19

LANDUSE AND TENURE

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19 Land Use and Tenure

This chapter provides a summary of the land tenure and land use values within and surrounding the Project area and an assessment of the potential for these values to be affected by direct and indirect impacts associated with the construction, operations and decommissioning phases of the Project. The detailed findings of the Project's impacts on land uses are set out in the Land Use and Tenure Technical Report (Appendix Q of this EIS). Environmental protection objectives and the avoidance, mitigation and management measures to achieve these objectives have been developed. Proposed avoidance, mitigation and management measures have the potential to reduce residual impacts of the proposed development.

A cross reference to the locations where each of the requirements of the ToR has been addressed is given in Appendix B which references both the study chapters (Sections 1 through 34) and/or the Appendices (A through EE).

19.1 Legislative Context

The primary means of environmental assessment of the Project is through the environmental assessment process under the *Environmental Protection Act 1994* (EP Act) for which this EIS is the main technical document. The Project also requires assessment under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999*. The Commonwealth's assessment process will be conducted in parallel with the State process under the bilateral agreement between the Queensland and Commonwealth Governments.

While this section makes reference to the legislation that establishes the environmental assessment process, the focus of the section is on other statutes and planning policies that provide the broader regulatory framework. This framework includes reference to local planning and relevant regulatory provisions to determine compatibility as required by the ToR for this EIS.

There are three primary pieces of legislation which regulate the form and content of this EIS, and which determine approvals that will be required (assuming a positive outcome from this EIS process) and which authorise the development of the Project, as detailed below.

19.1.1 Petroleum and Gas (Production and Safety) Act 2004

The *Petroleum and Gas (Production and Safety) Act 2004* (P&G Act) regulates the exploration and production activities associated with petroleum and gas resources in Queensland.

Exploration and production is controlled via a system of petroleum survey licences, petroleum pipeline licences, authorities to prospect and petroleum leases (PLs). Authorities to prospect permit exploration and testing to occur in order to confirm the viability of a resource. Following confirmation of a viable resource an application can be made to convert whole or part of an authority to prospect to a petroleum lease. Grant of a petroleum lease allows petroleum production and further exploration and appraisal activities to occur subject to appropriate landholder access agreements as required under the P&G Act.

A Chapter 5A Activity Project consists of all activities carried out, or to be carried out, under one or more petroleum authorities as a single integrated activity or project.

It is intended that the Project will take place across a number of PLs under petroleum authorities granted under the P&G Act, from the current exploration tenures held by Arrow and are subject of this EIS. It will comprise a series of wells connected to facilities extending over a large area and crossing boundaries between petroleum leases. It is therefore considered appropriate that all activities associated with petroleum production form part of a single Activity Project.

The Project may contain a number of petroleum authorities and activities, however it is intended that one environmental authority will cover all petroleum activities that form part of the Project, which will be amended to include additional petroleum authorities as they are awarded.

The NRM is responsible for the granting and administration of mining and petroleum tenures as set out in the P&G Act. Agency responsibilities under this legislation extend to land management for petroleum and gas activities, including exploration and production. Under this legislation the assessment and approvals process for petroleum authorities and environmental authorities occur in parallel.

19.1.2 Environmental Protection Act 1994

The responsibility for environmental management, approval and regulation of the petroleum and gas industry rests with the EHP, as outlined under the *Environmental Protection Act 1994* (EP Act). EHP is responsible for the granting of the environmental authorities and environmental regulation of the industry under Chapter 5A of the EP Act.

The EP Act is the principal environmental legislation in Queensland. It promotes ecologically sustainable development to protect Queensland's environment. It is primarily concerned with environmental pollution and land contamination. The EP Act, which is administered by EHP, outlines the environmental management, approval and regulation of the petroleum and gas industry.

The EP Act is intended to protect the environment of Queensland, and sets out the formal approval and regulation framework for environmentally relevant activities (ERAs).

The *Environmental Protection Regulation 2008* (EP Regulation) prescribes the various types of ERAs, which includes petroleum activities. Specific to petroleum activities, they are conditioned by levels of Environmental Authorities (EA), dependent upon the environmental risk associated with the activity. Level 1 petroleum activities are identified as a higher risk and are categorised in legislation as being ERA's. All other petroleum activities are conditioned by a level 2 EA.

Proponents are required to apply for an EA for all petroleum activities regardless of level. However the administrating authority (in this case EHP) has discretionary powers to request an EIS for Level 1 petroleum activities. In the case of the proposed Project, Arrow elected to prepare a voluntary EIS under the EP Act to accompany the Environmental Authority application for the Project. Arrow commenced the EIS process with the lodgement of a voluntary EIS application with EHP in April 2012. An initial advice statement that describes the Project, and draft ToR to guide preparation of this EIS, accompanied the application.

19.1.3 Sustainable Planning Act 2009

The ToR for the Project requires that the EIS is assessed for consistency with existing land uses or long-term policy framework for the Project area. The *Sustainable Planning Act 2009* (SP Act) is the principal planning legislation in Queensland. The SP Act provides a focussed and streamlined approach to the development framework.

The provisions of this Act extend to approvals for development that is proposed for sites not covered by the provisions of the *Petroleum and Gas Act 2004* (P&G Act) as well as for certain development approvals (including building works, reconfiguration of a lot and operational works) associated with petroleum activities.

Development for an activity authorised under P&G Act, and subject to a PL, is exempt development in accordance with section 232(2) of the SP Act and therefore not subject to the provisions of the statutory planning instruments administered under the SP Act, including SPPs, Regional Plans and Local Government Planning Schemes.

A number of post EIS development approvals will be required for any assessable development under the SP Act, including development assessable under each separate Local Government Planning Scheme relevant to land that is impacted by the Project and where not authorised by the environmental authority being sought.

The SP Act provides for the establishment of State Planning Policies (SPP). SPPs potentially relevant to the Project include:

- **SPP 1/92 Development and the Conservation of Agricultural Land**. SPP 1/92 provides for the protection of Good Quality Agricultural Land (GQAL) from incompatible land uses / activities that may impact on the on-going viability of that land for agricultural purposes. The nature of the Project's resource extraction activities requires specific locational requirements and the alienation of some productive agricultural land will inevitably occur as a consequence of development, generally on a temporary basis. Where the Project results in a temporary, or potentially permanent loss of GQAL to potential future cropping, an overriding need in terms of net public benefit must be demonstrated to justify that loss. In this instance, the extraction of CSG for export to national / international markets is considered to constitute an 'overriding need,' given the benefits that will accrue to the region and State as a result of the Project.
- **SPP 1/02 Development in the Vicinity of Certain Airports and Aviation Facilities**. This SPP sets out broad principles for protecting airports and associated aviation facilities from encroachment by incompatible developments. The Project does not interfere with any of the aeronautical facilities listed in the SPP; it is not applicable in this instance. However, consideration must be given to the intent of the policy with respect to preventing inappropriate land uses within proximity of aeronautical facilities.
- **SPP 2/02 Planning and Managing Development Involving Acid Sulfate Soils**. SPP 2/02 considers that development involving acid sulphate soils in low-lying coastal areas should be planned and managed to avoid potential adverse effects on the natural and built environment (including infrastructure) and human health. Within the local government areas listed in SPP 2/02, including Bowen and Broadsound, the SPP applies to all land, soil and sediment at or below 5 m

AHD where the natural ground level is less than 20 m AHD. The Project will seek to achieve compliance with the assessment criteria of SPP 2/02 where acid sulphate soils are encountered.

- **SPP 1/03 Mitigating the Adverse Impacts of Flood, Bushfire and Landslide**. SPP 1/03 aims to mitigate the adverse impacts of flood, bushfire and landslide for assessable development. The Project infrastructure will not increase the flood risk of any lands subject to or surrounding the network. Hydrology is not expected to be significantly altered as a result of the Project area development. Bushfires may potentially pose a risk to aboveground supporting infrastructure such as pigging stations, mainline valves, export compressing stations and gas wells. During operation and maintenance, the gas gathering networks will need to be kept clear of combustible materials to minimise risks from bushfires. The design of the Project infrastructure situates the nodes away from steep slopes, therefore minimising the risk of landslide to the Project.
- **SPP 5/10 Air, Noise and Hazardous Materials**. SPP 5/10 was developed to assist local governments when preparing structure plans and master plans, by providing a more effective way of reviewing the interaction between sensitive land uses and industrial uses in relation to air, noise and hazardous material issues. The gas and water gathering network components of the Project supports the strategic framework of the SPP, through locating the network as far as practicable from sensitive receiving land uses and applying mitigation methodologies (where required). This is an attempt to minimise land use conflicts and protect receptors from adverse effects. SPP 5/10 will apply in the assessment of Project related activities, such as the storage of hazardous materials, which occur outside the Project area.
- **SPP 4/11 Protecting Wetlands of High Ecological Significance in Great Barrier Reef Catchments**. SPP 4/11 aims to ensure that development in or adjacent to wetlands of high ecological significance in Great Barrier Reef catchments is planned, designed, constructed and operated to minimise or prevent the loss or degradation of the wetlands and their values or enhance these values. The Project area is located within the Great Barrier Reef catchments identified by the SPP 4/11. Adequate design and mitigation measures will need to be employed to minimise impacts and ensure that the Project is consistent with the outcomes sought by this SPP.
- **SPP 3/11 Coastal Protection**. This SPP sets out to protect resources of the coastal zone, setting out criteria for land-use planning, coastal activities and development assessment and enabling Queensland to manage development within the coastal zone, including coastal waters. While the Project does not directly impact upon coastal environments or resources, the quality of water within catchments flowing to the coast is relevant to the Whitsunday Hinterland and Mackay Region and Central Queensland Region. The Surface Water chapter (Section 15) of this EIS addresses the potential impact of the Project on surface water quality.
- **SPP 1/12 Protection of Queensland's Strategic Cropping Land**. SPP 1/12 is part of a legislative and planning framework, established under the *Strategic Cropping Land Act 2011* (SCL Act), which allows the impacts on Strategic Cropping Land (SCL) by resource activities, including petroleum projects, to be assessed as part of a proponent's environmental authority application. Any resource activities that will have a permanent or temporary impact on SCL or potential SCL must be assessed under the SCL Act. Further details regarding application of the SCL Act is provided in the Land Use and Tenure Technical Report (Appendix Q) of this EIS.

Stepping down from the SSPs, the next layer of planning instruments governed by the SP Act is a series of Regional Plans and Local Planning Schemes. The Regional Plans provide higher level

strategic direction and objectives and represent the State interest. The Local Planning Schemes reflect local and state interests and are developed to be consistent with the Regional Plans and SPPs.

The Project area is situated in two regional planning areas: the Mackay, Isaac and Whitsunday Regional Planning Area and the Central Queensland Regional Planning Area. Within these regions, the Project area is subject to the jurisdiction of the Whitsunday, Isaac and Central Highlands Regional Council areas.

The Central Queensland Regional Growth Management Framework or Central Queensland Regional Plan (CQRP) was endorsed in July 2002 by the Queensland Government and is a non-statutory document. The Mackay, Isaac and Whitsunday Regional Plan (MIWRP) was issued in February 2012 and replaces the non-statutory Whitsunday Hinterland and Mackay Regional Plan. The MIWRP was developed under the SP Act and is supported by the Mackay, Isaac and Whitsunday State Planning Regulatory Provisions 2012. The CQRP and MIWRP provide a policy framework for growth within their specific region, recognising the value of commodities to the economy and the importance of preserving and enhancing existing land uses and areas of environmental significance.

The Project is consistent with the outcomes sought by the regional plans, with the Project expected to enhance and promoting the growth and economic objectives of the plans, whilst identifying potential impacts and implementing appropriate mitigation measures, including the recognition of the need to work with landholders. Arrow understands that its development activities will have an impact on landholders and recognises that its development plans need to consider the location of infrastructure, the timing and duration of site access, and how drilling and construction activities are conducted in light of the needs of the landowner and landholders.

An assessment of the Project's compatibility with the state planning instruments regulated under the SP Act is provided in the Land Use and Tenure Technical Report (Appendix Q) of this EIS.

19.2 Assessment Method

The land use and tenure assessment comprised a desktop study to gain an understanding of and describe the existing environment. An initial assessment of land uses within the Project area was undertaken based on land use information derived from Queensland Land Use Mapping Program (QLUMP) data. This data identifies 16 individual land use categories and provides quantitative information detailing the total area of land utilised for each land use within the Project area. The QLUMP data, whilst sourced from NRM in 2012, is limited due to its age, but provides a baseline for development of the land use assessment undertaken as part of this study.

The potential direct and indirect impacts of the Project on property values, property tenure and compliance with the Queensland planning framework have been assessed using two of three impact assessment methods: significance assessment, risk assessment and compliance assessment. This study used both significance assessment for land use and property tenure values and compliance assessment for the Queensland planning framework.

To develop this section, existing land uses were identified through analysing aerial and satellite photography, examining land tenure and digital cadastral database information and ground truthing the results with field verification, undertaken from 14 May 2012 to 18 May 2012.

Further information on Impact Assessment Methodology is detailed in Section 6 of this EIS.

19.3 Existing Environment and Environmental Values

This section describes the tenure and land uses in the Project area and includes information on agricultural development and production, urban development and homesteads, mining and resource activities, areas of conservation, tourism and recreation and infrastructure.

The Project area covers an area of approximately 8000 km^2 in the Bowen Basin, extending from Newlands in the north to south of Blackwater. The topography of the Project area is best described as gently undulating with elevated areas and escarpments bordering the wider region. The regional geology can be generally described as comprising fine grained sedimentary rocks, intersected by quaternary alluvium systems associated with creek and river flats, floodplains and alluvial plains of the Isaac and Mackenzie River sub-catchments of the Fitzroy River Catchment and the Suttor and Bowen River sub-catchments of the Burdekin River Catchment.

Currently much of the Project area supports low density, low intensity grazing and agricultural activity. However, areas of rain-fed and dryland cropping exist within specific locations in the Project area. Extensive clearing for grazing and agricultural purposes has meant that remnant vegetation is largely confined to the riparian zone, predominantly along drainage lines and unallocated state land where outside of protected areas.

Homesteads are located over larger pastoral allotments within the Project area and typified by lease hold tenure. The subdivision pattern of these allotments is influenced by the topographical features and is often a remaining feature of historical surveying. Allotments that support horticultural type land uses are often smaller in nature and found along the fertile alluvial floodplains of the Isaac and Mackenzie Rivers. These allotments are characterised by more regular configurations and are not fixed to topographical features, such as ridgelines and rivers.

While grazing and agricultural activity dominates the Project area, other land uses are important and include:

- The urban communities of Glenden, Nebo, Coppabella, Moranbah, Dysart, Middlemount and Blackwater, the mining accommodation villages at Coppabella and Burton Gorge as well as residences and homesteads throughout the rural areas;
- Twenty-two operational coal mines as well as a larger number of mining, petroleum and exploratory lease and permits; and
- Areas of conservation, tourism and recreational land uses, including Homevale National Park and Conservation Park as well as a number of Native Refuges and areas of State Forest.

