drinking water supply. This assumes minimal treatment of water is required-for example, coarse screening and/or disinfection.
	Industrial Uses	Suitability of water supply for industrial use-for example, food, beverage, paper petroleum and power industries. Industries usually treat water supplies to meet their needs.
	Cultural and spiritual values	Indigenous and non-indigenous cultural heritage, for example, custodial, spiritual, cultural and traditional heritage, hunting, gathering and ritual responsibilities; symbols, landmarks and icons (such as waterways, turtles and frogs); and lifestyles (such as agriculture and fishing).

Table 7-47 Environmental Protection (Water) Policy areas (EPP(Water) areas), with applicable EV's

Environmental Protection (Water) Policy area												
Isaac northern tributaries (INT)	√	√	√	√		√	√	√	√	√	√	√
Upper Isaac main channel (UIMC)	√	√	√	√		√	√	√	√	√	√	√
Lower Isaac (LI)	√	√	√	√		√	√	√	√	√	√	√
Isaac undeveloped areas	√			√		√	√	√	√	√		√
Fitzroy central/southern tributaries (FCST)	√	√	√	√	√	√	√	√	√	√	√	√
Raglan Creek and tributaries (RCT)	√	√	√	√	√	√	√	√	√		√	√
Raglan Creek and tributaries estuarine reaches (RCTE)	√				√	√		√	√			√
Fitzroy main channel (above barrage) (FMC)	√	√	√	√	√	√	√	√	√	√	√	√
Fitzroy undeveloped areas	√		√	√		√	√	√	√	√		√

Results of the water quality assessment are summarised in Table 7-48.

The water quality objectives (WQO's) for dissolved oxygen (DO) concentrations apply to flowing watercourses; in intermittent watercourses where flow has ceased the DO concentration can be naturally lower than WQO values (DERM 2009). Several of the watercourses were not flowing and therefore the WQO's for dissolved oxygen saturation are not applicable. Of the sites with flow four had DO concentrations below WQO ranges, which is likely to result from microbial decomposition associated with increased loading of organic matter. This may result from land use activities such as agriculture and land clearing. One site (AP5, Inkerman Creek) had DO concentration in excess of the WQO range and was likely due to high rates of photosynthesis; moderate quantities of suspended and attached algae were observed at this site (Arrow Energy 2012, ABP EIS).

The day time pH exceeded WQO ranges at several sites including the Fitzroy River. High day time pH values can result from high instream primary production rates due to elevated nutrient concentrations and this is often associated with agricultural land use practices that incorporate fertilisers. No sites had day time pH lower than the WQO ranges.

Of the 14 sites classified as freshwater (EHP 2011, EPP (Water) Fitzroy sub basins) 6 exceeded the electrical conductivity (EC) WQO for aquatic ecosystems (slightly to moderately disturbed) and a further three exceeded the WQO's for drinking water supply (400µS cm^{-1}). Salt based contamination in the Fitzroy catchment does occur as a result of industrial activities, often associated with mining (DERM presentation to Central Queensland mining Rehabilitation Group (http://www.cqmrg.org.au)), however the EC of water in these catchment can be naturally high,

particularly in the upper Isaac (DERM 2011, EPP (Water) Isaac sub basin). EC will also rise in isolated water bodies during dry periods due to evaporation.

The WQO for turbidity were exceeded at six sites. Five of these sites were isolated pools that were subject to sediment disturbance by cattle access (Arrow Energy 2012, ABP EIS). The only flowing site with high turbidity was estuarine.

The water quality assessment was indicative of impacts on waters due to human activities and which are common in catchments with water courses that are slightly to moderately disturbed and highly disturbed. A range of land uses that potentially impact on water quality are extensive in the Fitzroy sub basins and includes mining, irrigated agriculture and grazing. The river is also heavily regulated resulting in alteration to the natural flow regime.