19.3.1 Land Tenure, Resource Tenements and Native Title

The Project area contains a total of 3,086 cadastral allotments within the land tenures of freehold, leasehold, areas of protected estate, reserves and unallocated state land. The location and extent of allotments within the various tenures are shown on Figure 19-1. Further land tenure information and real property description details on each allotment are provided in Section 3 of the Land Use and Tenure Technical Report (Appendix Q) of this EIS.

19.3.1.1 Freehold

2,145 allotments (approximately 70% of all allotments within the Project area) are held in freehold title. The majority of these allotments are located within the southern half of the Project area.

19.3.1.2 Leasehold

798 allotments (approximately 25%) are held in leasehold title. The majority of these allotments are located in the northern portions of the Project area.

19.3.1.3 State Land

State land includes Unallocated State Land (USL), State Forests (SF), Timber Reserves (TR), and Forest Reserves (FR). State land described as Protected Estate is addressed separately below. Other State land within the Project area includes reserves set aside for roads, rail and stock routes. These are described in further detail in Section 19.3.3 (Infrastructure).

Of the remainder, there are 84 Reserves and 53 allotments of USL in the Project area.

The Project area is largely devoid of land in the tenures of SF, TR and FR. There are, however, large reserves of land in these tenures that are located outside the petroleum tenements to the northeast and south of the Project area.

19.3.1.4 Protected Estate

Eight areas of protected estate are located either in whole or in part in the Project area. These include National Parks, Conservation Parks, Nature Refuges and State Forests.

Areas of protected estate are described in detail in Section 19.3.2 (Land Uses).

19.3.1.5 Mining Tenements

A number of active mineral development leases (MDL), mining leases (ML) and a variety of exploratory permit tenements are located within the Project area in June 2012 as shown on Figure 19-2, including the following:

- 80 MLs;
- 22 MDLs;
- 10 granted exploratory permits for minerals (EPM);
- 5 petroleum pipeline licences (PPL); and

- PL applications (PLA).

Further detail is provided in Section 4.4 of the Land Use and Tenure Technical Report (Appendix Q) of this EIS.

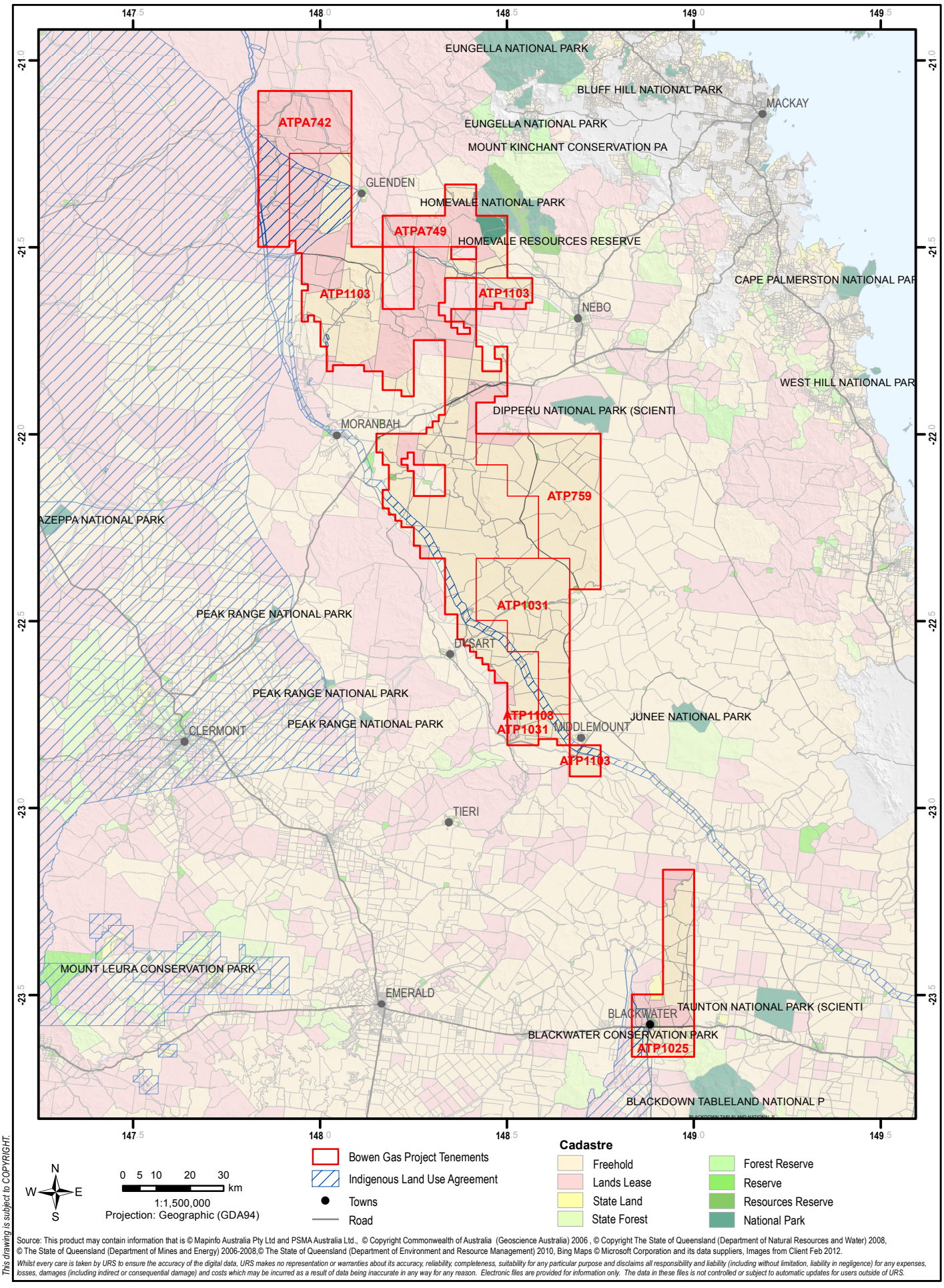
19.3.1.6 Native Title

Native Title is the recognition by the Commonwealth and State Governments of the laws, rights and interests over land and water possessed by Indigenous people in Australia, under their traditional laws and customs.

Indigenous Land Use Agreements (ILUAs) have already been settled with all Aboriginal Parties whose country falls within the study area and who have registered Native Title claims. This includes the Barada Barna, Birri, Jangga and Wiri Peoples.

Arrow is seeking to settle ILUAs with various other groups who have interests in the area but do not have registered Native Title claims. This includes the Kangoulu People, whose Native Title claim was deregistered in 2010. Further details are provided in the Indigenous Cultural Heritage chapter (Section 25) and the Indigenous Cultural Heritage Technical Report (Appendix W) of this EIS.

A search of the DEEDI online Interactive Resource and Tenure Maps Database (DEEDI, June 2012) identified four Native Title claims within Central Queensland of particular relevance to the Project and are detailed within the Land Use and Tenure Technical Report (Appendix Q) of this EIS.



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BOWEN GAS PROJECT EIS

LAND TENURE AND OWNERSHIP

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LAND USE AND TENURE

Figure: **19-1**

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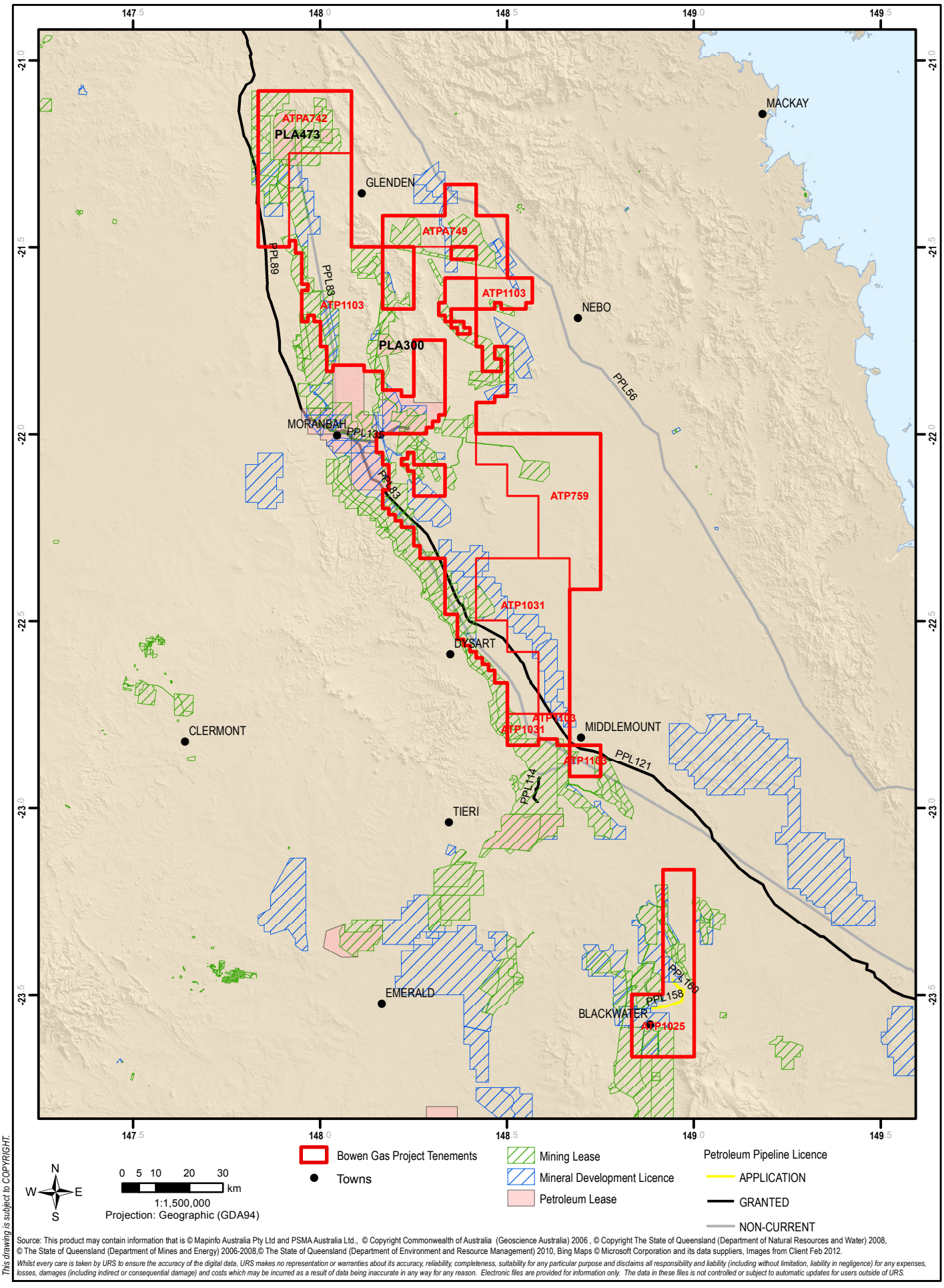

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BOWEN GAS PROJECT EIS

RESOURCE TENEMENTS

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LAND USE AND TENURE

Figure: **19-2**

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19.3.2 Land Uses

19.3.2.1 Agriculture

The predominant land uses within the Project area are agricultural, with pastoral areas (cattle grazing) comprising approximately 722,306 ha of the Project area (90.2%) and horticulture (irrigated and dry land cropping) comprising approximately 22,347 ha of the Project area (2.7%).

Field investigations undertaken as part of the EIS study identified the following notable agricultural land uses within the Project area:

- The north-western portion of Project area (in the vicinity of Weetalaba and Byerwen Stations) is characterised by cattle grazing and influenced by the Newlands coal mine. The area appeared to be covered in a mix of open grazing pasture, large pockets of remnant vegetation and large areas of regrowth vegetation where the pasture had not been maintained for grazing.
- The principal land use observed to the east of Glenden was cattle grazing on lands heavily disturbed by mining and mineral exploration activities including a high degree of drilling activities. Further disturbance was being generated from the expansion of the Powerlink high voltage network servicing the expanding mining sector. Land to the east of Glenden was generally covered in a mix of open grazing pasture, isolated pockets of remnant vegetation and areas of regrowth vegetation where the pasture had not been maintained for grazing.
- The principal land use observed in the area to the south-east of Glenden (along Suttor Development Road) was cattle grazing. However, areas of cropping were identified along the bottom of the Eungella range near Carrinyah Station.
- The central part of the Project area, to the east and south-east of Moranbah was principally used for cattle grazing on large tracts of cleared areas maintained for cattle grazing interdispersed with isolated pockets of regrowth vegetation.
- The lands surrounding Golden Mile Road are predominantly rain-fed broadacre cropping lands. Ground truthing revealed that this area had a number of different crops sown (primarily cotton and sorghum). Large portions of this area have been identified on the SCL trigger mapping as land that may contain SCL by Department of Agriculture, Fisheries and Forestry (DAFF).
- The Project area to the east of Dysart is characterised by land that is currently used for cropping (the majority of which have been designated as land that may contain SCL). However, large areas of cleared grazing land are also present. The Lake Vermont coal mine and associated rail infrastructure is located here and a PowerLink high voltage substation (Dysart Substation) and associated transmission lines are situated to the immediate west of the Project area.
- The land surrounding Rolfe Creek – Booroondarra Road is predominantly cleared grazing land with areas of remnant vegetation along drainage lines and regrowth vegetation located in some pastures that have not been maintained. The Norwich Park coal mine is situated within the Project area between Dysart and Middlemount.
- The Project area to the north of Blackwater is intersected by the Mackenzie River. As such, areas of arable cropping land occur along the river valley. Some of these areas are identified on the SCL trigger maps by the DAFF as land that may contain SCL. The Yarrabee and Jellinbah East coal mines and associated infrastructure are situated in this area. A haul road from these mines to the

train load out facility on the Capricorn Highway runs north-south along the eastern perimeter of the Project area. The dominant land use is grazing on cleared lands and coal mining.

- The Project area around the Blackwater township is intersected east-west by the Capricorn Highway and Central Railway line. The Curragh coal mine and rail spur is also located in this area. The area surrounding Blackwater is largely cleared and maintained for grazing with some areas of large lot rural residential type subdivisions present.
- The Project area to the south of Blackwater is dominated by cleared grazing land to the east of Blackwater – Rolleston Road. Lands to the west of Blackwater-Rolleston Road are characterised by the Blackwater coal mine and associated infrastructure including rail balloon loop, operated by BMA. This area also contains the Blackwater aerodrome.

Zones intended to sustain future agricultural land uses within the Project area are designated by identifying both GQAL and SCL under SPP 1/92 – *Development and the Conservation of Agricultural Land* and SPP 1/12 – *Protection of Queensland's Strategic Cropping Land*, respectively. Given GQAL and SCL is intended to sustain future agricultural land uses, there is the potential for impacts from the Project. The location and extent of GQAL and SCL within the Bowen Basin is shown on Figure 19-3 and Figure 19-4

As detailed in section 19.1.3, the Project is exempt to the statutory planning instruments administered under the SP Act, including SPP 1/92 and SP1/12. However, SPP 1/12 is part of a legislative and planning framework, established under the SCL Act, which allows the impacts on SCL by resource activities, including petroleum projects, to be assessed as part of a proponent's EA application.

Any resource activities that will have a permanent or temporary impact on SCL or potential SCL must be assessed under the SCL Act. There are two assessment pathways available to resource proponents proposing to undertake resource activities on SCL or potential SCL, being:

1. **SCL standard conditions code.** The standard conditions code simplifies the SCL compliance framework for certain resource activities that have a temporary impact and pose a relatively low risk of adversely impacting on SCL.
2. **SCL protection decision.** Resource activities that cannot comply with the standard conditions code must apply for an SCL protection decision, and are assessed and conditioned under chapter 3, part 4 of the SCL Act.

Agricultural land is defined as land used for crop or animal production, but excluding intensive animal uses (i.e. feedlots and piggeries) and is delineated as either GQAL or SCL as described below.

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. The Agricultural Land Class (ALC) classification system combines land suitability assessments for a number of specific land utilisation types into a single land classification. This ALC classification system has four categories: Arable (A), Limited arable (B), Pastoral (C) and Non-agricultural (D) as detailed in Table 19-1 below.

Table 19-1 ALC Classification

ALC Classification	Description
Class A - Arable land (Cropping land)	Land that is suitable for current and potential crops, with limitations to production which range from none to moderate levels.
Class B - Limited arable land (Limited crop land)	Land that is marginally suitable for current and potential crops due to severe limitations; however, it is suitable for pastures. Engineering and/or agronomic improvements may be required before the land is considered suitable for cropping.
Class C – Pastoral Land	Land that is suitable only for improved or native pastures due to limitations which preclude continuous cultivation for crop production; however, some areas may tolerate a short period of ground disturbance for pasture establishment.
Class D - 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.

(Source DPI, 1993)

SCL is a finite natural resource defined by soil, climatic and landscape characteristics which result in land highly suitable for crop production. Land that is defined as SCL comprises Queensland's best cropping land and is of state and national importance. For land to be considered as SCL, it must satisfy criteria relating to:

- Slope;
- Rockiness;
- Gilgai microrelief;
- Soil depth;
- Soil pH;
- Salinity; and
- Soil water storage.

An assessment of the potential for the Project to impact upon GQAL and SCL was undertaken using the *Guidelines for the Identification of Good Quality Agricultural Land* (QLD DPI and DHLG&P, 1993) and the SCL Policy Framework. An assessment of the soils within the Project area is detailed in the Soils chapter (Section 12) of this EIS and includes the results of the Land Suitability Assessment as detailed in Table 19-2 and shown in Figure 19-3.

As exemplified in in Table 19-2, large areas of land underlying the Project area are considered GQAL (Class A – C1) with those areas subject to the Class C2 and C3 being moderate and low quality pasture and Class D designation being disturbed from mining or urban type land uses activities.

The Project area is also situated within the Western Cropping Central Highlands and Isaac sub-zone beneath the SCL Policy Framework. The Project area contains land identified within Strategic Cropping Management Areas that may contain SCL as detailed in Table 19-3 and shown in Figure 19-4.

The extent of GQAL and SCL within the Project area is further defined and discussed in the Soils chapter (Section 12) of this EIS.

Table 19-2 GQAL Characteristics

GQAL Class	Area (Ha)
A (Cropping)	122,549
B (Cropping)	13,910
C1 (Pastoral)	260,903
Total	**397,362**

Source: DAFF, 2012

Table 19-3 SCL Management Areas

Class	Area (Ha)
Potential Strategic Cropping Land	82,628

Source: DAFF, 2012

19.3.2.2 Urban Development and Homesteads

The towns of Blackwater (with population of 7,550) and Coppabella are located within the Project area, whilst Glenden, Nebo, Moranbah, Dysart and Middlemount are located within the region, but outside of the Project area. In addition to these urban areas, two accommodation villages have been identified within the Project area, being the Coppabella MAC Camp and Burton Gorge Village. These urban areas and accommodation villages are shown on Figure 19-5.

Glenden, Nebo, Coppabella, Moranbah, Dysart, Middlemount and Blackwater all contain social infrastructure elements such as schools, hospitals, retirement homes and community groups. Potential impacts to social infrastructure are addressed in the Social chapter (Section 24) of this EIS. Residences, homesteads and accommodation villages located outside of the urban areas, but within the Project area, were identified through database searches and the interpretation of remote sensing data. An initial assessment of the number and location of these residences is detailed in the Land Use and Tenure Technical Report (Appendix Q) of this EIS and shown on Figure 19-5.

The state, regional and local regulatory instruments identify the future land uses within the region to comprise predominately agricultural and resource sector land uses, coupled with growth in infrastructure provision to support the mining activities and surrounding resource communities.

19.3.2.3 Mining and Resources

The Project area comprises a number of existing mine lease or existing mineral development lease tenements within the Bowen Basin, extending from Blackwater in the south to Newlands area in the north. Operating mineral resource activities within the Project area were identified through database searches and the interpretation of remote sensing data. In June 2012, twenty-two operational coal mines have been identified within the Project area. Mining areas and mining disturbance areas within the Project area have also been identified, including:

- Mining Areas, land subject to mining leases; and

- Mining Disturbance Areas, those areas which are disturbed as a direct result of mining activities, including areas currently being mined and those areas previously mined but still considered to be impacted (e.g. open-cut pits, tailings storage facilities and mining infrastructure areas).

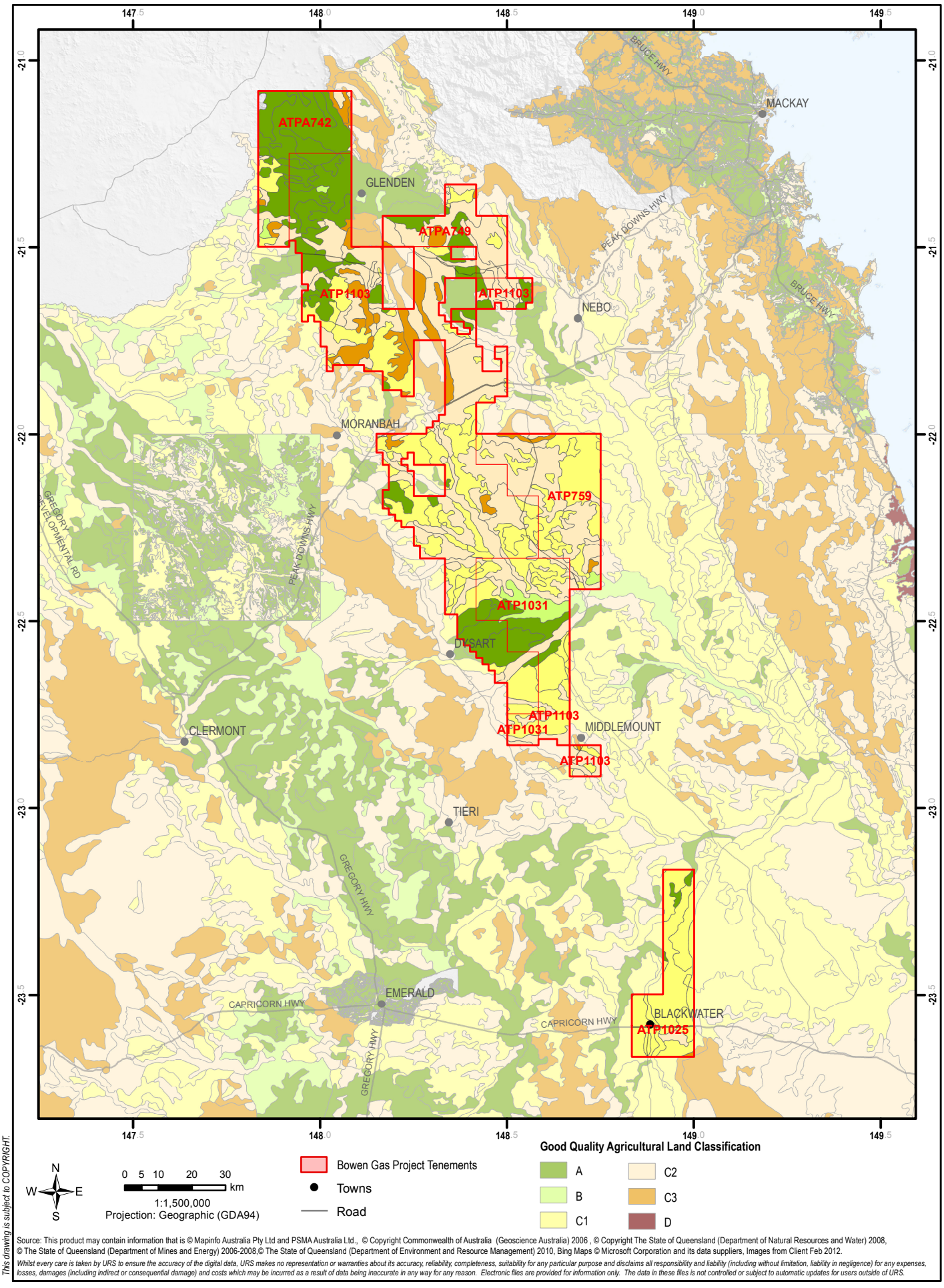
The location of these coal mines, mining areas and mining disturbance areas are shown on Figure 19-5 and further details are provided within the Land Use and Tenure Technical Report (Appendix Q) of this EIS.

As at June 2012, the Project area directly overlaid the following resource tenements:

- 80 MLs;
- 22 MDLs;
- 10 EPMs;
- 5 PPLs; and
- PLAs.

Whilst the Project area accommodates a number of extractive industries which are not mining activities (e.g., quarrying), no Key Resource Areas are located within the Project area.

Further details of these tenements are provided within the Land Use and Tenure Technical Report (Appendix Q) of this EIS.



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BOWEN GAS PROJECT EIS

GOOD QUALITY AGRICULTURAL LAND

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LAND USE AND TENURE

Figure: **19-3**

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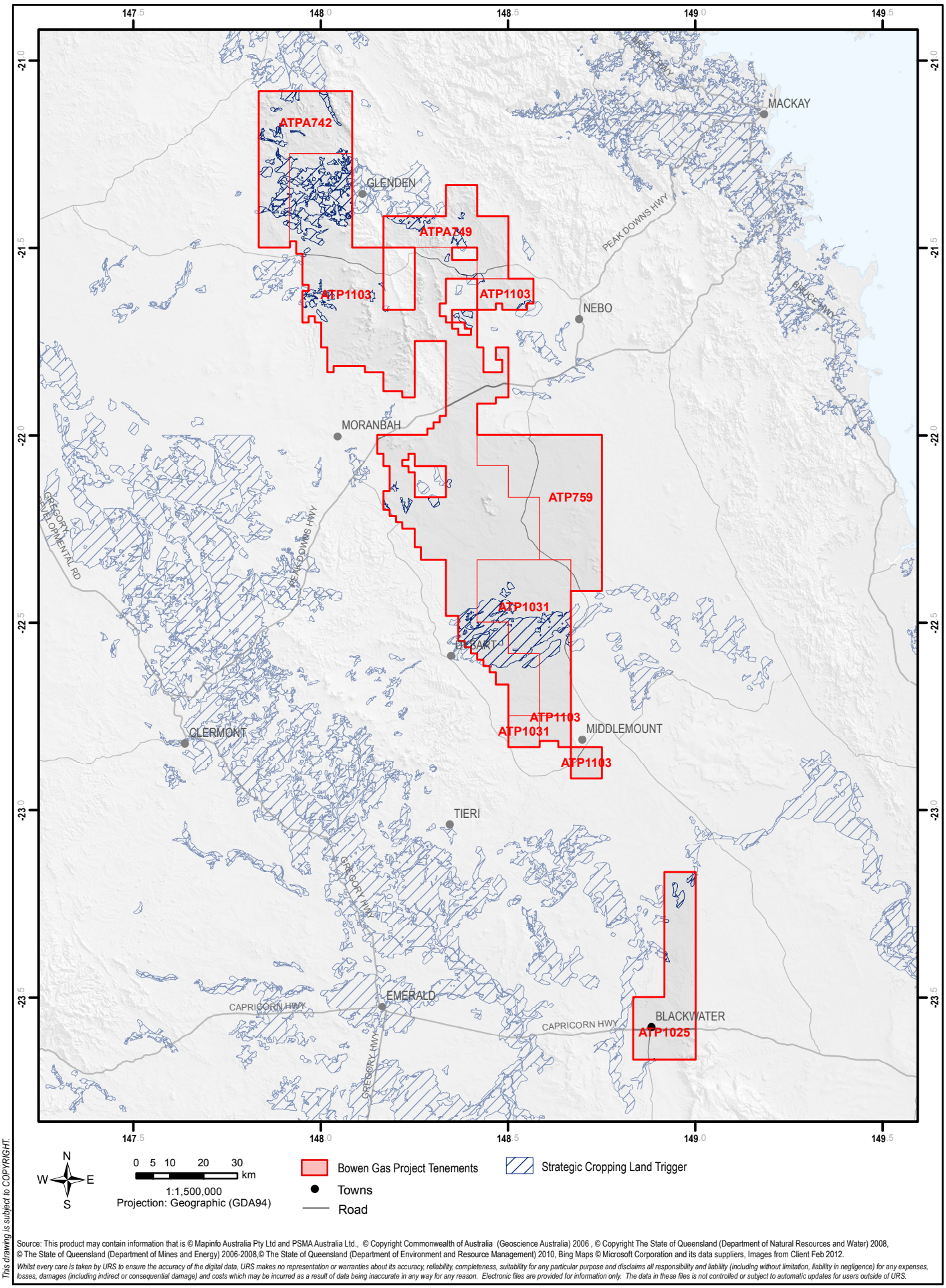