Table 7-48 Physico-chemistry at water quality assessment sites

Site	KP	Name	EPP Area	Water Zone	EC (µS/cm)	pH	DO (%Sat)	Turbidity (NTU)
AP1	AB476	Larcom Creek	RCT	FW Riverine	1315 (<445)	8.56 (6.5-8.5)	77 (85-110)	5 (<50)
AP2	AB447	Raglan Creek	RCTE	ME Riverine	Site not accessible			
AP3	AB439	Twelve Mile Creek	RCTE	ME Riverine	8552 (N/A)	8.73 (7-8.4)	95 (85 - 100)	8 (<100)
AP4	AB430	Inkerman Creek	RCTE	ME Riverine	43600 (N/A)	8.05 (7-8.4)	75 (85-100)	329 (<100
AP5a	AB429	Oxbow lagoon	RCTE	ME Palustrine	1440 (N/A)	9.73 (7-8.4)	100 (90-100)	35 (N/A)
AP5	AB426	Inkerman Creek	RCTE	ME Riverine	1942 (N/A)	8.73 (7-8.4)	116 (85-100)	3 (<100)
AP6	AB391	Scrubby Creek	FCST	FW Riverine	1971 (<445)	8.75 (6.5-8.5)	90 (85-110)	16 (<50)
AP7	AB371	Limestone Creek	FCST	FW Riverine	2666 (<445)	8.10 (6.5-8.5)	79 (85-110)	6 (<50)
AP8	AB319	Fitzroy River	FMC	FW Riverine	914 (<445)	9.00 (6.5-8.5)	96 (85-110)	14 (<50)
AP9	AB239	Stockyard Creek	LI	FW Riverine	No water			
AP9a	AB239	Stockyard Creek (NF)	LI	FW Riverine	694 (<410)	8.88 (6.5-8.5)	98 (85-110)	2 (<50)
AP10	AB238	Isaac River Anabranch	LI	FW Riverine	No water			
AP12	AB234	Isaac River Anabranch	LI	FW Riverine	567 (<410)	7.95 (6.5-8.5)	70 (85-110)	18 (<50)
AP13	AB217	Bellarine Creek (NF)	LI	FW Riverine	320 (<410)	7.06 (6.5-8.5)	72 (85-110)	696 (<50)
AP14	AB216	Isaac River Anabranch (NF)	LI	FW Riverine	263 (<410)	7.78 (6.5-8.5)	78(85-110)	121 (<50)
AP15	AB213	Rolf Creek (NF)	LI	FW Riverine	190 (<410)	8.72 (6.5-8.5)	74 (85-110)	277 (<50)

Site	KP	Name	EPP Area	Water Zone	EC (µS/cm)	pH	DO (%Sat)	Turbidity (NTU)
AP17	AB165	Isaac River	UIMC	FW Riverine		No water		
AP18a	AB162	Isaac River	UIMC	FW Riverine	624 (<720)	7.31 (6.5-8.5)	50 (85-110)	6 (<50)
AP23	AB109	North Creek	INT	FW Riverine		No water		
AP24	AB105	North Creek (NF)	INT	FW Riverine	360 (<720)	8.05 (6.5-8.5)	88 (85-110)	17 (<50)
AP25	AB69	Kenny's Creek (Teviot Brook)	INT	FW Riverine	696 (<720)	8.27 (6.5-8.5)	85 (85-110)	28 (<50)
AP22	AB50	Isaac River	UIMC	FW Riverine		No water		
AP26	SL19	Isaac River	UIMC	FW Riverine	373 (<720)	8.09 (6.5-8.5)	87 (85-110)	45 (<50)
AP19	SL14	Isaac River	UIMC	FW Riverine		No water		

Note: Shaded cells indicate water quality indicator is outside of local water quality objectives defined in the EPP (Water) for sub basins of the Fitzroy catchment. EPP (Water) area is defined in Table 7-47. FW and ME are freshwater and middle estuary water zones, respectively. NF indicates no flow at the site.

7.8.2 Potential adverse or beneficial impacts of the project activities on the identified environmental values

The main potential impacts to the environmental values of surface watercourses will arise during the construction phase and include:

- Impacts on existing water users, including extraction of water from existing watercourses
- Obstruction and/or diversion of water flows during construction
- Erosion, sedimentation, reduced surface water run-off, or the accidental release of pollutants on watercourses
- Effects of flooding
- Reduced aquatic ecosystem health.

Impacts to surface water are unlikely to occur during operation of the pipeline.

Water Supply/Demand

Water supply requirements for the project include quantities for potable and non-potable water demands. Potable water demands will primarily be required for the temporary workers' accommodation camps which will be assessed under a separate IDAS process.

SunWater has advised that a Water Options Study is required to set out the detailed arrangements for obtaining non-potable water from SunWater assets. Until the options study is completed, it is not possible to quantify the number of licences required. This work will include:

- Identification of options and management of water supply, including during periods of restricted water availability

- Access arrangements for potential water sources.

Environmental impacts will be dependent on the specific options adopted for supplying construction phase water. Environmental impacts, if any, will be assessed once these options are defined. Access to water allocations directly from a watercourse, off-stream storage or groundwater resource will also require regulatory approval and associated satisfaction of environmental considerations.

Daily non-potable water demand for construction uses is estimated at 500kL/day.

At this stage, the water demand for hydrostatic testing of the pipeline can only be estimated, as daily demand will be undertaken in a phased approach and includes for substantial reuse of water for sectional testing. Hydrostatic testing assumptions are as follows:

- Length of pipe filled at one time - 100km
- Test section length - 25km
- First flush wasted during section transfer, 0.5ML per transfer - 12.2ML in total
- Contingency, retesting allowance - 25%.