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BOWEN GAS PROJECT EIS

POTENTIAL STRATEGIC CROPPING LAND

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LAND USE AND TENURE

Figure: **19-4**

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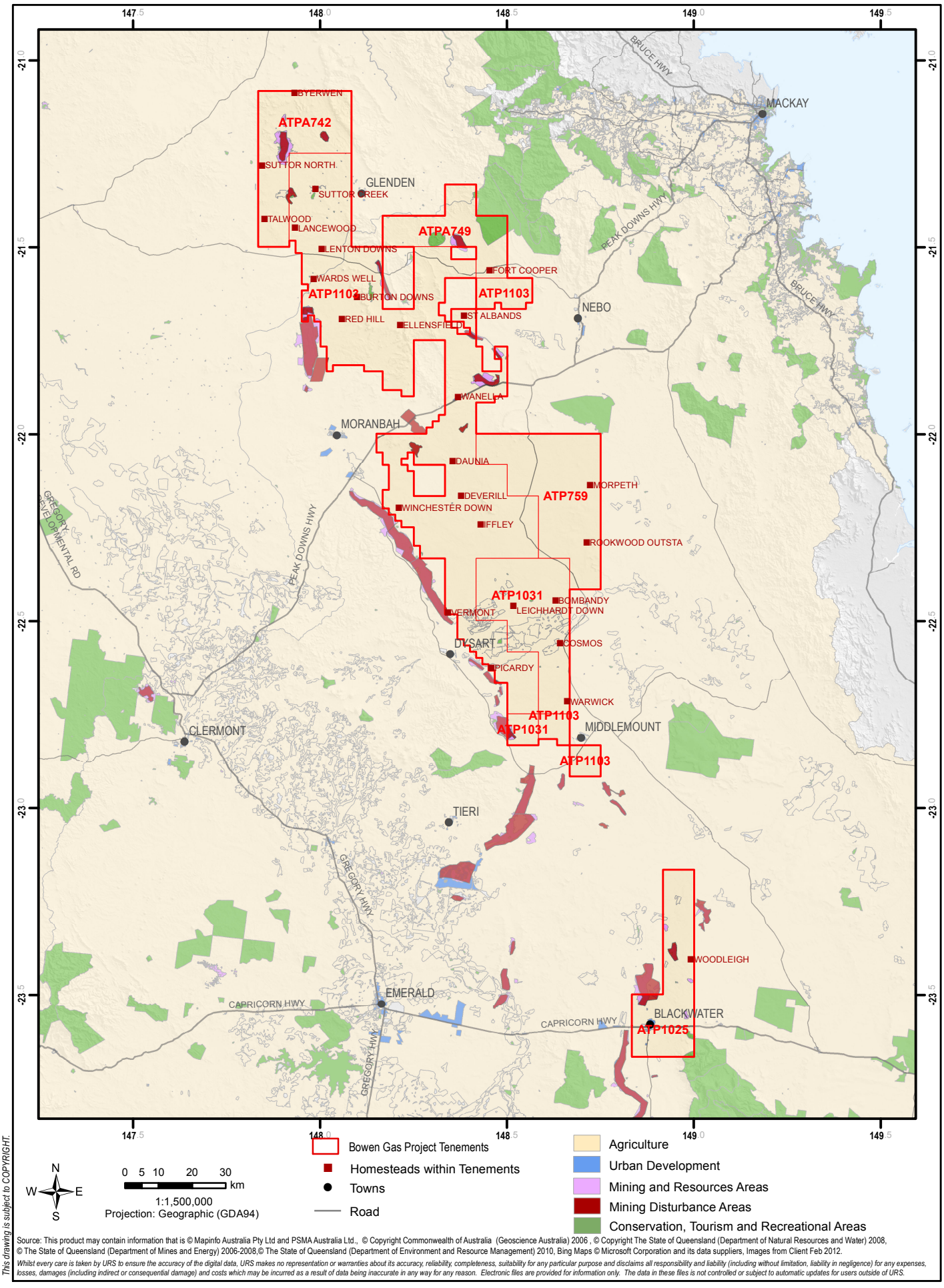

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BOWEN GAS PROJECT EIS

LAND USE

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LAND USE AND TENURE

Figure: 19-5

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19.3.2.4 Conservation, Tourism and Recreational Areas

Protected Estate

The Project area overlies a number of areas of Protected Estate. Of particular relevance is Homevale National Park and Homevale Conservation Park within the north-eastern part of the Project area, both of which are Category A protected areas under the Environmental Protection Regulation.

Also of relevance is Lake Elphinstone, a Wetland of National Importance (DIWA). Although located outside of the Project area, Lake Elphinstone is the largest natural freshwater lake in Central Queensland is a significant site for a range of fauna species. Lake Elphinstone also serves as a popular recreational destination for the surrounding towns of Nebo and Glenden. These areas, their ecological values and the potential impacts the Project will have on these values are discussed further in the Surface Water chapter (Section 15), the Aquatic Ecology chapter (Section 16) and the Terrestrial Ecology chapter (Section 17) of this EIS.

Large areas of the Project area comprise rural landscapes that are used for cattle grazing. These rural areas are considered to hold landscape and open space values by virtue of the low impact nature of the dominant land use. Whilst not afforded the protection given to an area of protected estate such as a National Park or Resource Reserves, these tracts of land contain both Category A and Category B protected areas such as remnant and re-growth ecosystems. Areas of protected estate within the Project area are shown in Figure 19-1 and further details are provided in the Land Use and Tenure Technical Report (Appendix Q) of this EIS.

Declared Catchments and Water Storages

Within Queensland, there are currently 20 declared catchment areas administered by NRM, none of which are located within the Project area. Burton Gorge Dam, whilst not a declared catchment, is a water storage facility on the upper reaches of the Isaac River with a storage capacity of 19,264 megalitres (ML) and primarily services the water supply requirements of surrounding coal mines. Whilst outside of the Project area, the Bedford and Bingegang Weirs are located on the Mackenzie River and service agricultural and mining uses. These weirs have capacities of 11,793 ML and 8,060 ML respectively.

A range of beneficial uses have been considered for waste CSG waters associated with the Project, including agricultural uses (irrigation and stock water), industrial uses (construction and processing), urban uses (town water supply) and the construction of a pipeline to take CSG water (with an appropriate level of treatment) to the ocean or another suitable discharge location such as an existing watercourse. The beneficial use options being considered by the Project are detailed within the Surface Water chapter (Section 15) of this EIS.

Wetland Areas

The Project area contains a number of Great Barrier Reef Wetland Protection Areas. These areas, their ecological values and the potential impacts of the Project on these values are discussed further

in the Surface Water chapter (Section 15), the Aquatic Ecology chapter (Section 16) and the Terrestrial Ecology chapter (Section 17) of this EIS.

Tourism and Recreation

The Project area comprises a number of tourism and recreational areas, including Homevale National Park and Conservation Park. Details of these areas are provided within the Land Use and Tenure Technical Report (Appendix Q) of this EIS.

19.3.3 Infrastructure

19.3.3.1 Roads

The central region of Queensland is serviced by a network of highways that provide connections to Rockhampton and Mackay to the east, Townsville to the north-east, Brisbane to the south-east, New South Wales to the south and Mount Isa to the west.

There are a number of major roads from potential ports to the local Project area for haulage routes, including the Interstate Route 70 from the eastern ports (Peak Downs Highway and Gregory Highway) to Clermont then the Gregory Highway (A7) to Emerald. From the east, the preferred route to the Project site is along the Capricorn Highway (A4) from Rockhampton or Peak Downs Highway (Interstate Route 70) from Mackay. From the southeast, the preferred route from Brisbane to site is via the Warrego, Carnarvon, Dawson and Gregory Highways to Emerald. Once at Emerald, these routes follow the Capricorn Highway (A4) to Blackwater, Gregory Highway (A7) then Peak Downs Highway (Interstate Route 70) to Moranbah and Coppabella.

Examination of the Queensland State Controlled Road Network and the Roads Connecting Queenslanders document prepared by the Department of Transport and Main Roads (TMR) revealed there were no additional road reserves, other than those already formed, within the Project area.

The major roads within the region are illustrated in Figure 19-6.

19.3.3.2 Rail

The central region of Queensland is serviced by a network of coal rail infrastructure that provides transport connections from the mining operations in the Bowen Basin to major coal export terminals along the eastern coast of Queensland. The Central Queensland Coal Network comprises approximately 2,300 km track network across the four major coal systems. Of those, three systems service the mining operations within the Project area, being the Blackwater, Goonyella and Newlands systems.

There are also a number of planned extensions to the Central Queensland Coal Network, including the Goonyella to Abbot Point Expansion project. Much of the existing and necessary future coal infrastructure is planned and provided for on a fully commercial basis by the private sector and government-owned corporate entities, such as QR National and various ports corporations.

The Project area is intersected by numerous branch and main rail lines and future rail corridors as shown in Figure 19–6 and detailed further in the Land Use and Tenure Technical Report (Appendix Q) of this EIS.

19.3.3.3 StockRoutes

Stock routes are an import component of Queensland's rural infrastructure. Stock routes are utilised for the movement of stock without reliance on the road or rail transport network and provide for alternative agistment areas during times of drought. The Queensland stock route network is utilised by large pastoral companies to move large herds of cattle between various holdings throughout the state and on to markets. Additionally, during times of drought, the network continues to provide pastoralists with opportunities to walk stock to non-drought affected areas or implement long-term drought management strategies (DERM, 2009).

As shown on Figure 19–6 and detailed in the Land Use and Tenure Technical Report (Appendix Q) of this EIS there are 13 stock route reserves that traverse the Project area. The current status of Stock Route Network infrastructure (watering points, bores, windmills and holding yards) across the Project area is unknown.

19.3.3.4 Water Infrastructure

SunWater manages an extensive network of water supply infrastructure within the Bowen Basin that supports mining, power generation, industry, urban development and irrigated agriculture land uses.

The Project area overlies the Burdekin, Eungella, Braeside, Bingegang, Bedford East and Bedford West systems of the SunWater BMA water pipeline network. There are also a number of proposed pipelines planned to service the increasing demands of the Bowen Basin and surrounding region. One of the proposed pipelines identified within this study is the Connors Dam pipeline, which will intersect central part of the Project area in an east-west direction, east of Moranbah.

Project related water infrastructure will also be constructed within the Project area. An integral part of extracting the CSG is the removal of large quantities of water to depressurise the coal seams allowing gas to desorb from the coal. A Water Management Strategy has been developed in line with the State Government's Policy[1] on Coal Seam Gas Water Management for the Project and is detailed within the Surface Water chapter (Section 15) of this EIS.

Arrow is exploring several water management options to maximise the beneficial use of CSG water and its by-products. In order to achieve this aim, it is likely that Arrow will need to construct a water infrastructure network to store, treat and transport the CSG water. Arrow will undertake investigation and evaluation of water management options, including emerging technologies, to determine the most appropriate option for the Project.

[1] The DERM Coal Seam Gas Water Management Policy 2010 was superseded by the DEHP Coal Seam Gas Water Management Policy 2012 on the 21/12/2012, subsequent to the compilation of the Draft Bowen Gas Project EIS. Arrow are reviewing the updated policy at the time of the Bowen Gas Project EIS being published, and may undertake further amendments to the Arrow CSG Water and Salt Management Strategy (Appendix AA) in keeping with the updated DEHP policy, as part of a supplementary report to the EIS.

These water pipelines are shown in Figure 19–6 and detailed further in the Land Use and Tenure Technical Report (Appendix Q) of this EIS.

19.3.3.5 Gas Infrastructure

The Project area overlies a number of gas pipelines, including:

- The proposed AGL Pipelines Investments gas pipeline (PPL 56);
- The proposed Stanwell Corporation gas pipeline (PPL 83);
- The North Queensland gas pipeline (PPL 89);
- The Central Queensland gas pipeline (PPL 121); and
- The CH4 (PPL 135) gas pipeline.

The proposed Arrow Bowen Pipeline (ABP), consisting of a main pipeline and several lateral pipelines, span across the Project area and will transport CSG from the Project appropriately 600 km from the Bowen Basin to Curtis Island, Gladstone for conversion to LNG. The steel pipeline will be buried at a minimum depth of 750 mm in a 30 m easement. The proposed ABP does not form part of this EIS.

The petroleum and gas pipeline licences within the Project area are shown in Figure 19–6 and detailed within the Land Use and Tenure Technical Report (Appendix Q) of this EIS.

19.3.3.6 Power Facilities

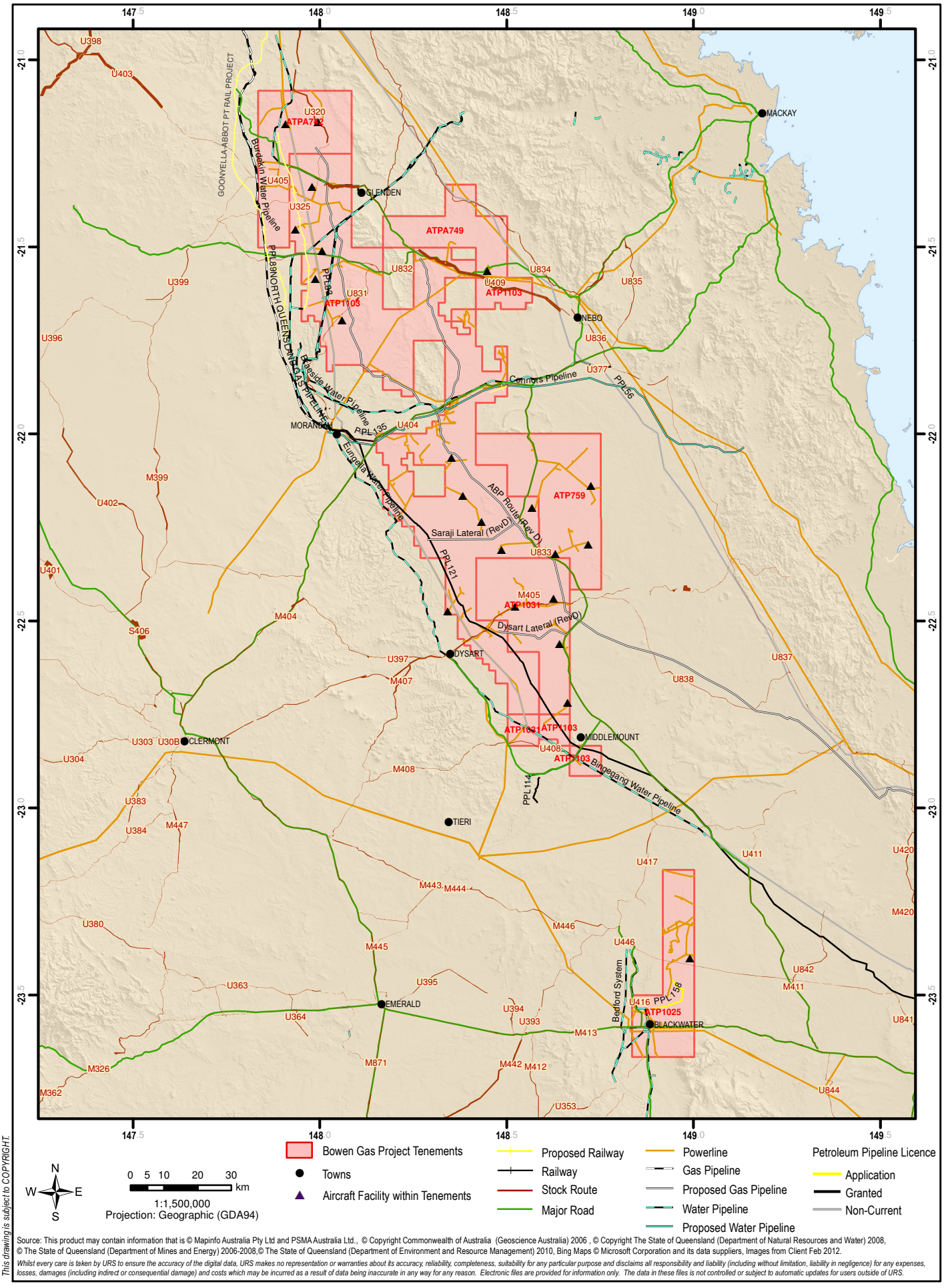
The Project area overlies a number of Powerlink and Ergon Energy transmissions lines servicing the mining sector and rural townships within the Bowen Basin. The electricity infrastructure comprises various 132 kilovolts (kV) and 66 kV (Powerlink and Ergon Energy) transmission lines and substations which span across the large portions of the Project area.