Water demands associated with the operation of the pipeline will be negligible and restricted to the operational workforce of approximately 15 people. Any water demands from the operations workforce will be handled by existing municipal supplies as required.

7.8.2.1 Watercourses and water users

Construction activities have the potential to take or interfere with the flow of water for existing downstream water users.

A trenchless crossing technique (e.g. HDD) is proposed at locations including the Fitzroy River, the Isaac River and Raglan Creek, subject to geotechnical constraints. Trenchless crossings do not result in an obstruction or diversion of existing water flows. In watercourses with flowing water at the time of construction, flows to downstream water users, environment and connectivity for aquatic ecology will need to be maintained throughout construction. This will be done through the use of coffer dams and stream diversion techniques, including dam and pump or flume diversion, where flowing water is present during open cut crossings (refer to Section 3.14.11).

Potable water will be sourced from local reticulated water supplies where available. Non-potable water supply will need to be obtained from an existing non-potable water service provider or existing landholder with available allocations. Relevant approvals and water extraction licences will be required for water harvesting along the proposed pipeline route.

SunWater have advised that they will assist in facilitating negotiated access to water resources for SunWater operated infrastructure. A Water Options Study will be undertaken to provide greater detail on available sources and facilitate further development of the water resourcing strategy for the projects construction phase.

7.8.2.2 Erosion and Sedimentation

Likely sources of erosion as a result of project construction include potential scouring of backfilled trenches in creek beds and banks as well as rilling and gullying of the easement on creek approaches and banks. Poor rehabilitation on creek approaches and banks may result in bank failure with the most significant risk being during the initial wet season flows following construction but prior to successful rehabilitation.

Flooding and bank stability investigations will be undertaken in detailed design to understand erosion risk at each watercourse crossing.

Pipeline construction activities have the potential to affect water quality at watercourse crossings subject to flowing water, primarily through the potential disturbance and mobilisation of sediments. The risk of these impacts is increased during periods of moderate to high flow, when disturbed sediments can be mobilised and transported large distances downstream.

Other potential impacts to water quality relate to the discharge of wastes arising from construction equipment and techniques including the refuelling of plant and equipment and wastewater derived from hydrostatic testing of the pipeline.

Given the degraded nature of water quality within watercourses along the proposed pipeline route, construction activities are not expected to have any significant impact on existing environmental values.

7.8.2.3 Water Pollution

Other potential impacts to environmental values arising from construction activities include the accidental release of hydrocarbons or other pollutants, including hydrotest waters.

The hydrotest water comprises flush water and testing water, both of which require disposal. The total volume of hydrotest water over the length of the proposed pipeline route has been estimated to be 100ML. The water will be piped into a lined temporary holding pond and any residues removed with other industrial waste.

Water used in hydrostatic testing will be tested before discharge, to prevent contamination of watercourses or groundwater. No hydrotest water will be discharged directly to watercourses.

7.8.2.4 Flooding

The flood assessment considered locations where significant lengths of the proposed pipeline route will be inundated during a 100 year Average Reccurance Interval event. The purpose of this investigation was to identify areas of the project where buoyancy controls may be utilised.

Creek crossings where shorter lengths of pipe are inundated in a flood event will be assessed in detailed design to assess the need for concrete coated pipe or concrete anchors to prevent the pipe from floating.

The low lying areas identified in the location analysis as prone to flooding may require buoyancy control measures. These measures will include extra depth (1,200mm in depth of cover), concrete coating of the pipeline, set on weights, or other buoyancy control measures (or a combination thereof) to ensure that the pipe is negatively buoyant.

Potentially flooded areas will be further investigated and considered in the detailed design. Construction of the proposed pipeline will be scheduled during the dry season to minimise potential impacts on flooding during construction.

7.8.2.5 Groundwater

Based on evidence to date, it is not anticipated that groundwater will be intercepted during construction of the proposed pipeline.

The proposed excavation depths for pipeline construction are shallow and unlikely to intercept groundwater. DNRM groundwater database records for the Bowen Basin indicate that target aquifers for groundwater users are greater than the proposed 2m depth of excavation.

Ungle Waterhole at KP237 is a waterhole potentially supported by a perched water table. Arrow will be undertaking further geotechnical investigations along the pipeline route to confirm the presence or absence of groundwater systems.

7.8.3 Management strategies

This Section describes measures to manage potential impacts of the project on water resources. Management strategies are summarised in Table 7-50 and Table 7-51.

7.8.3.1 Erosion and Sedimentation

Potential impacts from erosion and sedimentation will be minimised by constructing the pipeline route in the winter months, when dry or low flow conditions are anticipated during most of the construction period.

Construction work in watercourses will be restricted to the minimum area necessary for the works. The timing between clear and grade and restoration will be minimised to reduce the duration of soil exposure. The banks of watercourses will be progressively reinstated to their former profile following construction.

To manage potential impacts on surface waters, an Erosion and Sediment Control Plan will be developed and implemented (refer to Section 7.3). Water quality monitoring will enable potential impacts on surface water quality to be identified, controlled and reported. Construction activities will be conducted with reference to the guideline Activities in a watercourse, lake or spring associated with a resource activity or mining operations (DNRM 2012).

7.8.3.2 Water Pollution

All hazardous substances will be stored and handled in accordance with relevant EA conditions, legislation and standards.

Hydrostatic Pressure Testing
Use and disposal of hydrotest waters will be undertaken in strict accordance with a project specific Hydrostatic Test Water Management Plan and conditions of the project EA.

Prior to the discharge of any test water to the environment, it will be analysed, with test water then discharged in a manner that is appropriate. Hydrostatic test water which does not meet the required water quality standards for direct disposal will not be discharged directly to the environment.

Specific hydrostatic testing procedures, including water sourcing and disposal, will be determined during the detailed design and construction phase. At least one month prior to the intended commencement of hydrostatic pressure testing, the Hydrostatic Test Water Management Plan will be submitted to EHP for review and approval. The Hydrostatic Test Water Management Plan will include the following:

- Reference to relevant standards and guidelines for hydrostatic testing
- Details of the activities along the pipeline route associated with hydrotesting
- Volume and source of hydrostatic test water
- Source water quality characteristics and criteria that determine suitability of the water for hydrotesting
- Any additives to be used in hydrostatic test water, if applicable
- Their purpose, storage, spill management, disposal, mixing protocols, likely concentration range during release and a risk assessment for any spill, disposal or release
- Material Safety Data Sheets (MSDSs) for all potential hydrostatic test water additives, if applicable
- Identification and description of any strategies adopted that mitigate or avoid the requirements for additives in hydrostatic test water
- Identification of controlled and uncontrolled release scenarios for hydrostatic test water to land
- The location and storage volume of any proposed holding basins or holding ponds
- Identification and description of sampling, sampling methodology and monitoring of hydrostatic test water prior to any controlled release, proposed discharge limits and likely volumes for release
- Assessment and monitoring of the receiving environment prior to, and following any controlled release of hydrostatic test water
- Description of the water quality objectives and water quality characteristics of hydrostatic test water to determine its suitability for identified disposal options

- The proposed methods and locations of reuse, treatment, disposal and release of hydrostatic test water
- Management measures to avoid or minimise environmental risks associated with hydrostatic testing, including sourcing, storage, transport, treatment, leaks and spills, reuse and/or disposal or release of hydrostatic test water
- Description of the procedures for documenting and reporting of hydrostatic testing, sourcing, transport, storage, pressure testing, potential spills, leaks, treatment, disposal or release of hydrostatic test water.

Where hydrostatic test water is proposed to be released to land, it shall not exceed the water quality limits specified in Table 7-49.

Table 7-49 Proposed limits for the disposal of hydrostatic test water to land

Parameter	Maximum Release Limit
pH	6.5 - 8.5 (range)
Arsenic (mg/L)	2.0
Cadmium (mg/L)	0.05
Chromium (mg/L)	1
Copper (mg/L)	5
Iron (mg/L)	10
Lead (mg/L)	5
Manganese	10
Zinc (mg/L)	5
Nitrogen (mg/L)	5
Phosphorus (mg/L)	1
Electrical Conductivity (µS/cm)	2000

7.8.3.3 Groundwater

A detailed geotechnical study will be undertaken at proposed trenchless crossing sites to confirm the presence or absence of groundwater in the following watercourses:

- Isaac River from crossing (KP233.1)
- Fitzroy River from crossing (KP318.9)
- Inkerman Creek from crossing (KP428.9)
- Twelve Mile Creek from crossing (KP437.5)
- Raglan Creek from crossing (KP445.4).

Any groundwater inflow into areas where trenchless technology is proposed for watercourse crossings will be temporary. As such, it is considered that impacts to groundwater dependent ecosystems, if present, will be negligible.

The feasibility of options to manage hydrostatic test water will be assessed by the EPC Contractor and the selected management measure will be described in the Hydrostatic Test Water Management Plan.

It is proposed to offer the test water to landholders for beneficial use. The quantity given to any respective landholder will be determined by the demand at the time of disposal. Such water may also be used for rehabilitation. It is not proposed to utilise temporary holding ponds for the disposal of this test water.