The location of the power facilities within the Project area are shown in Figure 19-6.

Numerous power supply solutions are being investigated for the supply of energy to the Project. It is expected that bulk electricity supply for the Project will be achieved at either 66 kV or 132kV with the preferred option being to connect to existing transmission and/or distribution infrastructure. Arrow will work with the network service providers (NSP) to establish, subject to availability and location, suitable 66 kV or 132 kV connections at new zone or local substations on Arrow's PLs in the vicinity of the major facilities to be developed.

It is expected that the 66 kV or 132 kV bulk supply network from the NSP substation will consist of a fully redundant system to ensure adequate reliability of the power to the Arrow or NSP substations which will be located at the central gas processing facilities (CGPFs) and/or the integrated processing facilities (IPFs). The new Zone Substation and subsequent interconnected substations and transmission facilities will be focused in the areas of the greatest load concentration.

Further in field activities may see it advantageous to distribute grid connected power to other facilities determined by load requirements and key considerations. The voltages may be 66kV, 33kV, 22kV or 11kV as determined by requirements.



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BOWEN GAS PROJECT EIS

TRANSPORT INFRASTRUCTURE AND UTILITIES

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LAND USE AND TENURE

Figure: **19-6**

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19.3.3.7 Aeronautical Facilities

The Project area overlies the Blackwater aerodrome, Yarabee Mine aerodrome and a number of unnamed landing grounds servicing individual homesteads and mining operations. A number of other aeronautical facilities are located within the region, but outside the Project area, including Moranbah Airport and Glenden, Dysart, Middlemount aerodromes. The locations of these aeronautical facilities are shown in Figure 19–6.

19.4 Issues / Potential Impacts

Potential impacts of the Project on the identified environmental values of agricultural activities, urban development and homesteads, mining and resource activities, conservation, tourism and recreational areas and infrastructure is discussed below.

19.4.1 Agriculture

Project activities with the potential to cause adverse impacts to pastoral and horticultural activities during the construction, operations and decommissioning phases of the Project may include:

- Loss of productive land (temporarily and potentially permanently) from development of production facilities;
- Temporary or permanent alienation and sterilisation and associated diminished productivity as a result of the development of wellhead facilities, gathering systems, infield pipelines, access tracks, dams and compressor stations;
- Disruption to farm operations, such as tillage, planting, irrigation, weed control and harvesting, from locating Project facilities in inappropriate locations;
- Soil degradation from disturbance of the soil structure from all Project activities, resulting in impacts to fertility and biologic function and crop yield;
- Changes to surface irrigation infrastructure, including head ditches, bays and tail drains, from inappropriate placement of wells, gathering systems, pipelines and access tracks;
- Diversion of flows and changes to the hydrology of the landscape from poorly sited or
- constructed access tracks;
- Farm hygiene issues relating to weeds and disease management from construction and operations vehicles, plant and equipment;
- Reduced crop yield from unsuccessful rehabilitation; and
- Potential site contamination.

Potential impacts on the identified environmental values are disturbance of the soil profile, disruption to machinery operations, impediments to farm workability, increased or new management overheads (including integration with farm plans), loss of amenity and ground contamination, as detailed below.

19.4.1.1 Soil Profile

The Project has the potential to result in changes to soil profiles, impacting agricultural activities undertaken over these lands. The land suitability assessment identified six representative soil types

for broadacre cropping with moderate limitation and 10 representative soil types were assessed for cattle grazing and determined to have marginal limitations. The Project area is dominated by Sodosols (60%) and Vertosols (39%), Kandosols (0.7%) with Rudosols (0.3%), also present throughout the Project area. The soil profiles throughout the Project area vary with the land systems, with more permeable soil types, such as Sodosols and Vertosols, more susceptible to disturbance than less porous soils, such as Dermosols, and the sandy, clay loam Rudosols, Tenosols and Kandosols, with maintaining water flow through soils important to the horticultural value of land.

Potential impacts to soils in general relate to:

- Compaction from traffic;
- Inversion from mixing of soil horizons during excavation and preparatory works;
- Reduced organic matter from disturbance;
- Disrupted soil structure due to changes in soil constituents and plastic deformation;
- Crust formation;
- Biological degradation from stockpiling of the soil reducing organism vigour and seed stores;
- Impeded infiltration and drainage;
- Increased soil runoff during rain events;
- Reduction in plant available water;
- Reduced soil air, which may induce anaerobic soil conditions;
- Reduced fallow efficiency; and
- Reduced fertility due to lowered organic matter, soil water or denitrification (Arrow, 2011).

19.4.1.2 Machinery Operations

Mechanised horticultural farming is sensitive to:

- Soil compaction, especially at headlands, leading to reduced crop yields;
- Irregular paddock shapes requiring double passes of machinery, leading to soil compaction and increased machinery operating costs;
- Uneven planting rates;
- Tillage gaps and unplanted areas leading to reduced crop yields; and
- Tillage gaps and weed banks causing increased weed control costs.

Headlands are where machinery turns to start the next run down the paddock and are formed at the end of each tillage or planter run. The headland is subject to greater compaction due to the repeated turns of machinery. Figure 19-7a shows a typical tillage pattern in a rectangular, unobstructed paddock, with the headlands located at each end of the paddock. Inappropriately placed wells and tracks can obstruct tillage operations through the creation of more headlands, leading to a reduction in productivity as shown in Figure 19-7b. Figure 19-7c shows an example of how headlands can be reduced by locating infrastructure adjacent to the edges of paddocks or by aligning tracks and wells with the direction of tillage (Arrow, 2011).

19.4.1.3 Farm Workability

Changes to the layout of horticultural farming properties caused by the introduction of Project infrastructure can disrupt operations, leading to increased capital and operating costs. This is particularly evident in surface irrigation where modifications to irrigation channels, head ditches and tail drains can reduce the efficiency of delivery and distribution of water throughout the farm. Similarly, shortening of lateral booms and centre-pivot irrigators may require additional irrigators (e.g., big gun sprays) to irrigate the land inaccessible by the booms or centre pivots. Increased headlands may require smaller tractors and planters to negotiate the introduced corners leading to increased capital and operating costs.

Development of Project infrastructure may also limit the ability of farmers to change farm plans to incorporate proposed capital improvements to the property and to account for new technologies and farming techniques. Potential farm workability impacts to grazing activities will be limited to access restrictions to wellhead facilities, field compression facilities (FCFs) and gas and water processing facilities. Low pressure gas and water gathering systems and Medium Pressure Infield Pipelines are not anticipated to impact cattle grazing activities with both comprising minimum burial depths of 750 mm and 1000 mm, respectively (Arrow, 2011).

19.4.1.4 Management Overheads

Irrigated and dryland broadacre cropping properties in the Project area typically have farm plans that extend over a number of years. The plans set out the cropping and fallow cycles of each paddock and the rotation of crops to ensure soil organic matter is maintained and optimised, and they detail future development. They include information on the cultivation, planting, spraying and harvesting requirements for each crop. They may incorporate development plans that include the extension or augmentation of irrigation systems and associated infrastructure. Integration of Project construction and operations activities with farm operations may introduce a management overhead that does not currently exist (Arrow, 2011).

19.4.1.5 Loss of Amenity

Changes to the rural landscape as a result of the introduction of project infrastructure and access to properties by Arrow staff and contractors will affect the amenity currently enjoyed by the farmers and their families. The extent and configuration of Project infrastructure on each property and the frequency and duration of visits by authorised personnel, along with the lifestyle of the farmers and their families, will determine the degree to which amenity is affected.

The effect of the Project on land value is considered to be variable based on a range of factors. Factors that will influence land value include the quality of the soils, access to water, farm productivity before and after the Project, and the nature of compensation agreements. Arrow aims to integrate its activities with agricultural enterprises in a way that does not adversely affect their viability or the agricultural potential of the land (Arrow, 2011).

c) Example pattern of machinery movement resulting from relocation of wells and tracks to edges of paddock or in line with tillage direction

b) Example pattern of machinery movement resulting from multiple wells with track network

a) Typical unobstructed pattern of machinery movement

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BOWEN GAS PROJECT EIS

EXAMPLE PATTERNS OF MACHINERY MOVEMENT

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LAND USE AND TENURE

Figure: 19-7

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19.4.1.6 Ground Contamination

The establishment of water treatment infrastructure (as described in the Project Description chapter (Section 4) and the Surface Water chapter (Section 15) of this EIS to manage CSG water and the disposition of salt has the potential to impact on agricultural activities. Water and salt management will require construction of dams and storage facilities, pipelines and treatment facilities which are likely to result in the displacement of any underlying pastoral and horticultural pursuit for the life of the Project and potentially longer where site contamination occurs as a result of salinity. The potential impacts and mitigation measures to be implemented are addressed further in the Contaminated Land chapter (Section 11) and the Surface Water chapter (Section 15) of this EIS.

Impacts to agricultural land uses will vary depending on the contextual and operational characteristics of individual farming pursuits. Arrow will work with landowners to integrate development activities (and infrastructure) with farming operations recognising and understanding the particular farming practices and property specific development plans. Arrow will consult landowners on the location of infrastructure and construction methods to reduce overall impacts to the farming operation including capital and operating costs, and productivity.

19.4.1.7 Extent of Disturbance to Good-quality Agricultural Land and Potential Strategic Cropping Land

GQAL (Class A – C1) covers approximately 52% of the Project development area, with the balance comprising other agricultural land, unallocated state land, state forest, urban and industrial areas and mining and resource activities. Potential strategic cropping land is generally coincident with Class A GQAL and covers 11% of the Project development area. An assessment of the soils within the Project area is detailed in the Soils chapter (Section 12) of this EIS, and includes the results of the Land Suitability Assessment.

It is not yet possible to assess the impact of Project development on GQAL, potential strategic cropping land and specific agricultural enterprises, as locations of proposed infrastructure are not known and detailed mapping of strategic cropping land yet to be undertaken. However, Arrow's experience indicates that construction of a typical production well, together with associated gas and water gathering infrastructure, is likely to disturb 2% to 3% of land associated with a typical 160 acre (65 ha) production spacing. As gas field development is based on a series of production spaces, the estimate provides an indication of the overall area of disturbance to each property. Rehabilitation of gathering systems and temporary workspaces around wells will reduce this area with, the extent of the reduction depending on the success of rehabilitation.

There is also potential for medium-pressure pipelines and field compression facilities to be developed on GQAL and strategic cropping land. It is Arrow's intention to avoid locating the larger central gas processing facilities and integrated processing facilities on GQAL and strategic cropping land. The land requirements for this infrastructure are:

- Production well – Up to 0.5 ha for drilling and the installation of wellhead infrastructure, reducing to 10 m by 10 m (0.01 ha) during the 10-15 year life span of each well. A workover, which is required every 2 to 4 years, will require a similar area to that required to establish the well. Up to 6,625 wells are proposed over the life of the Project.

- Medium-pressure pipelines – Between 15 and 25 km in length, with a construction right of way up to 25 m wide.
- Production facilities – Seventeen production facilities are required: ten field compression facilities (typically 0.5 ha in size), three central gas processing facilities (each 15 ha) and four integrated processing facilities (each up to 220 ha).

Impacts resulting from the Project are unlike other land use impacts where the proposed activity displaces the existing land use. On rural land, the effect of the Project is to establish an additional land use which co-exists with existing uses. The land use impact will be determined by the individual characteristics of the land and the current or proposed agricultural use.

The main impact to pastoral activities is expected to occur during construction when some agricultural activities are likely to be temporarily restricted over the lands subject to the construction activities of the Project facilities. Of particular relevance to horticultural activities is the construction of the low pressure gas and water gathering systems where trenching will create linear disturbance to the subject land. Agricultural activities will be able to recommence upon rehabilitation of construction areas and continue for the life of the gas and water gathering systems without impediment, with the exception of well head sites and facility locations. Temporary access restrictions may also apply during the course of construction and rehabilitation works.

Impacts to agricultural land uses will vary depending on the contextual and operational characteristics of individual farming pursuits. Arrow will work with landowners to integrate development activities (and infrastructure) with farming operations recognising and understanding the particular farming practices and property specific development plans. Arrow will consult landowners on the location of infrastructure and construction methods to reduce overall impacts to the farming operation including capital and operating costs, and productivity.

19.4.2 Urban Development

The Project has the potential to impact on amenity afforded to urban land uses within the Project area, such as Blackwater township. These impacts are anticipated to be relatively minor as no Project infrastructure is proposed within the urban areas as defined by the relevant local government planning schemes. In addition, urban uses are not anticipated to encroach upon the various Project facilities during its operational life due to the limited scale and intensity of urban growth into the surrounding rural areas.

Rural towns (e.g. Coppabella), accommodation facilities (e.g. Burton Gorge Village), mining camps (off-tenure), residences and homesteads located outside of the defined urban areas may not be afforded the same setbacks to Project infrastructure. As a result, residents may experience impacts of the development and operation of the Project facilities. These impacts will include noise, vibration, air quality and visual effects both during construction and operation. These impacts are further discussed in the Air Quality chapter (Section 9), the Landscape and Visual Amenity chapter (Section 20) and the Noise and Vibration chapter (Section 22) of this EIS.

Potential amenity impacts to mining camps, where located on-tenure, will be addressed through negotiations between Arrow and the holder of mine tenements as part of agreements to coordinate the extraction of gas which is required to be undertaken prior to extraction of the coal. These agreements

will address potential amenity impacts of Project infrastructure on mine camps, including any required mitigation measures to be implemented.

The construction impacts are not anticipated to be significant due to the relatively short term and low intensity nature of construction; however, this is largely dependent on the separation distances, mitigation strategies and whether the topography or other factors will provide any form of buffering. Construction impacts are expected to be similar to those listed in the Project Description chapter (Section 4) of this EIS.

Potential operational impacts on the rural landscape include noise, vibration and air quality resulting from venting and flaring associated with the operation of the wells and gas compression stations. These matters are discussed in the Air Quality chapter (Section 9) and the Noise and Vibration chapter (Section 22) of this EIS.

From a land use planning perspective, Project infrastructure may discourage further residential forms of development outside the established urban areas.

19.4.3 Mining and Resources

The Project area overlies a number of existing mining and mineral development tenements. The extent of overlapping tenements are shown on Figure 19-2. These areas of overlapping tenements present potential for interactions between mining and resource activities.