Potential sources of contamination during construction include diesel and hydrocarbon-based lubricants associated with machinery. Uncontrolled releases and spills of contaminated water have the potential to degrade local groundwater quality. A comprehensive range of safety measures will be put in place for the construction phase. This will include a management plan for dangerous goods incorporating spill response measures.

Table 7-50 Water management strategies – construction

Element / Issue	Alterations to physical form of watercourses, changes to surface water flow, surface water quality degradation and riparian ecosystems and wetlands.

Performance Objectives	Implementation / Management Strategies	Performance Criteria	Monitoring	Corrective Action
Water levels and flows				
To maintain the function of watercourses.	▪ Horizontal Directional Drilling (HDD) method will be investigated for the crossing of major waterways (subject to geotechnical investigation) such as the Fitzroy River, Isaac River and Raglan Creek (C034). ▪ Flows to downstream water users and the environment will need to be maintained throughout construction in flowing waterways (C035). ▪ Flow diversion techniques will be used where flowing water is present during open cut crossings to minimise increase in turbidity (C036).	▪ Alterations to watercourse flows and channel crossings.	▪ Monitor watercourses before, during and after construction to ensure the stability of the watercourses is comparable to pre-construction conditions.	▪ Cease works and conduct investigations to determine potential impacts if physical changes to watercourses occur.
Avoid release of sediments to surface waters as a result of construction activities.	▪ Stormwater diversion banks/drains (e.g. whoa-boys) are to be placed at a distance of 10m back from each side of the top of the watercourse embankment (C037). ▪ Construction of watercourse crossings will be scheduled during the dry season wherever practicable when the intermittent rivers and streams traversed by the pipeline are generally not in flow (C038).	▪ Change to background water quality.	▪ Monitor water quality (e.g. turbidity, suspended solids, pH, conductivity) both upstream and downstream of the construction area. Conduct visual monitoring. ▪ Monitor meteorological forecasts for storm and heavy rain events to assist in scheduling key activities.	▪ Cease works and conduct investigations to determine potential impacts if a change in water quality is detected.
▪ Water supply				

Performance Objectives	Implementation / Management Strategies	Performance Criteria	Monitoring	Corrective Action
To source and dispose of water which minimises environmental harm.	▪ Water required during construction of the pipeline will be sourced from existing allocations (C039). ▪ Water supply agreements and resource authorities will be obtained for water supplies (C040). ▪ A Water Options Study will be undertaken to provide greater detail on available sources and facilitate further development of the water resourcing strategy for the project construction phase (C041).	▪ Change to environmental values of water.	▪ Monitor available supplies as part of the water servicing strategy. ▪ Monitor water quality of waters proposed for disposal.	▪ Cease works if environmental harm is identified.
Bank erosion and scour				
To minimise bank erosion and scour.	▪ Watercourse crossings will be undertaken in accordance with the Aquatic Values Management Plan (C042). ▪ Large riparian trees will be retained. Root stock will be retained for stabilisation of the banks (C043). ▪ Ongoing inspection of watercourses during operation will be undertaken and remedial action will be initiated (C044). ▪ The ROW will be 30m with 10m additional working space. The additional working space will not be cleared in environmentally sensitive areas (C045).	▪ Change to watercourse flow regimes.	▪ Monitoring of the watercourses before, during and after construction to ensure the stability of the watercourses is comparable to pre-construction conditions.	▪ Cease works and conduct investigations to determine potential impacts if physical changes to watercourses occur.
Riparian ecosystems and habitats				
To protect riparian ecosystems and habitats.	▪ Pre-stripping and stockpiling of topsoil and bed material will be in accordance with the Soils Management Plan and stored above the bank where it will not be buried or damaged, with topsoil and bed material stockpiled separately (C048). ▪ The disturbance corridor for the bed, bank and approaches to watercourses will be the narrowest for safe construction (C049). ▪ Training / induction of construction and	▪ Watercourse banks stabilised and rehabilitated in accordance with the Rehabilitation Plan.	▪ Monitor stream bank stability.	▪ Use of additional bank stabilisation as required.

Performance Objectives	Implementation / Management Strategies	Performance Criteria	Monitoring	Corrective Action
	maintenance crews will include environmental values associated with stream channels (e.g. habitat, water quality and areas of downstream significance) (C050). ▪ The Weed Management Plan to be developed and implemented shall apply to the whole of the project and shall include incursion into riparian areas at watercourse crossings (C051) (refer to Table 7-29).			
Water quality				
To maintain water quality.	▪ The water quality of watercourses, if flowing, shall be monitored at wet crossings both upstream and downstream of the construction area. (C052). ▪ At wet crossings, erosion control structures (such as sediment fences, floatation curtains, sand bags and hay bales) will be placed in the channel and/or stream banks to capture suspended sediment (C053). ▪ Watercourse crossings will be undertaken in accordance with the Aquatic Values Management Plan (C042) ▪ Clearing of the slopes leading to the watercourses will be delayed until the construction of the crossing is imminent. Where this is not possible, other soil protection measures will be applied (C054). ▪ No refuelling of plant and equipment will be undertaken within 50m of watercourses (C060).	▪ Changes in water quality.	▪ Water quality monitoring to be conducted upstream and downstream of the wet watercourse crossing during construction activities including electrical conductivity, dissolved oxygen, total and dissolved metals and metalloids, turbidity, total suspended sediments, pH, total petroleum hydrocarbons, and macroinvertebrates	▪ Conduct investigations to determine cause if changes to water occur and implement necessary additional management measures as required
Flooding				
To minimise the effects of the project on the existing flood regime of watercourses.	▪ Meteorological forecasts (e.g. Bureau of Meteorology (BOM) website) will be monitored for storm and heavy rain events to assist in scheduling key activities. (C055). ▪ Watercourse crossings will be completed	▪ Changes tostream hydrology and flow conditions.	▪ Monitor post flood stream conditions.	▪ If flooding occurs during construction, review monitoring procedures to ensure no damage to infrastructure or harm to

Performance Objectives	Implementation / Management Strategies	Performance Criteria	Monitoring	Corrective Action
	promptly and with due regard to the weather (i.e. construction will be scheduled for the dry season where applicable and postponed during significant rainfall and/or flood events (C056). ▪ In the event of flooding, remedial action will be taken in accordance with the Emergency Response Plan (ERP) where necessary (C057).			personnel.
Hydrostatic test water				
No release of contaminants into watercourses from hydrostatic test water.	▪ Hydrostatic test water will not be disposed of directly to watercourses (C058).	▪ Discharge of hydrostatic test water.	▪ Testing of hydrostatic test water quality prior to release, to ensure compliance with land disposal conditions. ▪ Monitor land disposal area for surface ponding and runoff.	▪ Rectify work procedures to comply with discharge criteria.
To ensure no release of contaminants directly or indirectly into watercourses.	▪ Test water shall be discharged to land or a holding pond / farm dam (for evaporation or subsequent beneficial use) and will be in compliance with regulatory and landholder requirements with all necessary permits obtained. (C059). ▪ Waste and dangerous goods management strategies outlined in the WMP and EM Plan will be adopted (C061).	▪ Method of disposal of hydrostatic test water.	▪ Testing of hydrostatic test water quality prior to release, to ensure compliance with regulatory limits, in accordance with *EHP Monitoring and Sampling Manual, 2009*. ▪ Monitor land disposal area for surface ponding and runoff.	▪ Rectify work procedures to comply with regulatory limits.

Auditing	▪ Audits to be conducted in accordance with Section 4 of this EM Plan.
Reporting	▪ Maintain records and report on: - the quality and quantity of hydrostatic discharge water - visual inspections - water quality sampling - drainage control monitoring and performance of sediment control devices - an incident, spill or other uncontrolled release of contaminants to the environment. ▪ Maintain records of complaints in Complaints Register. Address complaints and close out. Refer to Section 4 of this EM Plan. ▪ Maintain records of any non-compliances, incidents or accidents. Address and close out in accordance with Section 4 of this EM Plan.

Responsible Person(s)	▪ Construction Manager. ▪ EPC Construction Manager ▪ Environmental Officer.
Associated Documentation	▪ Hydrostatic Test Water Management Plan. ▪ Erosion and Sediment Control Plan. ▪ Dangerous Goods Management Plan. ▪ Rehabilitation Program. ▪ EHP Monitoring and Sampling Manual 2009, Environmental Protection (Water) Policy 2009. Version 2, 2010. ▪ Australian Water Quality Guidelines for Fresh and Marine Waters. ANZECC and ARMCANZ, 2000. ▪ Queensland Water Quality Guidelines 2009 (QWQG). EHP 2009. ▪ Corrective Action Procedure. ▪ Environmental Incident Reporting Procedure.

Table 7-51 Water management strategies – operation

Element / Issue	Alterations to physical form of watercourses, changes to surface water flow, surface water quality degradation.

Performance Objectives	Management Strategies	Performance Criteria	Monitoring	Corrective Action
To ensure watercourse crossings are stabilised until rehabilitation successful.	▪ Following construction banks will be rehabilitated in accordance with the Rehabilitation Management Plan. (C046).	▪ Post rehabilitation watercourse bank stability. ▪ Implementation of erosion and sediment control measures. ▪ Depth of cover over pipeline.	▪ Visual inspections of watercourse banks to ensure no visible evidence of: - Erosion following high rainfall; - Collapse/subsidence of banks at watercourse crossings or notable increases in flow levels or flooding associated with local waterways.	▪ Stabilise watercourse bed and banks if erosion has occurred.