Significantly, the extraction of CSG does not need to preclude the extraction of the coal resource as the Project only involves the removal of the gas from the coal seam, a step already undertaken prior to the establishment of underground coal mining. Mineral resource extraction can only occur after the completion of gas extraction for underground mining or it can be coordinated to occur in conjunction with open cut mining. Accordingly, coordinated coal and CSG production can be mutually beneficial and commercially feasible. However, it is important to ensure that appropriate measures are in place to minimise potential interactions.

Arrow will need to establish agreements with third party overlapping tenure holders to minimise impacts of the Project on the mining of coal resources within the fields for the timeframe of the Project. These provisions need to be in accordance with the provisions of the P&G Act.

The interaction of overlapping CSG production and coal mining needs to be managed with a ‘co-development agreement’, founded on the basis of mutual cooperation and coordination of the respective parties’ activities, and providing the means to agree, monitor and communicate appropriate mechanisms to manage safety, commercial, operational and environmental matters.

The primary considerations of coal mine operations in relation to the Project include:

- Reduction of gas content levels in the target coal seam prior to underground mining to meet safety and ventilation requirements;
- Management of gas released as a consequence of mining (including from overlying or underlying seams) to minimise safety risk to ongoing mining operations; and
- Carbon liabilities arising from fugitive gas emissions.

To minimise the impacts on resource activities, major infrastructure has been designed to avoid lands subject to existing mineral development lease tenements and minor Project infrastructure is placed in consultation with tenement holders to minimise impact. This ensures that existing mineral resource operations, which are well progressed through the planning and approval process are protected.

Where Project infrastructure is located in areas of overlapping tenure with coal mining projects, the design and placement of infrastructure and CSG wells, including the rate of production, will be flexible enough to accommodate coal mining activities. CSG production wells will typically be decommissioned ahead of coal mining activities commencing as part of the normal well abandonment processes.

Safety within the areas of overlapping tenure will need to be managed by Arrow in consultation with the relevant coal companies and include:

- Implementation of a compliant Safety Management Plan (SMP);
- Preparation and implementation of a Principal Hazard Management Plan (PHMP) with overlapping coal operations.
- Development of risk control and risk management processes with overlapping coal operations;
- Appointment and duties of site safety personnel;
- Reporting requirements; and
- Operating plant and equipment standards.

The existing Arrow SMP describes and documents the strategies that will be used by Arrow management, employees and contractors to maintain a high level of safety on-site. The SMP meets the requirements of the P&G Act and Arrow's Health, Safety & Environment Management System (HSEMS).

The PHMP required for each overlapping PL will need to identify risks and establish processes to manage gas activities and production so as to ensure the safe and efficient mining of coal in the overlap area. Arrow has measures in place to prevent, manage, and report on potential mining hazards arising from its CSG activities. Arrow maintains records of all sub-surface infrastructure associated with wells, including casing size, well depth, hole-diameter, and directional surveys. Finalising each PHMP will require consultation, including workshops, with the overlapping mining companies.

Arrow has demonstrated experience in working with mining companies to ensure that the value of the underlying gas and coal resources are maximised. Arrow has successfully worked with open cut mining projects, demonstrating its ability to install surface and sub-surface infrastructure in a manner that avoids impacts to mining operations. Similarly with underground mining, Arrow has demonstrated experience ensuring well and other project infrastructure placement does not impact on the safe and efficient extraction of underground resources. Arrow's commitment to cooperation and dialogue allows for negotiations surrounding infrastructure placement which will maximise gas yields and lower costs for the subject mining proponent, whilst still allowing safe access the resource reserves.

Deep surface to inseam degassing of coal delivers benefits to mining including improved health and safety outcomes as well as avoiding carbon liabilities. The coal and gas sectors have worked together on similar projects to ensure commercial certainty and viable co-existence. As a result, the Project offers a number of potential advantages to overlapping coal mining operations. These include:

- Extensive experience in the development and management of CSG extraction processes;
- Reducing coal mine development costs and improved safety by providing thorough pre-drainage ahead of coal mining;
- Leveraging gas infrastructure and relationships to supply gas to higher value markets;
- Reducing greenhouse gas liabilities for coal mining companies by:
  - Optimising gas production across a large acreage; and
  - Maximising the recovery of CSG from all coal seams within a mining lease area.

Exploratory permit holders for mineral extraction over lands subject to the Project area will need to coordinate proposed mining activities with Arrow.

19.4.4 Conservation, Tourism and Recreation

The Project will not directly impact on the Homevale National Park or Conservation Park, with no Project infrastructure proposed within Category A protected estate. Project infrastructure may be located within Category C protected estate (i.e., Arthurs Bluff State Forest and various nature refuges) throughout the Project area. Potential impacts to Category C protected estate are detailed within the Surface Water chapter (Section 15), the Aquatic Ecology chapter (Section 16), the Terrestrial Ecology chapter (Section 17) and the Environmentally Sensitive Areas chapter (Section 18) of this EIS, but may include:

- Soil compaction, erosion and sediment release to land and water;
- Disturbance of problematic soils such as dispersive or contaminated soils;
- Potential modification to surface water flows (drainage lines and streams);
- Disturbance of significant flora and wildlife habitat;
- Incursion of disease, weeds, vermin or destructive influences to the site; and
- Unauthorised third party access to previously inaccessible areas (Source: APIA ENV Practice Code).

The indirect impacts of the Project, such as noise and vibration, on natural systems, open space and recreational values may result in changes to land uses and land use activities.

The Project is not likely to impact on any of the values attributed to the existing tourist attractions or recreational areas within the Project area.

19.4.5 Infrastructure

19.4.5.1 Roads

Some minor disruptions are expected to the road network that may occur during construction of the Project infrastructure. Trenching or drilling may be required to provide access across both state controlled and local roads for the underground gas gathering systems. Impacts will vary depending on the local context of the road and the location of Project infrastructure.

No road closures are expected and no other impacts are expected as a result of the ongoing operation of the gas gathering system on the local or state controlled road network.

Further details on impacts to local roads from the construction of Project infrastructure are provided in the Roads and Transport chapter (Section 21) and a Traffic Impact Assessment (Appendix R of this EIS) has been prepared in accordance with the TMR 'Guidelines for Assessment of Road Impacts of Developments' (2006).

19.4.5.2 Rail

Project infrastructure will not directly impact on the operation of any rail infrastructure. Where the gas gathering or trunkline network is required to cross under a rail line, the crossing will be either bored or directionally drilled, thereby avoiding direct impacts.

Project infrastructure construction activities may necessitate the establishment of access tracks in the vicinity of existing railway lines. Minor service interruptions / disturbances may occur if construction is required in proximity to any rail lines, so as to satisfy likely recommended safety protocols (e.g. trains reducing speed near the construction zone). Impacts on rail infrastructure and services resulting from the ongoing operation of the Project are not expected.

19.4.5.3 Stock Routes

Locations within the Stock Route Network will be temporarily impacted during the construction of the Project infrastructure at those locations where it is necessary for the gas gathering system and infield pipelines to cross stock routes. Impacts on stock routes will generally arise from the clearing of vegetation and ground disturbance associated with the construction of the underground infrastructure. Significant impacts to stock routes resulting from the ongoing operation of the Project are not anticipated.

19.4.5.4 Utilities and Other Services

Project infrastructure will cross a number of existing gas and water pipelines. Where the gas gathering network intersects the alignment of an existing gas or water pipeline, the crossing will be either bored or directionally drilled to minimise disturbance and impacts on the third party infrastructure. Crossings will be undertaken in accordance with agreements reached with the various pipeline owners and operators. The design and construction of co-located medium and high pressure gas pipelines with other liner infrastructure will be carried out in accordance with AS 2885: *Gas and liquid petroleum*. Impacts resulting from the ongoing operation of the CSG fields are not anticipated. Please note that the proposed ABP does not form part of this study. Impacts associated with the ABP project have not been assessed within this EIS.

Project infrastructure will also intersect a number of high voltage easements. The proximity of project infrastructure to high voltage power infrastructure presents potential issues surrounding induced currents and the requirements for altered Project infrastructure design in these areas. Potential impacts to the high voltage distribution network are estimated to be relatively minor and are only expected to occur during construction. Appropriate construction techniques will be adopted to ensure the safety of personnel working in proximity to high voltage infrastructure.

The construction stage will not interrupt electricity supply to any users or yield direct impacts on any element of the high voltage network. Works will be regulated under the *Electrical Safety Act 2002* and any co-use development guidelines by the relevant operator. Potential issues regarding induced currents and other issues with respect to the proximity of the network to the existing high voltage network will be overcome and addressed during the detailed design of Project infrastructure.

During detailed design, Arrow will also liaise with Ergon Energy and Powerlink to ensure the final alignment surrounding power related infrastructure avoids any existing works. Safety aspects surrounding this element of the Project (e.g., setbacks) required under the *Electricity Safety Act 2002* will be administered by the EM Plan and Health Safety and Environment (HSE) Plan developed for the Project.

A number of aeronautical facilities are situated within the Project area, all of which, except for the Blackwater and Yarabee Mine aerodromes, serve individual properties. Project infrastructure will be designed to minimise impact to existing aeronautical facilities. However, there is the potential for some impacts during the construction phase, primarily those private facilities located near CSG fields. Consultation with landholders will occur to inform landholders about construction activities. Site specific mitigation methods will be developed depending on the intensity and scale of aeronautical facilities in proximity to the corridor.

19.5 Environmental Protection Objectives

The environmental protection objectives for land use and tenure are:

- To avoid or reduce adverse impacts to existing land uses and infrastructure;
- To avoid or reduce adverse impacts to amenity (noise, vibration, air quality and visual effects) during construction and operation of the Project; and
- To maintain or restore the land to support the intended land use.

19.6 Avoidance, Mitigation and Management Measures

Avoidance, mitigation and management measures have been proposed to achieve the identified environmental protection objectives.

19.6.1 Agriculture

Each pastoral and horticultural activity is unique and has developed unique management practices to maximise the productivity of their respective property. The planning, design and development of Project infrastructure and undertaking of Project activities will need to address the specific issues raised by each property. This is particularly relevant to intensively farmed land (Arrow, 2011).

Intensively farmed land is a term developed by Arrow to reflect agricultural areas on sensitive soils (i.e., black soils) that are currently intensively farmed (i.e., irrigated, cropped), where relatively minor

changes to the landform and farming activities can have a disproportionate impact on the productivity of the land (Arrow, 2011).

It is Arrow's philosophy that through appropriate consultation with landholders and the broader community together with CSG development planning, intensively farmed land and CSG developments can coexist without causing permanent alienation of, or diminished productivity from intensively farmed land. Siting of wells in consultation with landholders in locations which minimise impacts on productive areas and provide the best opportunity for rehabilitation, as well as locating of production facilities in less productive land are key strategies for reducing the potential for permanent alienation of intensively farmed land (Arrow, 2011).

The primary mitigation for reducing potential impacts on agricultural land use is the siting of infrastructure. The secondary mitigation is the design and development of construction and operations methods that enable Project activities to integrate with farm activities. The tertiary mitigation is the application of environmental management controls, i.e., proven methods and techniques for protecting the environment (Arrow, 2011).

Arrow intends to adopt a similar approach to mitigation in the Bowen Basin to that proposed for the Surat Basin CSG fields as detailed within the Surat EIS (Arrow, 2011). Primary and secondary mitigation is to be achieved through the implementation of 12 performance-based objectives that provide an opportunity for Arrow to work with the landowner to develop appropriate methods for the development and placement of the Project, having regard to the property-specific values and operational characteristics of each agricultural land use.

The proposed performance objectives are:

1. ***Integrate Development Activities***. *Integrate development activities (and infrastructure) with farming operations, recognising and understanding the particular farming practices and property-specific development and farming plans. Consult landowners on the location of infrastructure and on construction methods to reduce overall impacts to the farming operation, including capital and operating costs and productivity.*
2. ***Intensive Farming Operations***. *Avoid infrastructure and associated farm management areas of intensive farming operations, including piggeries, feedlots, vineyards, orchards, horticultural enterprises, poultry farms and small-lot plantations. Maintain a minimum separation (nominally 200 m) between animal enclosures and production wells and facilities to ensure biosecurity or animal health, as agreed with landowners or landholders.*
3. ***Production Facility Site Selection***. *Site production facilities, electricity substations and associated access tracks to avoid or reduce loss of cultivation areas and irrigation infrastructure.*
4. ***Medium-pressure Pipelines***. *Route medium-pressure pipelines along boundary fences, parallel to the direction of cultivation or soil conservation structures, or in the lowest quality soils to reduce impacts on cultivation and irrigation systems.*
5. ***Cultivation Paddocks***. *Minimise the introduction of additional headlands in cultivation paddocks.*
6. ***Controlled Traffic Operations***. *Minimise the loss of productive land in controlled traffic paddocks.*
7. ***Soil Conservation Structures***. *Maintain the operation and effectiveness of soil conservation structures.*

8. ***Spray Irrigation**. Locate wells, gathering lines and associated access tracks in a manner that does not significantly interfere with swept paths (effective coverage) of centre-pivot and lateral and low-pressure boom irrigators.*
9. ***Surface Irrigation**. Maintain the integrity and efficiency of surface irrigation systems.*
10. ***Cropping Cycles**. Maximise the opportunity to schedule development and routine maintenance activities, particularly drilling and construction with the cropping cycle (i.e., with fallow periods).*
11. ***Access Track Design**. Develop construction methods and design access tracks in cultivation paddocks to maintain the existing hydrologic and hydraulic regime of the site. Evaluate the material used in construction of the access tracks for potential impacts to the farming operations (e.g., gravel above a certain size can cause damage to machinery).*
12. ***Wellpad Design**. Minimise disturbance and temporary loss of productive land associated with drilling wells, particularly from workspace creep, by agreeing on the layout of the drill pad and associated work areas with the landowner subject to any safety requirements* (Arrow, 2011).

These objectives are the primary tools for the design, implementation and management of appropriate measures to mitigate the potential construction and operational impacts of the Project.

Measures to minimise farming impacts during construction may include:

- Minimising the disturbance to any valuable agricultural land that cannot be avoided; and rehabilitating it thereafter;
- Minimising fragmentation, alienation and sterilisation within individual land parcels and across areas of agricultural value;
- Restricting development on smaller properties which would become unviable for farming due to the Project impacts on subject land; and
- Positioning linear infrastructure along property boundaries where practicable and appropriate to minimise direct impacts on any cropping areas.

Potential operation impacts will be mitigated through development planning and modifying construction practices and rehabilitation methods to suit individual land holder needs, whilst ensuring appropriate controls are in place to protect the Project infrastructure (e.g. fire breaks). However, it is acknowledged there is the potential for ongoing operational impacts which is largely dependent on the incremental change in land use from agriculture to agriculture interspersed with Project infrastructure.

19.6.2 Urban Development

There are numerous potential impacts on urban development associated with the construction and operation of the Project. A potential impact of the Project is the full or partial displacement of land uses during construction and operation. Relevant mitigation measures include the design of the field layout to avoid placing FCFs, CGPFs and IPFs within close proximity to sensitive receptors. Consultation will be undertaken with the effected landowners so as to stage construction to better minimise effects on landowners where possible. Consultation will focus on better understanding landholders needs and requirements (such as mustering seasons, weather impacts and cropping), so that they may be taken into account and sufficiently addressed.

The issue of amenity (i.e. noise, air-quality, visual) represents another potential impact during construction and operation. Relevant mitigation and management measures include consultation with

affected landowners so as to stage construction to better minimise effects on landowners where possible. Mitigation of potential amenity impacts will be achieved through (noise and air) emission mitigation techniques (exhaust muffling, acoustic enclosures) detailed in the Air Quality chapter (Section 9), the Landscape and Visual Amenity chapter (Section 20) and the Noise and Vibration chapter (Section 22) of this EIS.

Access and vehicular movements during construction and operation of the Project is another potential impact on urban development. Arrow will liaise with residents and sensitive receptors and determine appropriate mitigation measures. This will ensure that residents are informed of the proposed nature, timing and location of operational access and maintenance requirements and any site specific mitigation measures proposed.

19.6.3 Mining Resources

There are numerous potential impacts on mining resources associated with the construction and operation of the Project.

An impact of the Project is increased coordination of mineral resource mining within the fields for the timeframe of the Project as well as commercial agreements for access of mineral resources before de-gassing and de-watering is complete. Arrow intends to enter into agreements with existing and future coal mine operators to coordinate the extraction of gas, which is required to be undertaken prior to extraction of the coal. Through this process, the Project has the potential to reduce carbon dioxide emissions as gas flared and/or vented as part of the coal mining process will be capture and reused. In areas where there are overlapping tenements and possibilities that land use conflicts will arise, Arrow is committed to reaching an outcome agreed by all relevant parties. In some instances, the extraction of CSG from the coal seam may assist in future mining endeavours. The *Mineral Resources Act 1989* (MR Act) and the P&G Act prescribe the process to be adhered to by persons or entities applying for a mineral resource tenement over petroleum and gas tenements and vice versa.

Over the last 12 months the coal and gas industries formed a working group to propose improvements to legislation. During this process Arrow has used its knowledge and experience in the Bowen Basin to take an active role in shaping the proposed new framework. The proposals have received favourable comments from government and further detailed work is proceeding so that it can be formalised in legislation.

The proposed framework is intended to deliver greater certainty and predictability of outcomes as well as facilitating the timely development of both resources by compressing tenement application processing times. Clarifying the rights and obligations of overlapping parties will also create a more commercially sensible and workable regime which maximises the recovery of both coal and CSG resources, as well as minimising fugitive methane emissions. Arrow has already adopted these principles in its discussions with overlapping coal companies.

Another potential impact of the Project on mining resources is that exploratory permit holders for mineral extraction over lands subject to the Project area will require additional controls for their land use activities until the cessation of the Project. Arrow will undertake consultation activities with the holders of exploratory permits for mineral extraction to ensure permit holders are aware of Project

staging and potential additional controls required for access and conduct of exploratory mineral activities.

Arrow has a demonstrated capacity to work with mining companies to ensure that the value of gas and coal is maximised. Arrow's experience with open cut mining is that it can place the surface and sub-surface infrastructure in a very flexible fashion to avoid impact on mining. With underground mining arrow has a similar experience, where it is possible to place wells to ensure the impact on safe and efficient mining is no different to that which the mining company can deliver but the arrow gas expertise and gas markets provide the path to maximise gas yield and lower the mining company's cost to safely access the coal. Deep surface to inseam degassing of coal can deliver large benefits to mining in improved health and safety outcomes as well as avoided carbon liabilities. The coal and gas sectors have defined a path to work together that will ensure commercial certainty and viable co-existence.

19.6.4 Conservation, Tourism and Recreation

There are numerous potential impacts on conservation, tourism and recreation associated with the construction and operation of the Project. Mitigation methods relating to protecting the flora and fauna values of the areas of protected estate are detailed within the Environmentally Sensitive Areas chapter (Section 18) of this EIS. Proposed mitigation methods for potential impacts on lands considered to be ‘natural and open space’ are contained within the Aquatic Ecology chapter (Section 16), the Terrestrial Ecology chapter (Section 17) and the Landscape and Visual Amenity chapter (Section 20) of this EIS. No specific land use mitigation methods are proposed for these areas.

The Project infrastructure will be sited to avoid areas that have identified conservation, tourism or recreational attributes. This will be of particular relevance when detailed gas field planning and development activities commence. Homevale National Park and Conservation Park (Category A protected areas) and areas of high ecological significance will not be considered for Project facility development.

Potential impacts and mitigation measures intended to address existing environmental values are set out in the Air Quality chapter (Section 9), the Geology chapter (Section 13), the Landscape and Visual Amenity chapter (Section 20), and the Noise and Vibration chapter (Section 22) of this EIS.

19.6.5 Infrastructure

There are numerous potential impacts on roads, rail, stock routes, utilities and other services associated with the construction and operation of the Project.

Potential impacts of the Project on roads are anticipated to be minor. Some disruptions may occur during construction of the Project infrastructure where trenching or drilling may be required to provide access across both state controlled and local roads for the underground gas gathering systems. Where state controlled roads or local roads are required to be crossed or intersected by the construction of Project infrastructure, all works will be carried out in consultation with the relevant stakeholders so as to minimise disturbance to the operation of the road. Further details on potential

impacts of the Project on road and associated avoidance, mitigation and management measures are detailed within the Roads and Transport (Section 21) of this EIS.

A minor potential impact on rail infrastructure associated with Project construction activities is that construction activities may necessitate the establishment of access tracks in the vicinity of existing railway lines. Minor service interruptions / disturbances may occur if construction is required in proximity to any rail lines so as to satisfy likely recommended safety protocols. Where the rail network is required to be crossed or intersected by the construction of Project infrastructure, the crossing will be either bored or directionally drilled, thereby avoiding direct impacts. All works will be carried out in consultation with the relevant stakeholders so as to minimise disturbance to rail infrastructure and operations. Furthermore, where Project infrastructure comes in proximity of a rail line it will be set back an appropriate distance, in accordance with the relevant standards, so as to avoid interference with railway infrastructure.

A further mitigation measure addressing the potential impact of construction activities on rail infrastructure is the opportunity to locate new access tracks alongside or parallel to existing railway line easements where tracks are required in the vicinity of railway lines. This is expected to reduce the extent of disturbance to previously undisturbed ground. The location, design and operational parameters of these access tracks will take into account any operational, safety and or design constraints, such as required set-back distances as stipulated in the relevant standards.

Impacts on stock routes are anticipated to be minor with only temporary impacts anticipated during the construction of the Project infrastructure at those locations where it is necessary to cross stock routes. In order to successfully mitigate the potential impacts, Arrow is committed to ensuring adequate alternatives are proposed during construction activities and ensuring the safety of stock and people utilising the temporary realignment. Proposed measures to minimise potential impact on the Stock Route network are set out in the EM Plan (Appendix Z) of this EIS. Measures include the progressive rehabilitation of disturbed areas and the ongoing management for protection against the spread of weeds after the completion of construction.

Impacts of Project activities on utilities and other services are anticipated to be minor. Project activities may necessitate the crossing or establishment of access tracks in the vicinity of existing utilities and/or aeronautical facilities resulting in minor service interruptions / disturbances. Where utilities and/or aeronautical facilities are required to be crossed or intersected by the construction of Project infrastructure, all works will be carried out in consultation with the relevant stakeholders so as to minimise disturbance to infrastructure and operations. Furthermore, where Project infrastructure comes in proximity of utilities and/or aeronautical facilities it will be set back an appropriate distance, in accordance with the relevant standards, so as to avoid interference with the infrastructure. Please note that the proposed ABP does not form part of this EIS.

19.7 Residual Impacts

Potential impacts can be managed through avoidance, mitigation and management measures detailed in the previous section. Similarly, they will reduce the severity of impacts related to displacement of

land uses due to impacts such as soil degradation and land contamination generated as a result of Project activities.

The success of rehabilitation and decommissioning activities associated with the Project will determine whether there are any residual impacts and their likely severity.

Table 19-4 summarises the potential impacts prior to mitigation, along with proposed avoidance, mitigation and management measures and the subsequent residual impacts, assuming successful implementation of proposed avoidance, mitigation and management measures.

As demonstrated, generally the pre-mitigation impacts with a high to serious likelihood, consequence or risk of impact is reduced through an assumed successful implementation of proposed avoidance, mitigation and management measures to reduce the residual impact to a moderate or low level.

The Project area will be rehabilitated to a stable, self-sustaining landform with a post-closure land-use comparable to the land-use prior to disturbance; unless an alternate suitable and agreed land-use is identified. Where land cannot be rehabilitated to a stable, self-sustaining landform, it may result in a residual permanent change in land use. For example, production facility sites may not be suitable for productive agricultural uses once rehabilitated but might be suitable for other uses such as grazing due to significant disturbances to the soil profile, or impacts to soil by degradation / salinity resulting from e.g. potential impacts from brine water storage dams. Site selection is the most effective way to manage this potential residual impact. Arrow will ensure that site selection considers low value agricultural land in preference to high value agricultural land to minimise potential residual impacts to land use.

The approach to inspection and monitoring in the following section will be used to identify residual impacts associated with the Project.

19.8 Inspection and Monitoring

Inspection and monitoring of construction, operations and decommissioning activities associated with the Project will be adopted to ensure the correct implementation of standard operating procedures that incorporate the proposed avoidance, mitigation and management measures. Monitoring of rehabilitation will also be undertaken to ensure the performance objectives have been met. Where the outcomes are not achieved, remedial measures will be implemented in order to achieve the desired outcomes.

Relevant monitoring and inspection measures associated with the Project include:

- The regular inspection of at risk erosion and sediment control measures following significant rainfall events to ensure effectiveness of measures is maintained [B094];
- Visual inspection of pipeline RoWs routinely until ground stabilisation and natural revegetation or pasture grasses or crops are established [B095];
- The inspection of work sites and access routes for notifiable weeds and pest plants and animals prior to accessing the site; and if detected, manage in accordance with *the Petroleum Industry – Minimising Pest Spread Advisory Guidelines* (Biosecurity Queensland, 2008);
- Inspection to ensure the integrity of diversion drains, waterways and sediment control structures;

- Preliminary sampling and analysis program (Phase 1) of potentially contaminated sites that have arisen from P&G activities will be undertaken. This will be used to determine whether a detailed assessment (Phase 2 – detailed investigation of contamination involving drilling, etc.) should be conducted to quantify the amount of contaminated material that may require remediation;
- The review of landowner feedback, comments and grievances on a regular basis, including status of Project actions and close-outs; and
- Implement quality control and quality assurance procedures in relation to construction, operation and decommissioning activities.

At the end of the gas field lifetime, the environmental monitoring program established for the operations phase of the Project will be maintained until all decommissioning and rehabilitation works have been completed. Notwithstanding this, there may be the need to establish some additional monitoring sites depending on the nature of the decommissioning works and also in response to finding possible sources of environmental pollutants.

The type and location of this monitoring will be determined by the outcomes from the Phase 1 and/or Phase 2 contamination assessment (see the Decommissioning and Rehabilitation chapter (Section 29.5.7 of this EIS) for further information), and other relevant inputs identified during the closure planning and decommissioning phase of the site.

Table 19-4 Summary of Land Use and Tenure Impact Assessment

Potential Impacts	Land Use Values	Pre-mitigation Impacts			Summary of Avoidance, Mitigation and Management Measures	Residual Impact		
		Likelihood	Consequence	Risk of Impact		Likelihood	Consequence	Risk of Impact
Impacts to agricultural land uses								
Construction activities resulting in disruption to on farm operations, such as tillage, planting, irrigation, weed control and harvesting, from locating Project facilities in inappropriate locations	Cattle Grazing and Horticultural	High	Serious	High	• Arrow will consult and negotiate with landholders prior to any onsite activities, so as to reduce impacts to the proper management of rural holdings. This may involve: compensation, negotiation in timing of construction, establishment and upgrading of new and existing tracks, etc. • Comply with the provisions of the P&G Act and the Land Access Code prior to accessing private land. • Ensure an Arrow representative is in attendance at the time of first entry to check contractors have the appropriate environmental management procedures and property-specific information.	Mod.	Mod.	Mod.
Reductions to the value of productive land from development of Project Facilities	Cattle Grazing and Horticultural	High	Serious	High	• Ensure wellhead facilities are located and designed in such a manner that planned development minimises disturbance and temporary loss of productive land associated with drilling wells, particularly from workspace creep, by agreeing on the layout of the drill pad and associated work areas with the landowner subject to any safety requirements. • Ensure dams for CSG water and brine are not constructed on intensively farmed land. • Remove salt from the landscape as part of decommissioning works and dispose of in an approved and regulated landfill, should beneficial uses of the salt not be developed.	Mod.	Mod.	Mod.

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Potential Impacts	Land Use Values	Pre-mitigation Impacts			Summary of Avoidance, Mitigation and Management Measures	Residual Impact		
		Likelihood	Consequence	Risk of Impact		Likelihood	Consequence	Risk of Impact
Subsurface infrastructure placing restrictions on land uses above.	Cattle Grazing and Horticultural	High	Serious	High	• Ensure gathering network infrastructure is located deep enough below ground level to allow for continued use of lands above. • Route below ground infrastructure along boundary fences, parallel to the direction of cultivation or soil conservation structures, or in the lowest quality soils to reduce impacts on cropping activities.	Low	Low	Low
Temporary or permanent alienation and sterilisation and associated diminished productivity as a result of the development of wellhead facilities, gathering systems, infield pipelines and access tracks.	Cattle Grazing and Horticultural	High	Serious	High	• Consult and negotiate with landowners on the appropriate location for infrastructure and access routes (to well sites and to and along pipelines). • Route below ground infrastructure along alignments agreed to by landholders as to reduce impacts on farm activities. • Site Project facilities and associated access tracks to avoid or reduce loss of cultivation areas and irrigation infrastructure. • Develop and implement a compensation framework to 'add value' rather than just compensating for impacts. • Locate access tracks in headlands or adjacent to boundary fences. • Utilise existing access tracks and trafficked areas. • Align gathering lines and new access tracks parallel to the direction of cultivation, soil conservation structures and controlled traffic runs and avoid perpendicular or lateral	Mod.	Mod.	Mod.