Auditing	▪ Independent audit every two years.
Reporting	▪ Reporting on performance of erosion and sediment control measures associated with watercourse crossings. ▪ Maintain records of complaints in Complaints Register. Address complaints and close out. Refer to Section 4 of this EM Plan. ▪ Maintain records of any non-compliances, incidents or accidents. Address and close out in accordance with Section 4 of this EM Plan. ▪ Annual Return.
Responsible person(s)	▪ Environmental Officer. ▪ Operations Manager.
Associated Documentation	▪ As required for operations activities, e.g.: - Erosion and Sediment Control Plan. - Rehabilitation Program (refer to Section 8).

8 Rehabilitation Program

A Rehabilitation Program will be developed for land disturbed by the project's activities. The aim of the rehabilitation is to return the disturbed area to a stable, pre-disturbance land use that does not represent a hazard to the public or wildlife. Rehabilitation will be progressively undertaken through the construction period.

A decommissioning program will be developed when the pipeline reaches the end of its project life. This program will manage the decommissioning of the project's infrastructure leading to final abandonment.

8.1.1 Rehabilitation and Decommissioning Goals

The goal of rehabilitation and decommissioning is to ensure that the project area is:

- Safe to humans and wildlife
- Non-polluting
- Stable
- Able to sustain an agreed land use.

8.1.2 Stages of Rehabilitation

The timing and works undertaken as part of rehabilitation activities will be dependent on each project stage.

8.1.2.1 Construction

With respect to the construction phase, clean-up, restoration and rehabilitation measures will be applied to all areas within the project ROW. Rehabilitation will be undertaken as soon as practical after pipe laying to stabilise the land. Restoration will be undertaken progressively as the pipeline is buried. Equipment and waste materials from construction will be removed prior to rehabilitation.

Final rehabilitation will involve surface contouring, respreading of topsoil, respreading vegetation and reseeding / revegetation, to return the disturbed land to its pre-disturbance condition.

Prior to commencing construction activities, a detailed Rehabilitation Program will be prepared by a suitably qualified person, in accordance with EA conditions, legislation and standards.

8.1.2.2 Decommissioning

Final decommissioning and rehabilitation will occur at the end of the project's operational life, or when the pipeline infrastructure is no longer required. Infrastructure that is present for the duration of the project will be subject to site-specific decommissioning and rehabilitation plans. Prior to decommissioning, detailed objectives, criteria and performance indicators will be developed for each of the above goals, in consultation with the appropriate regulatory agencies and landowners.

Decommissioning will be undertaken in accordance with the regulatory requirements and environmental procedures at that time.

8.1.3 Rehabilitation Management Strategies

Management strategies relating to post construction rehabilitation and decommissioning are provided in Table 8-1 and Table 8-2.

An outline Rehabilitation Program is provided in Appendix E.

Table 8-1 Rehabilitation management strategies - post construction

Element / Issue	Post construction rehabilitation of the ROW and immediate surrounds.

Rehabilitation Goal	Rehabilitation objectives	Management Strategies	Indicators	Completion criteria	Monitoring, auditing and reporting
Land					
To achieve a stable ROW landform.	▪ The landscape will be rehabilitated to pre-existing contours with natural drainage lines restored and protected. Land owners will be invited to comment on rehabilitation requirements for their property. (C007).	▪ Construction of the project will be progressed sequentially, with clean-up, restoration and rehabilitation initiated after backfilling is complete, while trenching and the other activities are advanced (C003). ▪ Beneficial use of cleared material will be maximised (C066). ▪ Compaction relief will be undertaken before spreading topsoil, to promote vegetation regrowth, protect against topsoil loss and to minimise rilling (EM044). ▪ The pipeline construction area will be re-profiled to original or stable contours, re-establishing surface drainage lines and other land features. ▪ Pre-stripping and stockpiling of topsoil and bed material will be in accordance with the Soils Management Plan and stored above the bank where it will not be buried or damaged, with topsoil and bed material stockpiled separately (C048). ▪ Stock routes will be rehabilitated following completion of construction activities (EM045).	▪ Land restored to a condition suitable for its intended land use.	▪ Disturbed land reinstated to the pre-disturbed soil suitability class. ▪ Landform is stable with no subsidence or erosion gullies. ▪ No complaints from landholders relating to land reinstatement or productivity.	▪ Monitoring activities include post-construction audits to be conducted annually for two years to evaluate re-vegetation, erosion control, weed control, watercourse integrity and success of bed and bank re-profiling. (C004). ▪ Conduct annual reporting of the Rehabilitation Program to the administering authority. ▪ Post-construction audits to be conducted annually for two years.
Site is safe for humans and	▪ No injuries to humans or animals.	▪ Construction of the project will be progressed sequentially, with clean-	▪ Landform re-established.	▪ No subsidence or major erosion gullies.	▪ Visual inspection of rehabilitated sites