Potential Impacts	Land Use Values	Pre-mitigation Impacts			Summary of Avoidance, Mitigation and Management Measures	Residual Impact		
		Likelihood	Consequence	Risk of Impact		Likelihood	Consequence	Risk of Impact
					connections. • Lay out drill pads in accordance with landowner requirements, subject to safety requirements, to reduce the overall impact on cultivation, where practicable. • Investigate alternative drilling technologies, such as using directional drilling to access coal measures, reducing gathering system pipe diameters and drilling multiple wells from one drill pad to potentially reduce the footprint on SCL. • Use surface tanks (not pits) to manage drilling muds on black soils when drilling production wells. • Remove sediment fencing prior to cultivation and dispose of in accordance with landowner requirements or in accordance with the waste management plan of the Arrow HSEMS. • Ensure CSG water used for dust suppression on roads or for construction and operation activities is of suitable water quality specifications for this purpose. • Ensure that the quality of CSG water used for dust suppression meets the prescribed limits.			
Crop losses or disturbance to stock	Cattle Grazing and Horticultural	High	Serious	High	• Fence the exclusion zone of production well sites (i.e., 10 m by 10 m) to exclude unauthorised personnel, stock and wildlife from that area. • When operating on black soils, collect, contain and store	Mod.	Mod.	Mod.

Potential Impacts	Land Use Values	Pre-mitigation Impacts			Summary of Avoidance, Mitigation and Management Measures	Residual Impact		
		Likelihood	Consequence	Risk of Impact		Likelihood	Consequence	Risk of Impact
					drilling fluids and waste (solid and liquid) on site in appropriate storage tanks until recycled, treated (if necessary) or disposed of off site. • Stockpile drilling cuttings adjacent to the well or in containers and dispose of appropriately. • Store onsite materials in suitable containment systems constructed to industry standards and Australian standards (AS 1940-2004, *The Storage and Handling of Flammable and Combustible Liquids* (Standards Australia, 2004a), and AS 3780, *The Storage and Handling of Corrosive Substances* (Standards Australia, 2008b) at a minimum). Maintain quality control and quality assurance procedures to monitor volumes and quantities. Bund aboveground storage areas to contain spills. • In the event that soil is impacted by oil, fuel and/or grease, handle the material in accordance with the hydrocarbon management plan (prepared as part of the Arrow HSEMS), which includes procedures for the excavation and removal to a licensed landfill or remediation at site. Where contamination has occurred, investigate and remediate in accordance with *Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland* (DE, 1998). • Develop or facilitate the development of a method for			

Potential Impacts	Land Use Values	Pre-mitigation Impacts			Summary of Avoidance, Mitigation and Management Measures	Residual Impact		
		Likelihood	Consequence	Risk of Impact		Likelihood	Consequence	Risk of Impact
					assessing impacts on productivity (crop yields) that incorporates statistical analysis and appropriate control and sampling sites. • Regrade work sites to original surface contours following reinstatement of soil. • Develop construction methods and design access tracks in cultivation paddocks to maintain the existing hydrologic and hydraulic regime of the site and in a way that does not cause erosion.			
Soil degradation from disturbance of the soil structure from all Project activities.	Cattle Grazing and Horticultural	High	Serious	Serious	• Avoid breaching, diversion or disturbance of contour banks, waterways and dams. • Avoid earthworks that affect waterway function. • Locate wells, access tracks and gathering lines downhill and parallel to soil conservation structures and avoid perpendicular or lateral connections. • Locate access tracks in headlands or adjacent to boundary fences. • Utilise existing access tracks and trafficked areas (where possible). • Ensure construction activities do not extend beyond the work site boundaries. • Cap or fit wellhead equipment to wells at the completion of	Mod.	Mod.	Mod.

Potential Impacts	Land Use Values	Pre-mitigation Impacts			Summary of Avoidance, Mitigation and Management Measures	Residual Impact		
		Likelihood	Consequence	Risk of Impact		Likelihood	Consequence	Risk of Impact
					drilling to ensure no uncontrolled release of gas or water. • Stockpile cleared or mulched vegetation along the inside edge of the work sites (separate from soil stockpiles), to aid the control of runoff and ensure stockpiled vegetation does not pose a bushfire hazard. • Prevent subsurface water flows and erosion along the backfilled trench by appropriate means, such as trench blocks and compaction of backfilled soils. • Mulch vegetation and reuse in site rehabilitation. • Strip, salvage and stockpile topsoil near the work site separately to subsoils (in consultation with landowners). Ensure topsoil stockpiles have a maximum height of 2 m, where the future use is intended for rehabilitation, and are protected from erosion. • Stockpile imported fill for bedding of pipes adjacent to the trench and away from vegetation, topsoil and subsoil stockpiles. • Develop an erosion and sediment control plan and install and maintain appropriate site specific controls. • Clean and reinstate (if necessary) erosion and sediment control structures prior to and following storm events and periodically during long periods of rain.			

Potential Impacts	Land Use Values	Pre-mitigation Impacts			Summary of Avoidance, Mitigation and Management Measures	Residual Impact		
		Likelihood	Consequence	Risk of Impact		Likelihood	Consequence	Risk of Impact
					• Construct batters and embankments of drill pads and production facility benches at appropriate slopes and protect from erosion. • Suspend works when rainfall or storm events produce onsite conditions that, if trafficked or worked, would compromise the effectiveness of erosion and sediment control structures, or would lead to rutting and compaction of soils or mixing or inversion of soil horizons. • Backfill soils in the reverse order of removal, and undertake backfilling progressively and regularly during pipeline construction. • Compact padding material and subsoils used to backfill pipeline trenches to reduce settling. Limit compaction to no deeper than 0.5 m below natural surface level. • Backfill and rehabilitate excavations, particularly pipeline trenches and drilling sumps. Conduct backfilling in a manner that will promote successful rehabilitation, including capping of exposed subsoil with topsoil and replacement of the land surface to preconstruction levels to reduce trench subsidence and concentration of flow. Mounding of soils to allow for settling may be required in some areas. However, in laser-levelled paddocks, this may not be practicable, and backfilling should be carried out in consultation with the landowner.			

Potential Impacts	Land Use Values	Pre-mitigation Impacts			Summary of Avoidance, Mitigation and Management Measures	Residual Impact		
		Likelihood	Consequence	Risk of Impact		Likelihood	Consequence	Risk of Impact
					• Remove excess imported fill and residual subsoil from the work site, and reuse or dispose of in accordance with landowner requirements. • Retain and regularly inspect erosion and sediment control structures until reinstated soils have been stabilised and sown. • Deep rip and cross rip all construction areas and temporary access tracks to a depth of at least 0.4 m. Repeat following topsoil reinstatement to promote infiltration and assist the reestablishment of connections between soil horizons. Only where appropriate and subject to a site specific assessment to determine the suitability of this mitigation method. • Rehabilitate clean water diversions, down-gradient soil erosion control works and temporary sediment dams to preconstruction site levels, and rip prior to sowing with crops or pasture grasses. • Visually inspect rehabilitated work sites for flow diversions and evidence of erosion associated with trench settling or incomplete reinstatement of surface contours. • Study methods to reduce impacts and maintain the soil profile during gathering system pipeline construction by understanding the soil type, minimising pipe diameters (where practicable), ploughing (instead of trenching) and potentially burying deeper than the minimum standard.			

Section 19 Land Use and Tenure

Potential Impacts	Land Use Values	Pre-mitigation Impacts			Summary of Avoidance, Mitigation and Management Measures	Residual Impact		
		Likelihood	Consequence	Risk of Impact		Likelihood	Consequence	Risk of Impact
Increased costs of farm management	Cattle Grazing and Horticultural	High	High	High	• Avoid infrastructure and associated farm management areas of intensive farming operations. • Develop CSG development property plans to address key issues raised by landowners relating to potential impacts on intensively farmed land. • Plan and integrate construction and operations activities with harvesting, spraying and withholding periods	Low	Low	Low
Impacts to amenity resulting from the location of Project facilities and their associated noise, venting and flaring from the wells compression and processing facilities.	Cattle Grazing and Horticultural	High	High	High	• Clear areas progressively and implement rehabilitation as soon as practicable following construction and decommissioning activities. • Install gates in fences of an appropriate standard to restrict access to authorised personnel, vehicles, plant and equipment. • Replace or rehabilitate all disturbed infrastructure to pre-disturbance condition. • Mitigation of potential amenity impacts will be achieved through (noise and air) emission mitigation techniques (exhaust muffling, acoustic enclosures). • Maintain the grievance process (complaint management system) for the community to register complaints, issues, comments and suggestions.	Mod.	Mod.	Mod.

Potential Impacts	Land Use Values	Pre-mitigation Impacts			Summary of Avoidance, Mitigation and Management Measures	Residual Impact		
		Likelihood	Consequence	Risk of Impact		Likelihood	Consequence	Risk of Impact
Access and service track proliferation and increased vehicle movements using on farm access tracks and the existing road network.	Cattle Grazing and Horticultural	High	High	High	• Integrate development activities (and infrastructure) with farming operations, recognising and understanding the particular farming practices and property-specific development and farming plans. • Consult landowners on the location of infrastructure and on construction methods to reduce overall impacts to the farming operation, including capital and operating costs and productivity.	Low	Low	Low
Farm hygiene issues relating to weeds and disease management	Cattle Grazing and Horticultural	High	High	High	• Arrow and all contractors involved in the construction of Project infrastructure will need to comply with the provisions of Part 3 of the Land Access Code administered by NRM. • Consultation will also be undertaken to identify any special property management measures required for an area or property, including weed or disease management provisions, quarantine provisions and certified area provisions (e.g. organic, disease / weed free). Modifications may need to be made to farm operations and management plans to accommodate the introduced activities. • Inspect work sites and access routes for notifiable weeds and pest plants and animals prior to accessing the site; and if detected, manage in accordance with the *Petroleum Industry – Minimising Pest Spread Advisory Guidelines* (Biosecurity	Low	Low	Low

Potential Impacts	Land Use Values	Pre-mitigation Impacts			Summary of Avoidance, Mitigation and Management Measures	Residual Impact		
		Likelihood	Consequence	Risk of Impact		Likelihood	Consequence	Risk of Impact
					Queensland, 2008) • Wash down vehicles and equipment that have potentially been in contact with weeds before entering new work sites.			
Impacts to Urban Development and Homesteads								
Full or partial displacement of land uses during construction and operation	Sensitive Receptor	High	High	High	• The field layout design will aim to avoid placing CGPFs and IPFs within close proximity to sensitive receptors or over intensely farmed lands. • Consultation will be undertaken with the affected landowners so as to stage construction to better minimise effects on landowners where possible. • Consultation will focus on better understanding landholders needs and requirements (such as mustering seasons, weather impacts and cropping), so that they may be taken into account and sufficiently addressed.	Mod.	Mod.	Mod.
Amenity impacts (i.e. noise, air quality, visual)	Sensitive Receptor	High	Serious	High	• Consultation will be undertaken with the affected landowners so as to stage construction to better minimise effects on landowners where possible. • Consultation will focus on better understanding landholders needs and requirements (such as mustering seasons, weather impacts and cropping), so that they may be taken into account and sufficiently addressed.	Mod.	Mod.	Mod.

Potential Impacts	Land Use Values	Pre-mitigation Impacts			Summary of Avoidance, Mitigation and Management Measures	Residual Impact		
		Likelihood	Consequence	Risk of Impact		Likelihood	Consequence	Risk of Impact
Impacts to mining and resources								
Project may restrict the mining of mineral resources within the fields for the timeframe of the Project. Potential sterilisation of mineral resources until de-gassing and de-watering is complete.	Availability of resources	High	Serious	High	• Arrow intends to enter into agreements with existing and future coal mine operators to coordinate the extraction of gas which is required to be undertaken prior to extraction of the coal. Through this process, the Project will reduce carbon dioxide emissions as gas flared and/or vented as part of the coal mining process will be capture and reused. • Arrow has an established record of reaching agreement with proponents of mineral resource tenements that ensure that the value of all resources are maximised and to minimise conflict with other mineral resources activities within the region. • In areas where there are overlapping tenements and possibilities that land use conflicts will arise, Arrow is committed to reaching an outcome favoured by all relevant parties. In some instances, the extraction of CSG from the coal seam may assist in future mining endeavours. • The MR Act and the P&G Act prescribe the process to be adhered to by persons or entities applying for a mineral resource tenement over petroleum and gas tenements and vice versa.	Low	Low	Low

Potential Impacts	Land Use Values	Pre-mitigation Impacts			Summary of Avoidance, Mitigation and Management Measures	Residual Impact		
		Likelihood	Consequence	Risk of Impact		Likelihood	Consequence	Risk of Impact
Exploratory permit holders for mineral extraction over lands subject to the Project area will be restricted in their land use activities until the cessation of the Project.	Availability of resources	High	High	High	• Arrow will undertake consultation activities with the holders of exploratory permits for mineral extraction to ensure permit holders are aware of Project staging and potential access and/or restrictions for exploratory mineral activities to be undertaken. • It should be noted that the extraction of CSG does not preclude the extraction of the coal resource; it only involves the removal of the gas from the coal seam, a step often undertaken prior to the establishment of underground coal mining techniques. Mineral resource extraction can occur after the completion of gas extraction for underground mines or can be coordinated with open cut mining.	Low	Low	Low
Impacts to infrastructure								
Temporary impacts during the construction of the underground gas gathering system at those locations where it is necessary for the gas gathering system and infield pipelines to cross stock routes.	Stock Route	Low	Low	Low	• In order to successfully mitigate the potential impacts on the stock route network, Arrow is committed to ensuring adequate alternatives are proposed during construction activities and ensuring the safety of stock and people utilising the temporary realignment. • Proposed measures to minimise potential impact on the Stock Route network are set out in the EM Plan (Appendix Z) of this EIS. Measures include the progressive rehabilitation of disturbed areas and the ongoing management for protection	Low	Low	Low

Potential Impacts	Land Use Values	Pre-mitigation Impacts			Summary of Avoidance, Mitigation and Management Measures	Residual Impact		
		Likelihood	Consequence	Risk of Impact		Likelihood	Consequence	Risk of Impact
					against the spread of weeds after the completion of construction.			
Project infrastructure construction activities may necessitate the crossing, or establishment of access tracks in the vicinity, of existing transport infrastructure, utilities and/or aeronautical facilities minor service interruptions / disturbances may occur if construction is required in proximity to this infrastructure.	Infrastruc-ture provision	Low	Low	Low	• Where transport infrastructure, utilities and/or aeronautical facilities are required to be crossed or intersected by the construction of Project infrastructure, all works will be carried out in consultation with the relevant stakeholders to minimise disturbance to infrastructure and operations. • Where the gas gathering system comes in proximity of transport infrastructure, utilities and/or aeronautical facilities it will be set back an appropriate distance, in accordance with the relevant standards, to avoid interference with the infrastructure. • Where tracks are required in the vicinity of transport infrastructure, utilities and/or aeronautical facilities, opportunities for locating new access tracks alongside or parallel to existing easements / infrastructure will be investigated. This is expected to reduce the extent of disturbance to previously undisturbed ground. The location, design and operational parameters of these access tracks will take into account any operational, safety and or design constraints, such as required set-back distances as required by the relevant standards.	Low	Low	Low