Rehabilitation Goal	Rehabilitation objectives	Management Strategies	Indicators	Completion criteria	Monitoring, auditing and reporting
animals.		up, restoration and rehabilitation initiated after backfilling is complete, while trenching and the other activities are advanced (C003).			for evidence of subsidence and/or erosion. ▪ Maintain records of subsidence and/or erosion.
Ecology					
Land use is self sustaining.	▪ Healthy crops and natural vegetation growth.	▪ Vegetation cover will be established to enable natural vegetation progression and minimal weed invasion. ▪ Native shrubs will be allowed to naturally regenerate. ▪ Re-vegetation/re-seeding efforts will be based on soil types, existing location vegetation characteristics and endemism of selected species (EM047). ▪ Where rehabilitation includes native vegetation and the area is not naturally regenerating, local indigenous species will be sourced preferably from a local seed bank (EM048). ▪ Where rehabilitation is not practicable, such loss will be offset by a variety of measures, as agreed with the responsible agencies (EM049).	▪ Restoration will be assessed by comparing the percentage cover and species diversity on the ROW with that of adjoining land.	▪ Establishment criteria will be developed for vegetation communities to ensure the rehabilitated area is resilient and self-sustaining. ▪ Monitor established vegetation at watercourse crossing/banks.	▪ Rehabilitation success will be monitored until re-growth is established. ▪ Seeded areas will be monitored to ensure growth. Appropriate reapplication of seed will be carried out in areas of poor or no regrowth.
Land use is self sustaining.	▪ Healthy crops and natural vegetation growth free from weeds.	▪ Implement annual weed treatment program along the ROW where pest or weed infestations are identified. Typically, this is implemented in conjunction with landholder spraying and weed control programs (EM046). ▪ Re-seed areas with appropriate	▪ Control over pest and weed infestation. ▪ Resumption of agricultural practices.	▪ No introduction or spread of weeds from rehabilitation activities.	▪ Monitoring will include an assessment of the effectiveness of weed control measures.

Rehabilitation Goal	Rehabilitation objectives	Management Strategies	Indicators	Completion criteria	Monitoring, auditing and reporting
		native or pasture seed mixes during rehabilitation to prevent weed species establishing (EM050). ▪			
Waste					
Non-polluting.	▪ No soils, surface water or groundwater contamination.	▪ All pipeline packaging waste material (e.g. ropes and straps) will be removed from the Right of Way (ROW) and disposed in accordance with local government requirements (C020). ▪ General refuse shall be collected and transported to a Local Government approved disposal site (C023).	▪ Disposal of construction wastes in accordance with the WMP.	▪ No waste materials within the pipeline construction area. ▪ No contamination to soils, surface water or groundwater, as indicated via monitoring and/or leak detection systems.	▪ Pipeline patrols will monitor the effectiveness of clean-up activities.
Water					
Stable.	▪ Minimise erosion at watercourse crossings.	▪ Watercourse crossings will be undertaken in accordance with the Aquatic Values Management Plan (C042) ▪ Following construction banks will be rehabilitated in accordance with the Rehabilitation Management Plan (C046). ▪ Inspection and monitoring of watercourses will be ongoing during operation and remedial action will be initiated (C047). ▪ Trenching of watercourse crossings should be completed promptly and with due regard to the weather forecast (C001).	▪ Stability of watercourse channel or bank erosion following site reinstatement.	▪ Creek banks are stable with no subsidence or erosion gullies.	▪ Visual inspections and photographic representation of bank reinstatement after construction of watercourse crossings. If bank erosion has occurred, rehabilitate and stabilise watercourse banks.

Table 8-2 Rehabilitation management strategies - decommissioning

Element / Issue	Pipeline decommissioning.

Rehabilitation Goal	Rehabilitation objectives	Management Strategies	Indicators	Completion criteria	Monitoring, auditing and reporting
Site is safe for humans and animals.	▪ No injuries to humans or animals.	▪ Pipeline decommissioning will be undertaken in accordance with relevant regulatory standards at the time (EM052).	▪ All above ground areas rehabilitated to a condition consistent with the surrounding area. ▪ No evidence of waste, redundant equipment, signs or markers along decommissioned pipeline.	▪ No subsidence, erosion or waste.	▪ A monitoring program will be developed as part of a detailed decommissioning plan. ▪ ▪ Audits and reviews (non-compliance and incident reporting) will be conducted in accordance with Section 4 of this EM Plan. ▪ ▪ Reporting will be undertaken in accordance with the detailed decommissioning plan.

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